Manager Interests, Breakups and Performance of State Enterprises in Transition

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Abstrakt

Tato práce analyzuje chování manažerů během restrukturalizace státních podniků v podmínkách cenové kontroly. Vlna rozpadů státních podniků v letech 1990-1991 byla zkoumána. V rámci práce byl vyvinut jednoduchý model popisující proces rozpadu, který vede k empiricky ověřitelným hypotézám. Tyto hypotézy byly testovány na údajích o podnicích z let 1990-1991. Výsledky empirické analýzy umožnují získat závěry o chování manažerů použitelné pro hospodářské rozhodování.

Abstract

The paper analyzes the behavior of managers during restructuring of state owned enterprises (SOEs) in the period of price control. The massive wave of breakups of the SOEs that occurred in Czechoslovakia in 1990-1991 has been investigated. A simple model that describes the process and yields testable predictions has been developed. The predictions of the model have been tested on firm level data set from 1990-1991. The results of the empirical analysis enable us to draw policy oriented conclusions about the behavior of the managers of the SOEs in such period.

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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 price 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.

As events unfolded in the first phase of transition, many of these issues have been obviated by spontaneous events. In particular, in virtually all the transforming economies one had observed massive breakups of SOEs before the governments had an opportunity to set a clear-cut policy on these issues. Czechoslovakia for instance started 1990 with about 700 industrial enterprises employing more than 25 workers. By mid 1992 the number of firms in this category equalled about 2000.[1]

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. Based on emerging stylized facts in the transitional economies, three competing hypotheses may be advanced **a priori:**

1. In the first scenario the breakups occur because top managers of the 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.

2. The second hypothesis 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.

1The latter number included the newly created firms as well. However, a significant part of the growth of firms is due to the breakups of SOEs.

3. 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 resut of the spinoff. In this third scenario, managers of divisions strive to gain complete control over the unit because they derive pecuniary and/or nonpecuniary benefits by being top management of a firm.

The three hypotheses yield the following empirical predictions about enterprise performance. In the first scenario the performance of the remaining master enterprises should be superior to that of the spun off subsidiaries. Under the second hypothesis the opposite outcome should be observed as the spun off units are the superior performers. In the third case one should observe the post breakup performance to be worse in both the master firms and the newly independent subsidiaries.

These competing hypotheses are in principle testable by comparing the performance of broken up enterprises to those that did not go through a split as well as by comparing the performance of the spun off units with the surviving master enterprises. In this paper we analyze this issue using data on Czechoslovak enterprises from 1990-91. These data are appropriate because Czechoslovak SOEs experienced a major wave of breakups during the 1990-1991 period. Parts of large SOEs (some of them called "Vyrobne hospodarske jednotky" -- VHJ) applied to their supervisory ministries for permission to split off from the main (master) enterprise. The process reflected a complicated set of negotiations among government officials, top managers of the SOEs and managers of the divisions (subsidiaries). The timing in many respects preceded the reform as prices were still firmly under state control in 1990 and even in 1991, when prices were already by and large free, the state still owned the firms. Yet the outcome of the process had important implications for the structure of industry and the subsequent program of privatization.

2. The Theoretical Framework for Spinoffs and Breakups

2.1. The Existing Literature

There is an extensive literature on the optimal scale of the firm. The topic was systematically pursued by a number of researchers, including Coase (1937), Alchian & Demsetz (1972), Williamson (1975, 1985), Chandler (1977), Klein et al. (1978), Grossman and Hart (1986), Hart and Moore (1990), and Radner and Van Zandt (1992). 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. As Radner and Van Zandt (1992) have shown, the latter inefficiencies need not necessarily increase with the scale of an enterprise.

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 SOE, 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 as a game among these players and leads to predictions that we test in the empirical part of the paper.

2.2. A Simple Model of Enterprise Breakups

In this section we present a model that yields the predictions of the first two hypotheses outlined in the introduction. The third hypothesis entails rather special behavior motivation which we do not formally incorporate into the model. It should also be noted that while the order of moves of the players is structured in the model so as to reflect the real world setting, the order would naturally not matter if the players had perfect information about the payoffs and possible strategies.

