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The Econometric Model of Enterprise Breakups

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ABSTRACT
we present the model that describes the process of enterprise breakups. We carried out regression analyses relating several common measures of performance to standard explanatory variables and a variable measuring the importance of the spun off unit in the master enterprise.
Keywords: state owned enterprises, enterprise breakups, regression analyses.

1. INTRODUCTION

One of the most hotly debated issues in transitional economies has been the timing, extent and method of restructuring of state owned enterprises (SOEs). On timing, the arguments have revolved around the question of whether prize liberalization should be preceded by restructuring of SOEs, or whether liberalization of prices is needed first in order to send correct signals for restructuring and privatization. With respect to the extent and method, one strand of the debate has focused on whether the SOEs tend to be too large and need to be broken up into smaller units or whether their size is appropriate for the world market. A related issue has been whether the restructuring should be guided by existing managers, the supervisory ministries or external institutions such as foreign investors or management companies. There is an extensive literature on the optimal scale of the firm. The topic was systematically pursued by a number of researchers, including Williamson (1983, 1998), Klein et al. (1978). The models vary in their focus and approach but their overall implication is that the desirability of integration of ownership through takeovers or mergers, and its disintegration through spinoffs and breakups, depends on the tradeoff between transaction costs via markets and the internal inefficiencies within organizations. While these aspects of the problem are relevant in the transitional situation, the conceptual framework of enterprise breakups in transition requires a model focused on the different goals and interactions of the management of the SOEs, management of the divisions (subsidiaries) and the government. In the next section we therefore present a simple model that captures the process of enterprise breakups.

2. THE MODEL

In our empirical work we undertake two types of comparisons: (a) the performance of newly independent subsidiaries v. that of master enterprises from which these subsidiaries broke away and (b) the performance of master enterprises that experienced spinoffs v. performance of those that did not. Given the nature of the data, the former comparison is carried out in a straightforward way. The second comparison requires the use of more complex techniques. In order to estimate the impact of a split on the master enterprise, using the data on master enterprises that both did and did not experience breakups, we estimate coefficient α in the following model:

$$cme_i = \beta' X_i + \alpha df_i + e_{2i}, \tag{1}$$

where cme_i is a "common measure of efficiency" of the i-th enterprise, X_i are relevant characteristics of the i-th enterprise for which we control, and df_i is a variable capturing the spinoff of the subsidiary. In our empirical work, we have defined df_i as the share of the spun off subsidiary in the total scale of the i-th master enterprise or as a dummy variable coded 1 if a split occurred and 0 otherwise.

If unobserved random characteristics of an enterprise did not influence the occurrence of a split and the share variable, the usual estimation methods such as the ordinary least squares (OLS) would give us consistent estimates of α and β. However, the process of determination of df_i is most likely correlated with unobserved characteristics of the *i*-th enterprise, such as the ability of management, know-how, etc. As a result, it is likely that

$$E(e_{2i} \mid df_i) \neq 0 \tag{2}$$

The error term in equation (1) is hence likely to be correlated with the right hand side variable df_i and OLS estimates are likely to be inconsistent. The solutions for this problem are well known (see e.g., Madalla (1983)), with the simplest solution being the use of instrumental variables (IVs). Instrumenting for df_i with variables that are correlated with df_i but not with e_{2i} is the obvious remedy, but the method is not always efficient. This is particularly the case when df_i is captured by the share variable because one is then instrumenting a variable that takes on positive as well zero values. A class of methods that is widely used in this situation assumes that there exists an equation that decides whether df_i is zero or positive. In particular, assume that one can specify an equation

$$df_i^* = \gamma' W_i + e_{1i} \text{ and } df_i = df_i^* \; if \quad df_i^* \geq 0,$$
$$df_i = 0 \, if \quad df_i^* < 0, \tag{3}$$

where df_i^* is the unobserved and df_i the actual value for observed splits. It follows that variables W represent potential instruments for the IV method discussed earlier as well. Next we postulate the joint distribution of $(e_{1i}, e_{2i})'$ and develop the appropriate estimator. The above equations do not reflect particular structural forms. The success of the above two-step method hinges on obtaining a consistent estimate of γ in the first step and adding into equation (1) another variable that represents a consistent estimate of $E(e_{1i} \mid df_i, W_i)$. In the case of a joint normal distribution of $(e_{1i}, e_{2i})'$, γ could be estimated via a standard tobit equation. However, if we are willing to assume normality in errors and known forms of equations (3), then under identical assumptions one can estimate equations (1) and (3) more efficiently by a maximum likelihood estimator (MLE). The likelihood function of our set of equation may be written as

$$L = \prod_0 \text{Prob}(\text{"Observation without split"}) \times \prod_1 \text{Prob}(\text{"Observation with split"}), \tag{4}$$

where **0** in theproduct denotes the set of observations for which the split was not observed and **1** denotes the observations with the split. Using equations (1) and (3), the likelihood can be written as

$$L = \prod_0 \text{Prob}\left(\gamma' \mathrm{W_i} + e_{1i} < 0,\; cme_i = \beta' X_i + e_{2i}\right) \times \\ \prod_1 \text{Prob}\left(df_i = \gamma' \mathrm{W_i} + e_{1i},\; cme_i = \beta' X_i + \alpha df_i + e_{2i}\right) \tag{5}$$

