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THE INFORMATION EFFICIENCY OF MARKET PRICES

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by

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Informational efficiency of (stock) market prices is one of the cornerstones of modern financial theory. A market is called informationally efficient if prices always fully reflect available information (See Fama, 1970). In recent times, however, the possibility of efficiency has been questioned on theoretical grounds (Grossman and Stiglitz, 1976 and 1980), the argument being that if prices fully reflected available information, nobody would be interested anymore in producing (costly) information, and, as a result, prices could impossibly reflect such information.

The consensus seems to be that markets are partially efficient, i.e., prices 'partially' reflect available information, so that there remains room for (costly) information analysis. It is said that markets have 'An equilibrium degree of disequilibrium' (Grossman and Stiglitz, 1980, p. 393). However, it will be argued here that such a disequilibrium will not hold: an analyst who has paid to obtain valuable information will always have an incentive to disseminate it as quickly as possible (given the cost of dissemination), so that prices rapidly adjust to the available information. Like in the Grossman-Stiglitz model, a key assumption will be that markets do not fully aggregate information, so that data processing in order to obtain valuable information becomes part of the production side of an economy, generating information that would otherwise never or only partially become available. Information production is then similar to any other production process, so that the classical results of economic analysis may also hold here. Specifically, given certain additional assumptions, an equilibrium information production will exist and it will be Pareto

efficient, so that the distinction between allocational and informational efficiency (Rubinstein, 1975) will become artificial. In short, prices will always reflect avaliable information - where the 'availability' is subject to cost restrictions emanating from information production and dissemination, restoring the validity of Fama's conjecture.

In Section 1, the informational efficiency is explained in much detail. In Section 2, it will be demonstrated where, in the present context, the argument of Grossman and Stiglitz that prices can never fully reflect all available information breaks down. An example of the efficient production of information concerning inflation is discussed in Section 3. In Section 4, the assumptions needed to obtain Pareto efficient information production are considered. Section 5 concludes with a comment on the applicability of the conceptual framework introduced here.

1. Prices always fully reflect 'available' information

Consider an analyst who has come to the conclusion, after extensive study, that the stock market underprices a certain company. Our analyst may buy shares in this company, but that will not resolve the underpricing problem, given the fact that the market cannot fully aggregate all information, specifically the information generated by our analyst. Hence prices will not adjust, not even in the future, unless our analyst - or somebody else, spreads the information that a company is underpriced. Our analyst has interest in disseminating this information as quickly as possible, in order

to get a swift price reaction in the shortest possible time, i.e., the highest possible return per time unit. Hence, the price rapidly adjusts to the new information.

A key assumption in this exposition is that markets cannot fully aggregate available information, which is not irrealistic, both on theoretical and empirical grounds. Many have investigated whether a market could ever fully aggregate diverse information and the answer generally has been negative (see Grossman, 1976, Hellwig, 1980 and Diamond and Verrecchia, 1981). Moreover, many empirical findings disprove the aggregative power of markets. For instance, the fact that interest rates do react to money supply announcements (see Cornell, 1983), or that stock prices do react to price index announcements (Schwert, 1981), is inconsistent with full aggregation. Price index announcements will be discussed in the present context in Section 3.

Three elements appear in the production of information. First, the expected return (if the expected return of trading on the information is 'too low', the information may not be produced at all). Next, the cost of producing information with which to earn money. And finally, the cost of disseminating the information, such that the expected return indeed will be realized. The kind of information that will be produced and the speed of incorporation of the information in prices will depend on the above three elements, very much like in the production of ordinary goods marginal costs and revenues are constantly equilibrated.