The modelling is motivated by the fact that in the first two years after the Velvet Revolution of November 1989, the Czechoslovak government by and large displayed a passive posture toward the issue of restructuring and breakups of SOEs. Nevertheless, individual units of SOEs could and did apply to the supervisory ministries for permission to spin off from their master enterprises. In many cases their requests were granted. On the basis of stylized facts about this process, we model it as a sequential game with perfect information on the side of the enterprise. Since the government was not directly involved in the process, we merely allow it to influence the probability of breakups according to a set of rules.

The game is described in Figure 1. There are two agents: **M** - Master Enterprise (the top management of the SOE) and **S** - Subsidiary (the management of a unit of the SOE that is considering whether or not to apply to

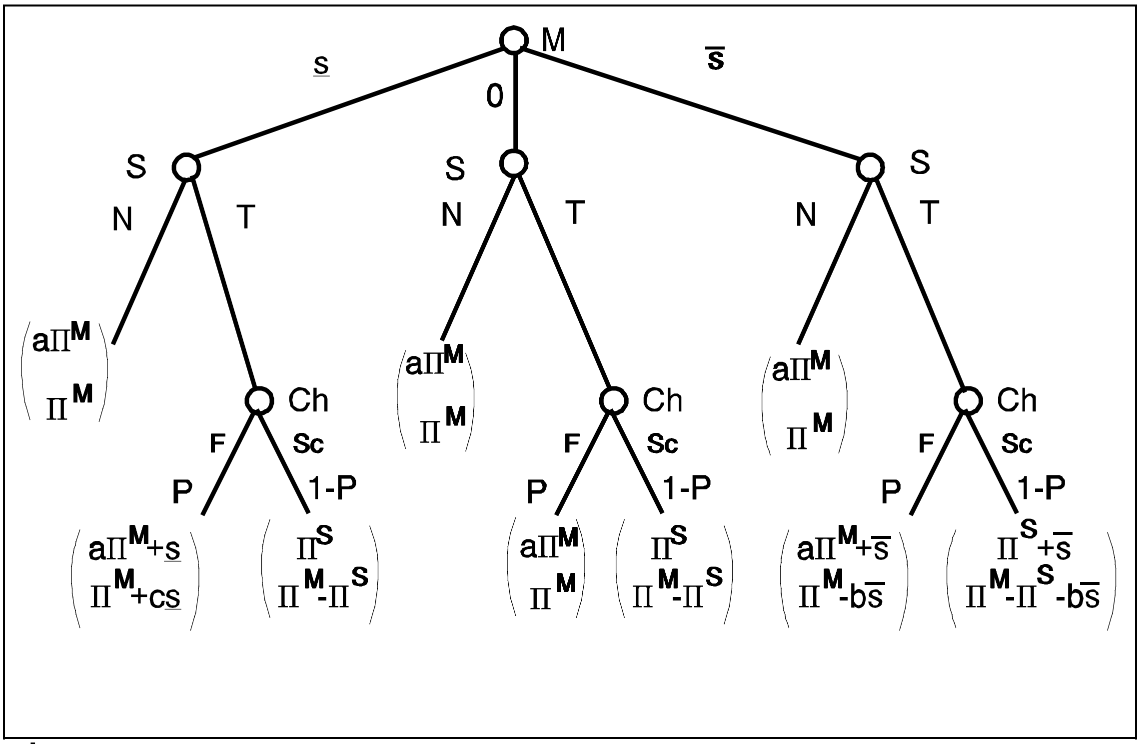

Figure 1

the relevant ministry for independence). The master enterprise has three strategies, with sidepayments $\underline{\mathbf{s}}$ (punish the applicant), 0 (remain neutral) and $\bar{s}$ (offer a payment to the management of the subsidiary to induce a spinoff). The strategies are such that $\underline{\mathbf{s}} < \mathbf{0} < \bar{s}$. The subsidiary moves second and has two strategies: **T** - to apply to the ministry for a split, **N** - not to apply. If the subsidiary decides not to apply, the enterprise remains in its original shape and form. The objective functions of the master enterprise and the subsidiary are linear in performance indicators such as profit of the relevant enterprise. In the initial situation, the master enterprise's payoff is $\Pi^{\mathbf{M}}$, while the subsidiary gets $\mathbf{a}\Pi^{\mathbf{M}}$, where **a** is some measure of the relative importance of the subsidiary within the master enterprise -- e.g., in terms of the number of employees ($\mathbf{a} = \mathbf{N}^{S}/\mathbf{N}^{M}$).[2] We assume $\Pi^{\mathbf{M}}>\mathbf{0}$, which could be achieved for any $\Pi^{\mathbf{M}}$ by adding a constant to $\Pi^{\mathbf{M}}$. If the subsidiary applies to the ministry for permission to break away, chance (**Ch**) moves and the ministry decides with probability **P** (determined by individual characteristics of the enterprise) not to allow the split (**F -** the application fails) and with probability **1-P** to allow it (**Sc** - the application succeeds).

