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ON UNANIMITY AND MONOPOLY POWER

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In his comment on the present authors' paper (Aivazian and Callen, 1981), Booth makes an error in logic. Specifically, he argues that since value maximization is not in *general* the appropriate objective for the monopoly firm in a risk-free world, it can *never* be, even under specific assumptions, the appropriate objective in a risky world. That value maximization is not, in general, the appropriate objective for the monopoly firm, whether in a riskless or risky environment, is beyond dispute, and this has been shown by many authors (see Nielsen, 1976, for example).[1] Since Booth's comment relates entirely to this latter issue, his remarks add little to the literature.

What was shown *inter alia* in the original paper was that under very specific assumptions, the security market line criterion is the appropriate investment criterion even for a monopolist. This result is based on three explicit assumptions. First, the industry average rate of return function $r(I, \theta)$ is additive, that is $r(I, \theta) = r(I) + \theta$, where I is industry investment and θ is a random variable. Second, assets are valued according to the Mean-Variance Capital Asset Pricing Model. Third, all capital market participants are *ab initio* in long-run steady state equilibrium with respect to their portfolio holdings – this is the so called *ex post* unanimity condition. A violation of any one of these assumptions would vitiate the present authors' conclusion, but, it has never been claimed otherwise.

The essence of Booth's criticism is that the analysis is flawed because it ignores the fact that value maximizing decisions by a monopolist firm may result in relative price effects which could conceivably end up reducing the welfare of its shareholders. In other words, it is possible that as the monopolist reduces his investment (and output) to exploit potential monopoly rents, the increase in relative prices may ultimately end up reducing some shareholder's overall welfare (or utility). Hence, 'this individual would "vote" to increase firm investment and firm output, which would lead to a fall in market value and the price of C_2.'[2] Thus, Booth concludes that under monopoly unanimity breaks down and that the present authors' conclusion that with an additive risk structure value maximization may be the appropriate objective for the monopoly firm, does not make sense.

The present authors do recognize one important shortcoming of their framework, namely, that it ignores the impact of investment decisions on

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relative output prices – it is a single consumption good model. But the framework is consistent with a multi-commodity economy if profits in alternative states depend only on output but not on prices. Given fixed output prices, the downward slope of the return on investment function,[3] $r(I)$, can be justified by the assumption of diminishing returns with respect to I; that is, the firm is not a price taker in the market for its input assets.[4] Thus monopoly power in the authors' framework signifies market power in the real asset market and not in the output market. In fact, that is the sense in which monopoly power was described in the original paper.[5]

While the present authors' analysis ignored the impact of investment on relative output prices it focused on its impact on the risk market, and alternative risk structures in the constrained *ex post* unanimity framework were examined. In the framework under multiplicative risk structure, risk effects did indeed matter and the Security Market Line was indeed inappropriate. Only with an additive risk structure did risk effects not matter.

Furthermore, it is important to emphasize (and this is contrary to Booth's claim, page 679) that an analysis of the appropriate objective function of a *perfectly competitive firm* is subject to *exactly* the same problems which underlie Booth's criticism of the present authors' model. Even if the firm is a price taker in *all* markets, value maximization may be the inappropriate objective function for the perfectly competitive firm. In general, while each firm may be a price taker in output and risk markets, aggregate industry output changes will still generate relative price effects in these markets. This is why value maximization was inappropriate with multiplicative risk in the original model even with the *ex post* unanimity criterion. As Stiglitz has pointed out[6]:

> In a competitive market, it is reasonable to assume that the firm believes that the price in each state of nature is unaffected by its actions; thus, if each firm has 'multiplicative uncertainty' (i.e. relative output in different states of nature is fixed), it believes that by doubling its scale of output, its market value will be doubled. But when all firms increase their scale, not only does the level of prices change, but, more importantly, prices change by different relative amounts in different states of nature. Thus, for the industry as a whole, there is not multiplicative uncertainty: changing the level of investment does change relative profits in different states, changing the investment level changes the set of risk markets; firms will not take this into account but a social planner would. As a result, the market equilibrium is almost never a (constrained) Pareto optimum.'