Consequently, information production could possibly be represented

by a production function, giving output (namely, expected return per time unit r) as a fuction of inputs. To keep the exposition simple, it will be assumed that two factors enter the information production process, namely, labour (l), and data, which are modeled to flow in according to a Poisson law with intensity λ. Hence:

$$r = f(l,\lambda)$$

Given markets for both factors of production, and a market for services of the analyst, standard economic analysis will apply to information processing. One could think in two possible ways about the latter market. Either could one imagine the analyst to be a company that hires people (l) and buys data (λ) and that trades on its own account, generating returns r, to be distributed to the stockholders after paying out wages and data costs. Or one could imagine the analyst to be a company that does not trade on its own account, but that provides privileged 'members' with the information it produces for a fee. Those 'members' can then take positions and after the analyst has revealed the information to the outside world, the members 'realize' r. The decision to analyse can take many forms. It could be looked at as an investment in an analysing firm similar to investment in any other company: it gives a certain expected return and it entails certain risk characteristics. On the other hand, it could be looked at as a strategic decision similar to the one proposed by Cornell and Roll (1981), where two persons meet and each of them knows the other is informed with a certain probability p. Cornell and Roll did not specify where the difference in return between informed and noninformed trading originated. A possible explanation is brought forward here: informed traders

make more money by revealing their information after trading. The dissemination of information by informed investors is quite important and it probably explains why so much 'publication' surrounds the analysis business.

In any event, given perfect competition in factor markets and the market for the services of an analyst, and given certain conditions on the information production process (which will be discussed in Section 4), it is clear that information will be produced in a Pareto efficient way. Hence, to say that prices will always fully reflect available information (where 'availability' is restricted by costs of information production and dissemination) is the same thing as to say that the economy produces information in a Pareto efficient way. In this sense, the distinction between allocational and informational efficiency becomes artificial. Prices will reflect the information that is 'economically' sensible to produce.

Notice that in the present context the trading of noninformed investors who become informed through the analyst's information dissemination makes prices move. This may explain the differences between overnight and day stock price variances, if noninformed investors tend to assimilate the analyst's information during trading hours (see Fama, 1965, Granger and Morgenstern, 1970, Oldfield and Rogalski, 1980 and French and Roll, 1985). Noninformed investors make prices move and therefore on average make less money than informed investors, who were able to trade before the disclosure of their information.

2. On the impossibility of an equilibrium degree of disequilibrium

The above analysis contrasts with that of Grossman and Stiglitz (1976 and 1980). Indeed, they argue that prices will always only partially reflect available information in order to give room to costly information analysis. However, if prices only partially reflect available information, then the informed person will never be able to 'realize' his superior information by buying at the incorrect price and selling at the correct price. Once again, the medieval dictum holds: 'Res tantum valet quantum vendi potest'. The stock is worth only what it is worth to others (the others being the partially informed market). If you want to 'realize' your superior information, you must tell the market about its valuation error, so that prices can adjust to their correct level. Of course, you can buy the share of stock and hold it until eternity, thus realizing your superior information by, say, receiving higher dividends than the market expected. But, in general, you create a disequilibrium in your portfolio in order to maximize the gains from your superior information. You obviously want to restore your equilibrium portfolio as quickly as possible, hence, it will be advantageous to tell the market about the valuation error and 'realize' your superior information now. The Grossman-Stiglitz argument breaks down in the present context because the superior information some investors have (i.e., the signal they observe) is worth more when you convince the world about the signal after taking a 'speculative' position.

A similar argument applies to any market, not just the stock market.

Assume you have just discovered a superb Côtes du Rhône French wine, clearly underpriced. You may keep the information for your own and buy each year a couple of bottles of your preferred wine - hoping, of course, that nobody else would discover the quality of it. This is the Grossman-Stiglitz strategy. However, might it not be better just to buy the whole château that produces your Côtes du Rhône and then convince the world about the quality of its wine, reaping profits from selling the wine at a higher price, and, at the same time, being able to enjoy a splendid wine from your own château ? Your superior information will quickly be reflected in the price of the Côtes du Rhône.