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2 For the sum of the payoffs to equal the the profit of the enterprise, we assume that total profit $\Pi = \mathbf{(1} + \mathbf{a)}\Pi^{\mathbf{M}}$.

Payoffs depend on the strategy of the master enterprise. If it selects the punishment strategy ($\underline{s} < 0$) and the subsidiary's application fails, the subsidiary remains within the SOE and receives a payoff $a\Pi^M + \underline{s}$, with the lowerbound on $\underline{s}$ being $-a\Pi^M$. We allow for the possibility that punishing the management of the subsidiary is costly and the payoff for the master enterprise is hence $\Pi^M + c\underline{s}$, where $c \in [0,1]$ sets the bounds on the cost of punishment and it is assumed that some of the punishment may be nonpecuniary (e.g., demotion). In case the application of the subsidiary is approved, the master enterprise cannot punish the newly independent subsidiary and the payoffs are Π^S and $\Pi^M - \Pi^S$ for the subsidiary and master enterprise, respectively.

If the master enterprise is neutral on the issue of the spinoff of the subsidiary, there is no punishment and the payoffs are $(a\Pi^M,\Pi^M)$ if the subsidiary's application fails and $(\Pi^S,\Pi^M-\Pi^S)$ if it succeeds.

In situations such as when the subsidiary is loss-making, the master enterprise may want to get rid of the subsidiary. The master may try to bring about this outcome by offering the subsidiary $\overline{s}>0$ if it applies for permission to break away.[3] The payoffs then are $(a\Pi^M+\overline{s},\Pi^M-b\overline{s})$ in case the application fails and $(\Pi^S+\overline{s},\Pi^M-\Pi^S-b\overline{s})$ in case it is approved. Analogously to the case of the punishment strategy, we assume that the master enterprise may not have to pay all sidepayments from its own sources and include $b \in [0,1]$ in the payoff of the master enterprise.[4]

As can be readily verified, the chance moves may be collapsed and the game expressed with payoffs given by expected values, as in Figure 2.

We consider next the perfect equilibria of the game.

Proposition 1: If $a\Pi^M < \Pi^S$ and $(1-P)(\Pi^S-a\Pi^M) \geq -P\underline{s}$, the master enterprise selects s=0 and the subsidiary applies for permission to spin off.

The conditions in Proposition 1 mean that the gain the subsidiary obtains from separating is so high that it applies irrespective of the possible punishment.

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3 In order to avoid problems of credibility, it may be assumed that the payment is made when the subsidiary sends in its application.

4Some of the sidepayment may for example come in the form of government subsidies that the top management arranges for the subsidiary if it tries to break away.