It will now be shown that even in a risk-free world which is *suitably constrained* (that is, subject to assumptions analogous to the ones we made in a risky world) value maximization is the objective of the monopoly firm.[7] Consider an investor-consumer with a (exogenous) labour endowment of L and share endowment of $\bar{\alpha}$ in a monopoly firm. The investor's budget constraint is

$$C + (\alpha - \bar{\alpha})(V - I) = L \tag{1}$$

where

C is the investor's current consumption
V is the value of the monopoly firm
I is the cost of the investment
α is the equilibrium share of the monopoly owned by the investor

Since the environment is assumed to be risk-free

$$V = R_F^{-1}\, r(I)I \tag{2}$$

where r denotes the return on investment – which is assumed to be a function of I because of the firm's monopoly power – and R_F is one plus the risk-free rate.

The investor's programme is to:

$$\max_{\alpha,C,I} U(\alpha[r(I) - R_F]I, C) + \lambda[C + (\alpha - \bar{\alpha})(V - I) - L]$$

where $\alpha[r(I) - R_F]I$ is the consumer's future income (known with certainty) and λ is the appropriate multiplier. Solving the consumer-investor's maximization problem yields, in addition to the budget constraint, the following first-order conditions:

$$U_1'(\cdot)(r(I) - R_F)I + \lambda(V - I) = 0 \tag{3}$$

$$U_2'(\cdot) + \lambda = 0 \tag{4}$$

$$U_1'(\cdot)\,\alpha\left[\frac{dr(I)I}{dI} - R_F\right] + \lambda\left[(\alpha - \bar{\alpha})\frac{d(V - I)}{dI}\right]$$

$$+ U_1'(\cdot)\,(r(I) - R_F)I\frac{d\alpha}{dI} + U_2'(\cdot)\frac{dC}{dI}$$

$$+ \lambda\left[\frac{dC}{dI} + (V - I)\frac{d\alpha}{dI}\right]$$

$$+ [C + (\alpha - \bar{\alpha})(V - I) - L]\frac{d\lambda}{dI} = 0 \tag{5}$$

Substituting equations (1), (3) and (4) into equation (5) gives

$$U_1'(\cdot)\,\alpha\left[\frac{dr(I)I}{dI} - R_F\right] + \lambda\left[(\alpha - \bar{\alpha})\frac{d(V - I)}{dI}\right] = 0 \tag{6}$$

Given the *ex post* unanimity condition $\alpha = \bar{\alpha}$, equation (6) becomes

$$U_1'(\cdot)\,\alpha\left[\frac{dr(I)I}{dI} - R_F\right] = 0 \tag{7}$$

so that

$$\frac{dr(I)I}{dI} = R_F \tag{8}$$

Finally, from the valuation equation (2), one has

$$\frac{dr(I)I}{dI} = R_F\frac{dV}{dI} \tag{9}$$

Substituting (9) into (8) yields

$$\frac{dV}{dI} = 1 \tag{10}$$

which is the value maximization requirement.

As Booth's model was formulated in a single firm (and basically single investor) framework, the present authors chose to prove the value maximization result in a similar fashion. However, it is a rather simple matter, at least, in a risk-free world, to generalize this result to a multiplicity of firms and market participants. The issue is far more complex in a risky environment. This is precisely why the authors had to assume the Mean-Variance CAPM framework and additive risk to show the optimality of the security market line criterion in the original paper.

NOTES

1 Indeed, in the 1981 paper the authors showed that value maximization is *not* appropriate for a multiplicative risk structure even in a Mean-Variance CAPM framework.

2 L.D. Booth (1983) page 679.

3 Booth correctly points out that a weakness of the original paper is that it does not explicitly specify where $r(I)$ comes from.

4 Booth, on the other hand, justifies the downward slope of $r(I)$ by assuming a negatively sloped output demand curve and constant returns to scale production function.

5. Thus, ignoring changes in relative output prices is not as serious a problem for our model as Booth claims. Alternatively, relative price effects can be ignored if we assume that investors' utility functions are homothetically separable (a commonly made assumption underlying mean-variance portfolio theory) so that any investor's choice of which securities to invest in becomes independent of his consumption-investment decision.

6 See Stiglitz (1981), page 242.

7 In any case, Booth's oversimplified framework had to be modified somewhat because it is essentially timeless and did not allow for the making of the *ex post* unanimity assumption which is crucial for generating the present authors' result. Attempts were made however, to conform as much as possible to Booth's framework.

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