3. An example

Schwert (1981) observed that the stock market reacts to price index announcements. That means that the stock market does not aggregate the information that is available dispersed over the economy, namely, a certain inflation rate. One would think that analysts could possibly profit by computing their own price indices before the public announcement (or by computing it more frequently), and then making money on revealing their own price index before the government does. Presumably, the cost of computing their own index does not cover possible gains, and this may be the reason that we do not observe analyst's price indices. We do observe other indices computed by analysts which the government either does not provide or does provide, but too infrequently. What is computed will make economic sense: marginal costs and revenues are carefully balanced, so as to ensure a Pareto optimal production of information.

The above may give us a rule to determine whether the government should provide its own economic information, and, if so, how much. The government could produce that type of information for which it has an absolute cost advantage. The amount of information to be produced (frequency, quality) may be determined by observing price reactions when the information is revealed.

4. Pareto effiency

It is clear that in the present context one could use standard economic analysis to prove the existence and Pareto optimality of an equilibrium information production. One of the assumption needed is the convexity of the production possibilities set (Debreu, 1959), which means that the production function $f(1,\lambda)$ (see Section 2) should be concave, which is not an irrealistic assumption. However, production externalities may exist between information production functions of competing analysts, leading to overproduction of valuable information (Hirshleifer, 1971), destroying Pareto optimality. If this is true, stock markets may be informationally 'over-efficient', i.e., more information is reflected in prices than is admitted on pure social welfare grounds.

5. Conclusion

It was shown that prices should always fully reflect the information that becomes available, subject to cost restrictions as to information production and dissemination. The conclusion is based on the hypothesis that markets cannot fully aggregate diverse information.

The Grossman-Stiglitz type of 'equilibrium degree of disequilibrium' in which prices only partially reflect available information cannot hold in this context.

The conceptual framework of information production introduced here leads itself to an economic investigation of the business analysis industry. Specifically, it could be used to answer questions such as what the optimal industry size is, how to explain differences between overnight an day variances, why certain types of statistics are produced privately and others are not, what the effect is of a change in stock price variances (i.e., potential return on information production) on the optimal industry scale.

References

Cornell, B. and R. Roll, 1981, Strategies for pairwise competitions in markets and organizations, Bell journal of economics, Spring, 201-13.

Cornell, B., 1983, The money supply announcement puzzle: review and interpretation, American economic review, September, 644-57.

Debreu, G., 1959, The theory of value, New Haven; London, Yale university press.

Diamond, D. W. and R. E. Verrecchia, 1981, Information aggregation in a noisy rational expectations economy, Journal of financial economics, September, 221-35.

Fama, E. F., 1965, The behavior of stock market prices, Journal of Business, January, 34-105.

Fama, E. F., 1970, Efficient capital markets: a review of theory and empirical work, Journal of finance, May, 383-417.

French, K. R. and R. Roll, 1985, Stock return variances: the arrival of information and the reaction of traders, UCLA working paper.

Granger, C. W. J. and O. Morgenstern, 1970, Predictability of stock market prices, Lexington, MA, Heath-Lexington.

Grossman, S., 1976, On the efficiency of competitive stock markets where trades have diverse information, Journal of finance, May, 373-85.

Grossman, S. J., and J. E. Stiglitz, 1976, Information and competitive price systems, American economic review, May, 246-53.

Grossman, S. J. and J. E. Stiglitz, 1980, On the impossibility of informationally efficient markets, American economic review, June, 393-408.

Hellwig, M., 1980, On the aggregation of information in competitive markets, Journal of economic theory, June, 477-98.

Hirshleifer, J., 1971, The private and social value of information and the reward to inventive activity, American economic review, 561-74.

Oldfield, G. S. and R. J. Rogalski, 1980, A theory of common stock returns over trading and nontrading periods. Jounal of finance, June, 729-52.

Rubinstein, M., 1975, Securities market efficiency in an Arrow-Debreu economy, American economic review, December, 812-24.

Schwert, G. W., 1981, The adjustment of stock prices to information about inflation, Journal of finance, March,