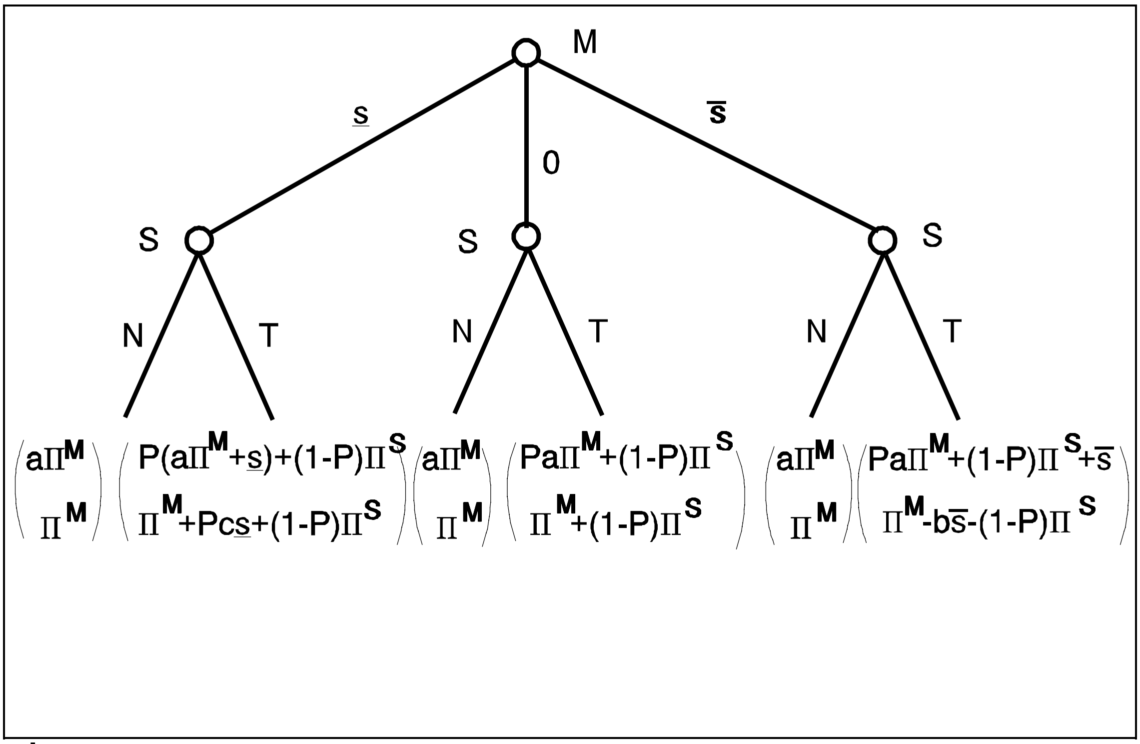

Figure 2

Moreover, since the subsidiary is going to apply anyway and both punishment and sidepayments are costly, the master enterprise cannot do better than to remain neutral (select s=0). Note that if the master enterprise set the maximal punishment ($\underline{s} = -a\Pi^M$), the condition for applying would collapse into $(1\text{-}P)\Pi^S > a\Pi^M$.

Proposition 2: If $\Pi^S > a\Pi^M$ and $(1\text{-}P)(\Pi^S\text{-}a\Pi^M) < -P\underline{s}$, then $s=\underline{s}$ and the subsidiary does not apply for permission to spin off.

With $s=\underline{s}$, the subsidiary cannot gain by applying and the master enterprise gains by keeping the subsidiary within its fold. If the master enterprise chose another s, the subsidiary would apply and the master enterprise would lose. As this case indicates, the master enterprise has the power to induce some subsidiaries not to try to split. These are subsidiaries that are less efficient than the master enterprise but, given their normal payoff, they would benefit from separation.

Proposition 3: If $a\Pi^M > \Pi^S > 0$, then s=0 and the subsidiary does not apply for permission to spin off.

This is a clear-cut case where the master enterprise would lose by letting the subsidiary go and the subsidiary would lose by trying to leave.

Proposition 4:

If $a\Pi^M > 0 > \Pi^S$ and $(P\text{-}1)(\Pi^S\text{-}a\Pi^M) < \bar{s} < (P\text{-}1)\Pi^S/b$, then $s=\bar{s}$ and the subsidiary applies for permission to leave the master enterprise.

The expression in Proposition 4 follows from the fact that loss making subsidiary would try to leave if $\bar{}>(P\text{-}1)(\Pi^S\text{-}a\Pi^M)$ and the master enterpriseThe expre8 subsidiary: $\Pi^{M-S}/N^{M-S} < \Pi^S/N^S$. In this case $\Pi^S/N^S > (\Pi^{M-S}+\Pi^S+\Delta)/(N^M+N^S)$ would still be a necessary condition for the more profitable subsidiary to apply.

The theoretical framework hence provides the prediction that the effects of the breakups on performance should either be positive for both the master enterprise and the subsidiary,
or positive for one and negative for the other. The third hypothesis described in the Introduction of course provides a competing prediction that the effect could be negative on both units.