Now expressing the errors on the left hand sides in probabilities we get

$$L = \prod_0 \text{Prob}\left(e_{1i} < -\gamma' W_i, e_{2i} = cme_i - \beta' X_i\right) \times \\ \prod_i \text{Prob}\left(e_{1i} = df_i - \gamma' W_i, e_{2i} = cme_i - \beta' X_i - \alpha df_i\right). \tag{6}$$

Note however that **Prob(.)** stay in the likelihood for the combination of density and cumulative distribution functions. The maximization such a likelihood function would require numerical integration procedures for all observations. However, since ***Pr(A,B) = Pr(A|B) Pr(B)***, we can condition in the first product on e_{2i} and obtain

$$L = \prod_0 \text{Prob}\left(e_{1i} < -\gamma' W_i \mid e_{2i} = cme_i - \beta' X_i\right) \times \prod_0 \text{Prob}\left(e_{2i} = cme_i - \beta' X_i\right) \times \prod_1 \text{Prob}\left(e_{1i} - df_i - \gamma' W_i, e_{2i} = cme_i - \beta' X_i - \alpha df_i\right). \tag{7}$$

If we are willing to assume the joint normality of errors, i.e.

$$\begin{pmatrix} e_1 \\ e_2 \end{pmatrix} \sim \begin{pmatrix} 0 & \sigma_1^2 & \sigma_{12} \\ 0 & \sigma_{12} & \sigma_2^2 \end{pmatrix},$$

we can re-express our likelihood with the help of a joint normal density $f_{12}(.)$, normal density $f_2(.)$ and cumulative normal conditional density $F_{1.2}(.)$ as

$$L = \prod_0 F_{1.2}\left(-\gamma' W_i\right) * f_2\left(cme_i - \beta' X_i\right) \times \prod_1 f_{12}\left(df_i - \gamma' W_i, cme_i - \beta' X_i - \alpha df_i\right). \tag{8}$$

For the normally distributed errors of equation (1) it follows that

$$e_{1.2} \sim N\left(\frac{\sigma_{12} e_2}{\sigma_2^2}, \sigma_1^2 - \frac{\sigma_{12}^2}{\sigma_2^2}\right).$$

The cumulative distribution function of normal distribution errors $e_{1.2}$ could be evaluated with the help of standard normal cumulative distribution function $\Phi(.)$, since

$$F_{1.2}\left(-\gamma' W_i\right) = \Phi\left(-\frac{\gamma' W_i - \left(\frac{\sigma_{12}}{\sigma_2^2}\right)\left(cme_i - \beta' X_i - \alpha df_i\right)}{\sigma_{1.2}}\right).$$

Now we can maximize the likelihood respectively with respect to its parameters α, β, γ and the elements of the variance-covariance matrix of $\left(e_1, e_2\right)'$ using numerical optimization procedures. Optimal theoretical properties of MLE estimators in large samples are of course based on the assumption of a correct specification of the probability model. Should our joint normality assumption be incorrect, our parameter estimates would be inconsistent and inefficient. A simple test of misspecification may be carried out by applying the Hausman test on our coefficient of interest α. In applying the test we use the fact that, if equation (1) is correctly specified and instruments properly selected, the IV estimator yields consistent estimate of our coefficient of interest α. Under the null hypothesis of no misspecification the MLE is efficient and the Hausman test statistics yields the attractively simple form,

$$h = \frac{\left(\hat{\alpha}^{IV} - \hat{\alpha}^{MLE}\right)^2}{\widehat{Var}\left(\hat{\alpha}^{IV}\right) - \widehat{Var}\left(\hat{\alpha}^{MLE}\right)},$$

where hats denote estimates of α from IV and MLE estimation methods and $h \sim \chi_{(1)}$.

3. CONCLUSIONS

The question that naturally arises is whether the observed breakups have had systematic economic effects in the sense that better or worse performing units were spun off and the resulting units benefited or suffered from the split. There are three scenarios that can answer that question: The breakups occur because top managers of SOEs discard bad divisions in order to improve the performance of the master enterprises. The bad divisions are thus not essential for the operation of the rest of the firm and it is profitable to get rid of them. we can assumes that it is the managers of the divisions (subsidiaries) of the master enterprise that strive to spin off their units because they are more efficient than the master enterprise and can perform better separately than as part of the large firm. finally, the third view is that managers of subsidiaries may try to break away from the master enterprise even if their unit and the master enterprise perform worse as a result of the spinoff. In this third scenario, managers of divisions strive to gain complete control over the unit because they derive pecuniary and/or non pecuniary benefits by being top management of a firm.

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