Transmission of Risk-Averse Behavior in Small Firms

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Abstract:

Small-sized firms are typically more entrepreneurial and engage in more innovation and risk-taking behavior. For that reason they are considered the engines of future economic growth. One policy for stimulating such activity is to provide government contracts for small firms. However, such contracts as typically written result in increased risk-averse behavior on the part of small firms out of a desire by government officials to shift the risk to the firms. This, in turn results in a reduced level of innovative and entrepreneurial activity. To eliminate the disincentive to engage in innovation and entrepreneurial activity, government needs to bear the risk associated with such contracts. One possible solution, given the natural risk aversion of elected officials, is to engage in a portfolio approach to small firm contracts by which the government can diversify away some of the risk.

Article:

1. Introduction

Small-sized firms are typically more entrepreneurial and engage in more innovation and risk taking than their larger counterparts. For that reason they are considered the engines of future economic growth and, as a result, are often the target of various governmental policies designed to encourage their activity. Paradoxically, however, the practice of elected officials targeting small firms with governmental contracts may stimulate small-firm activity at the expense of the entrepreneurial activity that makes them so attractive.

This paper presents a positive analysis of the effect of governmental contracts on small-firm behavior. Because of characteristics unique to small firms, we find that such contracts will result in a reduction in the willingness of small firms to engage in risk taking, and with that reduction in risk taking is a general reduction in entrepreneurial and innovative activity.

This result is important because it suggests that public policies that seek to stimulate entrepreneurial and innovative activity by targeting small firms for governmental contracts will at best achieve a Pyrrhic victory that increases small firm activity but actually reduces the level of entrepreneurial and innovative activity. Assuming that the stimulation of entrepreneurial and innovative activity is a desirable policy objective, the problem is not whether government should target small firms at all, but rather how governmental contracts could be designed to insulate the small firm from direct influence by elected governmental officials and yet provide sufficient levels of oversight.

Our results are also important from a private-sector perspective. We find that small firms are particularly susceptible to reduced levels of entrepreneurial activity and innovation if a significant part of their revenue comes from government contracts. As a result, small firms interested in avoiding such reductions need to examine closely the structure of their government contracts if they wish to avoid the problems often attributed to public-sector enterprises.

This paper is outlined as follows. Section II characterizes the special nature of small firms that differentiates them from their larger counterparts. It also explains the relationship between a firm's revenue function and risk-averse behavior. Section IIII then provides an analysis of the relationship between influence by elected governmental officials and risk-averse behavior on the part of small firms. Finally, Section IV contains a brief summary and some observations about the implications for public policy.

II. A model of small firm behavior

It is well known that small firms are typically exposed to greater competitive pressures and uncertainty in the production process than their larger counterparts.

Consider, then, a small firm producing in a perfectly competitive, output market in which its production process is uncertain.[1] Because the revenues for this firm will be a positive, linear function of output Q, we can represent revenues by the function:

$$R = R(Q) \qquad (1)$$

where:

$$\frac{\partial R}{\partial Q} > 0 \qquad \frac{\partial^2 R}{\partial Q^2} = 0. \qquad (2)$$

Because the firm encounters uncertainty in the production of the good, let the level of output Q be an uncertain function of the firm's effort E:

$$Q = Q(E, \theta) \qquad (3)$$

where 0 is an index variable representing the presence of the production risk and assumed to be a random draw from a set of possible states-of-nature with known distribution function f(θ). Let θ take on non-negative values with greater values of θ implying increasingly lower values of Q:

$$\frac{\partial Q}{\partial \theta} < 0 \qquad \frac{\partial^2 Q}{\partial \theta^2} \leq 0. \qquad (4)$$

For a given level of effort, define the maximum output level to be the output level associated with 0 equal to zero. Finally, assume that Q *is* a positive, strictly concave function of E and that increases in θ reduce the marginal productivity of E:

$$\frac{\partial^2 Q}{\partial \theta \partial E} < 0 \qquad (5)$$

The cost of producing Q is assumed to increase at an increasing rate with the total level of effort expended:

$$C = C(E) \qquad (6)$$

such that:

$$\frac{dC}{dE} > 0 \quad \text{and} \quad \frac{d^2 C}{dE^2} = 0. \qquad (7)$$

Hence, the small firm's problem is to maximize expected profits:

$$\max_E \int (R(Q(E, \theta)) - C(E)) f(\theta) d\theta. \qquad (8)$$

The solution to the small firm's problem is an unique, optimal level of effort characterized by the first-order condition that expected marginal revenue should equal marginal cost:

$$\int \frac{dR}{dQ} \frac{\partial Q}{\partial E} f(\theta) d\theta = \frac{dC}{dE}. \qquad (9)$$

Whether or not the firm engages in risk-averse behavior will depend on whether such behavior increases the expected profits of the firm. Within the context of our model, the firm's decision centers on the level of output to produce. We define risk-averse behavior to be a costly act that reduces the firm's exposure to future uncertainty in order to better achieve its objective. Within the structure of our model, such behavior will allow the small firm to produce the expected quantity $Q^e = \int Q(E, \theta) f(\theta) d\theta$ with reduced uncertainty, perhaps to the point of certainty.

