Do Managers Use their Information Efficiently?

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It is often true that a manager's opinions about events relevant to production are valued but are not fully known by others. This note suggests that in such circumstances there may be a problem with production. Consider a competitive equilibrium in a standard Arrow-Debreu model of an economy. In such an equilibrium production decisions are guided by prices and, in particular, by contingent commodity prices (which in fact may be implicit in stock market prices). Moreover, in such an equilibrium the managers of production processes play a strictly passive role since complete instructions for production are implicit in the criterion of profit maximization.[1] However, if the probabilistic beliefs of the managers are valued but are not fully known by the other agents in the economy, then it seems that these agents might well prefer to have the managers play an active role in making production decisions. In other words, it seems that profit maximization with respect to contingent commodity prices may encourage managers to act contrary to what would be the best wish of others, and consequently that the absence of markets in certain contingent commodities might not be undesirable.[2]

Our discussion of this issue will make reference to a simple example. An economy with many identical individuals and few identical managers uses seed to produce wheat which may be grown in two regions, A and B. Managers decide where to plant the seed. The wheat harvest is uncertain—it is either positive or zero—depending on which of the two possible states of nature, α and β, occurs. This is described in Table 1, where s_i is the amount of seed planted in region i and f is the usual type of production function ($f' > 0, f'' < 0$). Let us suppose for simplicity that consumers alone determine prices in competitive equilibrium, that is, the few managers have only a negligible impact on the prices.

Assume initially that consumers have fixed beliefs, independent of those which the managers might have. Specifically, assume that consumers believe the state α will occur with probability a. Then, since a competitive equilibrium in which there are markets for contingent wheat is Pareto efficient, it must in this case maximize expected utility of consumers. Consequently, if each consumer's endowment consists of one unit of seed and his von Neumann-Morgenstern concave utility function $U(\cdot)$ depends only on consumption of wheat, the problem solved by the market is to maximize expected utility:

(1)
$$\max_{s_A \in [0,1]} aU(f(s_A)) + (1-a)U(f(1-s_A))$$

As one would guess, the first-order condition (which shall be assumed to hold)

$$\frac{a}{1-a} = \frac{f'(1-s_A)U'(f(1-s_A))}{f'(s_A)U'(f(s_A))} \tag{2}$$

implies that the higher the probability a of the state α, the more seed s_A is planted in region A. The beliefs of profit-maximizing managers do not affect the amount of seed planted in the two regions;[3] given the prices

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[1] See Kenneth Arrow.

[2] This point may be compared with those in Jack Hirshleifer's important article, which emphasizes matters related to investment in and dissemination of information. Here there is no investment in information nor is there any transfer of information among agents in the economy; the stress is instead on logically distinct questions concerning the use of information as it exists in the economy, information "in place."

[3] As is well known, in the situation described managers would be instructed by consumer-stockholders to maximize profits (or, equivalently, stock market value).

TABLE 1—WHEAT HARVEST

	State of Nature	
Region	α	β
A	$f(s_A)$	0
B	0	$f(s_B)$

of seed and of contingent wheat, managers' beliefs influence only their purchases of contingent wheat (for their own consumption).

Now assume that the consumers' beliefs would be influenced by the managers', if only they knew them. Assume furthermore that consumers learn nothing about managers' beliefs.[4] Let $a_1 > a_2$ be the two probabilities of the state α which consumers believe could possibly characterize the opinions of the managers. Let μ be the consumers' probability that the managers' probability is a_1 and let a^1 and a^2 be the consumers' probabilities of α conditional on the managers' probabilities of a_1 and a_2, respectively. Then the consumers' probability a of α satisfies

$$(3) \qquad a = \mu a^1 + (1 - \mu)a^2$$

which is to say that the consumers' beliefs are a weighted average of what they would be, given the two possibilities for those of the managers. If managers are regarded as experts by consumers, then a^1 would be close to a_1 and a^2 to a_2. If the consumers believed in a theory of "contrary opinion," it might be that $a^1 < a^2$. As long as $a^1 \neq a^2$ and μ is not zero or one, the consumers would wish to know the managers' beliefs. In general, it seems natural to say that one individual's probabilistic beliefs are *valuable* to another if the latter thinks that there is a positive probability that his probabilistic beliefs would change on revelation of those of the first.

Assuming that the manager's beliefs are valuable to consumers, it is clear that the consumers might be made better off if production were affected by the managers' beliefs. To make consumers as well off as possible, a benevolent dictator would solve the following problem.

$$(4) \quad \max_{s_{Ai}\epsilon[0,1]} \mu[a^1U(f(s_{A1})) + (1 - a^1)U(f(1 - s_{A1}))] + (1 - \mu)[a^2U(f(s_{A2})) + (1 - a^2)U(f(1 - s_{A2}))]$$

where s_{A1} is the amount of seed planted in region A if the manager's probability of α is a_1 and s_{A2} is defined similarly. This problem is obviously different from (1), what the market solves. Suppose, for example, that $a^1 > a > a^2$—the consumers would change their beliefs in the direction of the managers'. Then the benevolent dictator would order the manager to plant more in region A if his probability is a_1 than if it is a_2.[5]

This notional inefficiency might be viewed in a purely formal way as arising from a lack of markets—in wheat contingent on pairs, one element of which is the usual state of nature and the other, the probability distribution of the manager. Markets in wheat contingent on such pairs are hard to imagine, especially because of consumers' difficulty in verifying the "occurrence" of the managers' probability distribution.

In actual fact, the absence of markets in many contingent commodities—contingencies now being taken in the usual sense of states of nature—may mitigate the type of inefficiency of concern here. This is because the absence of markets for commodities in certain contingencies means that managers are not given (implicitly) complete instructions for operating the production process by the market. Instead they are forced to make decisions which are influenced by their own beliefs, and are therefore of potential benefit to consumers.

Let us conclude by illustrating how the

[4]As will be clear, only the presence of valuable opinion—of less than full communication of beliefs—needs to be assumed. It therefore does not seem crucial that we have ignored how consumers might in fact learn something about managers' beliefs.

[5]From (4), it is clear that the optimal s_{Ai} maximizes $a^iU(f(s_{Ai})) + (1 - a^i)U(f(1 - s_{Ai}))$. But from (2), we know that the solution to this is increasing in a^i.

absence of markets in contingent commodities may improve matters. Suppose in our example that there is only a market in wheat, not a market in wheat contingent on the two possible states of nature. Suppose further that the managers have the same utility function as consumers and act so as to maximize their expected utility, where the expectation is with respect to their probability distribution.[6] Then the consumers' expected utility is given by

$$(5)\quad \mu[a^1 U(f(s_{A1})) + (1 - a^1)U(f(1 - s_{A1}))] + (1 - \mu)[a^2 U(f(s_{A2})) + (1 - a^2)U(f(1 - s_{A2}))]$$

where the s_{Ai} are chosen by the managers so as to

$$(6)\quad \max_{s_{Ai}\epsilon[0,1]} a_i U(f(s_{Ai})) + (1 - a_i)U(f(1 - s_{Ai}))$$

[6]If managers are given an appropriate share of total wheat output, this is what they would wish to maximize.

It is clear that consumers might be better off with expected utility determined by (5) and (6) rather than by (1). For example, if $a^1 = a_1$ and $a^2 = a_2$—the consumers would agree with the managers' beliefs if they knew them—then consumers would enjoy exactly the expected utility achieved under the benevolent dictator's first best solution.[7]

[7]For under this assumption, expected utility determined by (4) and by (5) and (6) are identical.

REFERENCES

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