Managerial Compensation in Bertrand and Cournot Oligopoly

The issue of executive compensation has received considerable attention from academics and the popular press. Much of the work in this area attempts to estimate the relationship between firm performance and executive compensation. Classical microeconomic theory suggests that managers will be rewarded for maximizing firm profits. In 1959, William Baumol proposed that firms benefit from increases in sales. Since then, analysts have attempted to analyze the relationship among executive pay, profits, and sales.

More recently, Chaim Fershtman and Kenneth Judd developed a model of compensation contracting that incorporates aspects of oligopoly theory. These authors argue that managers of perfectly competitive firms will be rewarded only for profits; however, they find that managers of oligopolistic firms may be rewarded or penalized for increases in firm sales. The model suggests that by carefully choosing the terms of compensation contracts, firm owners are able to influence the decisions of both their own manager and managers of competing firms. Whether managers are rewarded or penalized for increases in firm sales depends on whether firms interact in a Cournot (quantity-setting) or Bertrand (price-setting) environment.

For example, assume two firms, Acme and Mustang, are quantity setters. If Mustang's manager is rewarded only for increases in profits while Acme's manager is rewarded for increases in both profits and sales, Acme's manager will become a more aggressive seller. As a result, Acme's sales will increase and the market price of the product will fall, which in turn will lead Mustang's manager to reduce output and sales. Acme will become the dominant firm. It can be shown that the best thing Mustang's owner can do, regardless of the contract written by Acme's owner, is to also reward his or her manager for increases in sales. It is interesting to note that when both managers are rewarded for increases in sales, both firms' profits and product prices decrease as sales increase.

In contrast, if these firms are price setters, owners will penalize their managers for increases in sales. When Acme's manager is penalized for sales, this signals to Mustang's manager a willingness to price less aggressively. Mustang's manager, in turn, will increase the price of her or his product. It can be shown that when managers are price setters, compensation contracts that penalize them for increases in sales are optimal. In this case, output will be lower, and profits and prices greater than in the Bertrand pricing game without contracting.

In each scenario just outlined, performance can be thought of as a linear combination of profits and sales, with owners choosing α:

$$\text{Performance} = \alpha \text{ Profits} + (1 - \alpha) \text{ Sales}$$

In a Cournot oligopoly $\alpha < 1$, while in a Bertrand oligopoly $\alpha > 1$.

Marc Chopin adapted this model to empirically examine executive compensation in oligopolies. The empirical model includes an estimate of the salary payment and the degree to which measured performance affects compensation. The degree of dependence is represented as δ in the following equation:

$$\text{Pay} = \text{Salary} + \delta[\alpha \text{ Profits} + (1 - \alpha) \text{ Sales}]$$

Using this model, Chopin estimated the terms of incentive contracts for 233 firms competing in 50 industries and found significant differences in the terms of compensation contracts across firms. As Table 9–1 shows, retail variety stores appear to have almost homogeneous measures of performance, with the majority of the weight placed on profits and a small but significant disincentive for sales. As suggested by the estimates of δ, the effect of performance on pay varies significantly across firms.

For example, these estimates indicate that the CEO of Dayton-Hudson will receive an additional $545.95 for each $1 million increase in profits (since $517 \times 1.056 = 545.95$), while cash compensation falls by $28.95 for each increase in sales of $1 million (since $517 \times (1 - 1.056) = -28.95$). When compared

to Zayre's CEO, Dayton-Hudson's manager appears relatively insulated from performance. The CEO of Zayre earns additional cash compensation of $2,882.74 for each $1 million increase in profits; cash compensation decreases by $165.74 for each $1 million increase in sales.

Sources: William J. Baumol, *Business Behavior, Value and Growth* (New York: Macmillan, 1959); Marc C. Chopin, "Executive Compensation in Oligopolies: Sales, Profits, and Pay," *Advances in Applied Microeconomics* 9 (1999), pp. 101–22; Chaim Fershtman and Kenneth L. Judd, "Equilibrium Incentives in Oligopoly," *American Economic Review* 5 (December 1987), pp. 927–40.

TABLE 9–1 Estimates of Owners' Choices of α and the Degree of Dependence of Compensation on Measured Performance for Retail Variety Stores

Firm	δ (*t*-statistic in parentheses)	α (standard deviation in parentheses)
Dayton-Hudson	517	1.056
	(3.57)	(0.009)
K Mart	170	1.035
	(2.27)	(0.010)
Woolworth	847	1.048
	(4.92)	(0.013)
Zayre	2,717	1.061
	(2.08)	(0.007)