In practice, this reduction in uncertainty can be achieved through a variety of methods. Besides the familiar purchasing of insurance, the firm can engage in greater monitoring of the production process, hiring outside agents to manage or perform the production process, and so forth. All such actions increase costs either directly through increased payments to others or indirectly by slowing the production process and thus increasing the costs borne by the firm.

In order for risk-averse behavior to be rational, it must be that the gains associated with reducing exposure to risk exceed the increased cost associated with reducing that exposure. However, for the small firm in a competitive market, there will be no gain associated with engaging in risk-averse behavior because such behavior is costly and because there is no associated gain in expected revenues. To see that, consider the case illustrated in Figure 1 of a small firm faced with an uncertain production function that takes the form $Q^{low}(E)$ with probability p and the form $Q^{high}(E)$ with probability (1 — p).

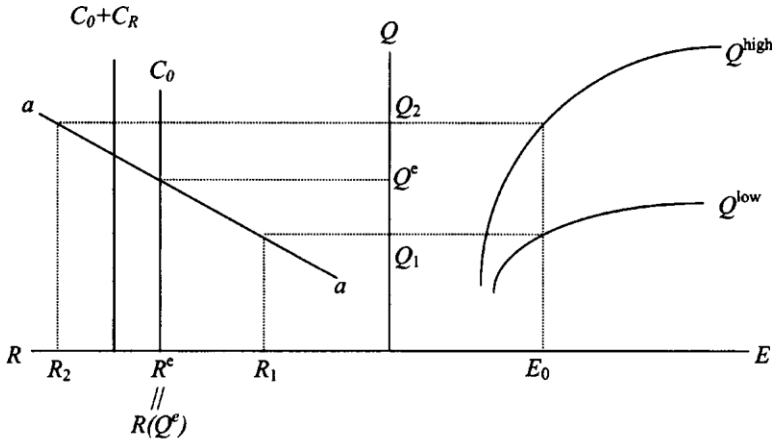

Figure 1.

Suppose further that the firm has incurred the (certain) cost $C_0 = C(E_0)$ based on its efforts E_0, and is now awaiting either a low output, defined as $Q_1 = Q^{low}(E_0)$ (with probability p), or a high output, defined as $Q_2 = Q^{high}(E_0)$ (with probability $(1 — p)$). In such a situation, expected output will be $Q^e = pQ_1 + (1 — p)Q_2$ and expected revenues will be $R^e = pR(Q_1) + (1 — p)R(Q_2)$. Because the revenue function $R(Q)$ is linear in output (recall equation (1)), the relationship between output and revenue can be represented by the straight line aa in Figure 1, and an inspection of that figure reveals that the expected revenues associated with producing output with uncertainty, R^e, will be equal to the revenues $R(Q^e)$ associated with producing the expected output Q^e with certainty.

Because risk-averse activity increases total costs (represented by *CR* in Figure 1), the firm will find that engaging in risk averse activity will increase its costs from Co to Co + *CR*, leave revenues unchanged at Re, and thereby reduce profits. As a result, there is no advantage to the firm engaging in risk-averse behavior.

III. The effect of government contracts

Now suppose that the small firm receives its revenues not from selling in a competitive market but from contracting with elected officials for the production of some good or service. Because of the difficulty observing the entire production process, elected officials typically monitor a small subset of the attributes of the

good or service (Lindsay (1976)). To make this more concrete, assume that the contract requires that the firm produces some quantity of a good or service by an agreed date. If the firm meets the target quantity and date, the firm will receive its contracted payment, sometimes with some small additional reward if the firm finishes early or if the output is greater than originally specified. However, if the firm fails to meet its target, there are often large penalties that significantly reduce the total revenue received from the government. Such contracts are designed to assure that the target is hit and are based on a general risk-aversion on the part of elected government officials concerned with their chances of reelection.[2] Thus, the relationship between the firm's output and its total revenue will no longer be linear as noted in equation (1) but will instead be more or less concave. Assume, therefore, that the revenue function associated with a government contract is:

$$R = \hat{R}(Q) \qquad (10)$$

such that:

$$\frac{\partial \hat{R}}{\partial Q} > 0 \qquad \frac{\partial^2 \hat{R}}{\partial Q^2} < 0. \qquad (11)$$

The degree of concavity can of course vary, but in general it will increase with the importance that the government puts on the output and the degree to which the elected officials are risk averse.

