A Model of the Effect of Mergers and Acquisitions on Plant Closures

The descriptive data suggest that M&As may not have been the prime reason for plant shutdowns (and the worker layoffs that would follow) over 1977-92. However, those data do not indicate the role, if any, that M&As did have nor show why some plants prospered and others failed. To answer those questions, we construct a model of plant closures that closely follows one used by McGuckin et al. (1997).

As claimed by a number of economists, including Anderson et al. (1998) and Muth et al. (2002), plant closures can be viewed as a measure of profitability and incorporated into a Probit regression. Let Y = 1 if a plant closes (i.e., is not profitable) and Y = 0 if it survives (remains profitable), and let X be defined as a vector of independent variables that measures whether the plant was acquired, decreases plant technology, and controls for other factors. Mathematically, this is written as:

$$\text{Prob}\ (Y_i = 1) = \text{Prob}\ (\prod_i < 0), \qquad (1)$$

where longrun profits $\prod_i$ equal $\beta'\mathbf{X}_i + \varepsilon_i$, with X_i equal to a vector of characteristics that affect profitability and ε_i is a random error term:

$$= \text{Prob}\ (\beta'\mathbf{X}_i + \varepsilon_i < 0) = \text{Prob}\ (\varepsilon_i > \beta'\mathbf{X}_i) \qquad (2)$$

$$= 1 - F(B'\mathbf{X}_i) \qquad (3)$$

where $F(B'\mathbf{X}_i)$ is a cumulative distribution. Marginal effects are estimated separately as:

$$\frac{\partial E[y]}{\partial x} = \left\{ \frac{dF(\beta' x)}{d(\beta x)} \right\} \beta = f(\beta' x)\beta \qquad (4)$$

where f (.) is the density function that corresponds to the cumulative distribution, F(.). For technical details, see Greene (1993, p. 643).

The technology variables include relative labor productivity, plant size, and plant age. McGuckin et al. (1997) have shown that relative productivity affects plant survival and Dunne et al. (1989), Baldwin (1991), and Dunne and Roberts (1990) determined that plant size and age strongly affect plant closure. The dummy variables include whether the plant is owned by an acquiring (buyer) or nonacquiring (nonbuyer) firm, industry type, and whether the plant is part of a multiplant firm. Finally, since MacDonald et al. (2000) document a large reduction in labor costs over 1972-92, we consider the effect of labor costs.

The empirical model is expressed as follows:

$$\text{Prob}\ (PC_t) = a_0 + a_1\ \text{Pr}\ (AC_t) + a_2\text{Ln PROD}_{t-1} + a_3\ \text{Ln SIZE}_{t-1} + a_4\text{AGE72} + a_5\text{AGE77} \qquad (5)$$

$$+ a_6\text{Ln WAGE\_SHARE}_{t-1} + a_7\text{BUYER\_PLANT} + a_8\text{MULTI} + a_9\text{OUTSIDE}$$

$$+ a_{10}NOT\_FOOD + a_{10} Pr (AC_t)*Ln\ SIZE_{t-1} + a_{11}Ln\ PROD_{t-1}*Ln\ SIZE_{t-1}$$

$$+ a_{12}Ln\ WAGE\_SHARE_{t-1}*Ln\ SIZE_{t-1} + a_{13}AGE72*Ln\ SIZE_{t-1} + a_{14}AGE77*Ln\ SIZE_{t-1}$$

$$+ a_{15}BUYER\_PLANT*Ln\ SIZE_{t-1} + a_{16}MULTI*Ln\ SIZE_{t-1} + a_{18}OUTSIDE*Ln\ SIZE_{t-1}$$

$$+ a_{19}NOT\_FOOD*Ln\ SIZE_{t-1} + \varepsilon_{zi},$$

where PC_t equals 1 if the plant was closed by year *t* and zero otherwise. Since M&As are influenced by plant productivity and size and both of those attributes are included in our model, we use an instrumental variable—the estimated probability of ownership change—to represent ownership change Pr (AC). The other variables are defined as follows: PROD is relative plant labor productivity and is discussed in detail below, SIZE (plant size) equals the number of plant employees, AGE72 equals 1 if the plant first appeared in the data in 1972 and zero otherwise, AGE77 is identical to AGE72 except it is for 1977, WAGE_SHARE is worker compensation costs as a share of total costs, BUYER_PLANT is a dummy variable defined as 1 for plants owned by buyer firms and zero otherwise, MULTI is a dummy variable equal to 1 if the plant is owned by a firm that owns other establishments and zero otherwise, OUTSIDE equals 1 if the plant produces food but is not in the industry of plant *i* and zero otherwise, and NOT_FOOD equals 1 for plants that do not produce food products and zero otherwise.

Productivity can either be measured for each input, such as labor (labor productivity), or for all inputs, total factor productivity (TFP). Theoretically, TFP is superior to labor productivity because it takes into account all inputs, but, because plant capital data are not available, we use relative labor productivity—the ratio of plant labor productivity (value of output in current dollars, divided by the total work hours) to average industry labor productivity.[3] We would have preferred to define labor productivity as real output divided by labor inputs, but we do not have output prices and the value of output varies across plants and over time due to price dispersion and inflation.[4]

[3]This relative productivity ranking approach was suggested by Christensen et al. (1981) and has been applied in recent productivity analyses using plant-level data from the LRD (e.g., Olley and Pakes, 1992; Bartelsman and Dhrymes, 1992; Bailey et al., 1992; and McGuckin and Nguyen, 1995). An important property of this productivity measure is that it does not depend on an output deflator because output in all plants is measured in current-year dollars. Accordingly, it can be used in intertemporal comparisons (see Bailey et al., 1992, p. 192).

[4]Using plant-level 1982 Census of Manufactures data, Abbot (1989) found that seven-digit product-level prices vary substantially across plants.