Under such circumstances, there is a potential advantage to the firm engaging in risk-averse behavior because such behavior allows the firm to produce Q^e with greater certainty and thereby increase its expected revenues. To see that, consider once again the simple production process in which output takes the form $Q^{low}(E)$ with probability p and the form $Q^{high}(E)$ with probability $(1 — p)$. Assuming that the revenue function can be represented by the curve *bb* in Figure 2, the concavity of bb results in expected revenues $R = pR(Q_1)+(1 — p)R(Q_2)$ being less than the revenues associated with producing expected output $Q^e = pQ_1 + (1 — p)Q_2$ with certainty.

For the firm, this means that there is a revenue gain associated with engaging in risk-averse behavior. As a result, if the cost of risk-averse behavior is less than this gain in revenues associated with such behavior, the firm will find such behavior profitable and will therefore choose to act in a risk-averse manner. In Figure 2, the gain to the firm associated with eliminating production uncertainty completely would be an increase in revenue from R^e *to* $R(Q^e)$. Because the increase in cost associated with risk-averse behavior in Figure 2 is assumed to be some C_R, which is less than the revenue increase, the firm will find it to its advantage to engage in risk-averse behavior and increase its profits by $R(Q^e) — R^e — C_R$.

IV. Conclusion

If the stimulation of entrepreneurial and innovative activity in small firms is a desirable policy objective, the above analysis suggests that the typical contract with elected officials may not work. The fundamental problem is that the elected officials seek to reduce the risk associated with the production process through the design of incentive contracts that result in a concave revenue function.

Moreover, while one might imagine that having a government bureaucracy issue the contract would be better, that is not, in fact the case. As Leyden and Link (1993) show, bureaucracies are also affected by the risk aversion of elected officials. As a result, when they contract with a private-sector firm for the production of some good or service, they will generally insist on the firm taking actions to indemnify the bureaucracy from production risks. Such contracts with bureaucracies typically result in either a fixed-fee contract with full insurance or a cost-plus type contract and thus do not generate a concave revenue function for the firm. However, the effect is the same because such contracts increases the costs of the firm and induce it to take risk-averse actions either directly in the production process or indirectly through the purchase of some form of insurance such as performance bonds.

How, then, can elected officials stimulate small firm activity without creating the disincentives to engage in innovative and entrepreneurial activity?

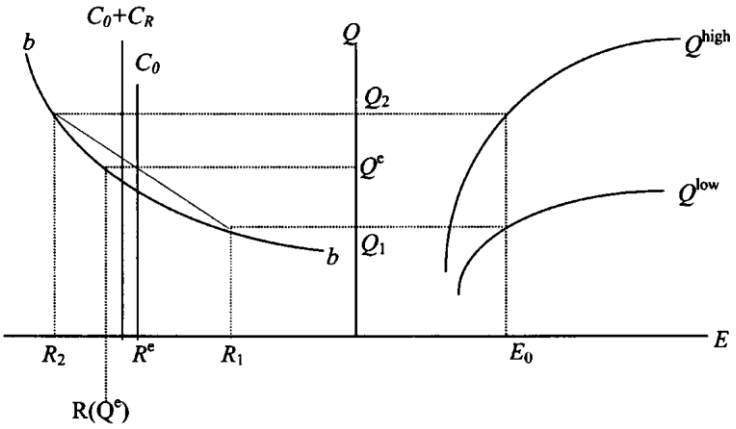

Figure 2.

The key would seem to be to offer small firms contracts similar to what they would get in competitive markets with, in particular, linear revenue functions. This, in turn suggests that elected officials must either be willing to bear the risk associated with such contracts or to reduce that risk through other means. One possibility is to reduce the risk by contracting with a number of small firms so that, on average, performance on contracts is closer to what the elected officials desire. Because this "portfolio" approach requires a fairly large volume of contracts, such an approach is more likely to be feasible at the state and especially federal level than at the local government level.

Notes

[1] Bozeman and Kingsley (1998, p. 10) define risk as "the exposure to the chance of loss from one's actions or decisions." Within the context of our model, such exposure centers on the production process that the firm engages in.

[2] Governmental contracts may also be designed by bureaucrats. However, because bureaucrats ultimately depend on elected officials for their budgets and compensation, they too have an incentive to act in a risk-averse manner. See Bendor, Taylor, and Van Gaalen (1985) for a more detailed examination of the penalties and rewards that elected government officials design, and see Leyden and Link (1993) for a more detailed explanation of how bureaucrats transfer risk to private-sector firms in the contracts they design.

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