3. The Empirical Analysis

In this chapter we present the results of our econometric analysis of breakups of Czechoslovak SOEs. In Section 3.1. we describe the data and discuss our ability to identify the breakups and the pairs of master enterprises and spun off subsidiaries. In Section 3.2. we point out the problems arising with respect to the estimation of the impact of the spinoff of a subsidiary on a common measure of efficiency of its master enterprise. In Section 3.3. we outline the form of estimated equations and the estimation techniques. The main results of our empirical analysis are given in Section 4.4.

3.1. The Data and Identification of Breakups

3.1.1. The Data

Our empirical analysis is based on quarterly and annual data reported by Czechoslovak industrial enterprises to the government. The data set covers all industrial enterprises employing more than 25 employees. As mentioned earlier, at the start of 1990 the set included 700 enterprises, while the latest available data (from mid 1992) cover approximately 2000 firms.

The data are unique in that they represent a relatively careful compilation by the Federal Statistical Office of all data supplied by enterprises to different ministries and agencies of the Czechoslovak government. Despite the careful processing carried out by the statistical authorities, the data suffer from a number of shortcomings, including incomplete reporting and errors in variables. These strengths and weaknesses are described in detail in the Appendix.

From the standpoint of our analysis, the main problem is that the data contain no explicit indicator of organizational changes such as a breakup of the enterprise. As a result, major changes in the economic situation of a firm, such as a sudden decline in production as a result of the collapse of the Soviet market, cannot be readily distinguished from changes brought about by a breakup of the enterprise.

3.1.2. Identification of Breakups

In identifying the breakups, we used the fact that in each report enterprises submit also last year's values of variables. If a breakup occurs, the newly independent subsidiary therefore reports for one year both current data corresponding to itself and values of lagged variables that correspond to the entire master enterprise to which it belonged. After experimenting with a number of variables, we decided to use data on the number of workers to identify breakups. For instance, if an enterprise reported 2000 employees in the first quarter of the 1990 sample but only 1500 employees as the last year's value in all quarters of 1991, we considered the firm to be a master enterprise from which a subsidiary (or subsidiaries) with 500 employees broke away in the first quarter of 1991. Using quarter by quarter comparisons, we thus identified the breakups and the quarter of their occurrence for those master enterprises that were present in all 1990 - 1991 quarterly sets. The cumulative statistic on the number of firms thus present is given in Table 1.

Table 1 - Enterprises Continuously Present in the Sample

Quarters	# enterprises	# contin. enterpr.*
I -90	647	451
II -90	856	518
III -90	1197	957
IV -90	1365	1135
I -91	1552	1418
II -91	1694	1613
III -91	1818	1656
IV -91	1855	

* The cumulative number of enterprises that were in the data from the indicated quarter until the end of 1991.

As can be seen from Table 1, our procedure allowed us to identify 451 enterprises that were continuously present in the data set from the first quarter of 1990 to the fourth quarter of 1991. Using in addition monthly data furnished by the firms, we were able to increase this number to 476 master enterprises. After eliminating unreliable observations we ended up with 373 enterprises.

The number of master enterprises in which we were able to identify spinoffs is 152. The distribution of these spinoffs by quarter is given in Table 2. We can clearly see that the majority of splits occurred at the end of 1990 and at the beginning of 1991.

Table 2 - Number of Spinoffs in 8 Consecutive Quarters of 1990 - 1991

Qtr.	I.-II.	II.-III.	III.-IV.	IV.-V.	V.-VI.	VI.-VII.	VII.-VIII.
#	8	0	57	78	2	6	1

The procedure used so far did not allow us to identify the newly independent subsidiaries. In order to identify these units, we have engaged in a search, comparing the number of employees of all newly appearing enterprises with the number of employees lost by identified master firms. The method did not work unambiguously for clusters of new firms but it did work on the assumptions that in a given quarter only one subsidiary could break away from a given master enterprise and that the spun off firm would operate in the same industry as the master enterprise. Using this approach and eliminating observations with missing data, we obtained a set of 30 subsidiaries and master enterprises with spinoffs in the fourth quarter of 1990 or the first quarter of 1991. The description of the set is given in the Appendix.

3.2. The Econometric Models

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 ofthose that did not. Given the nature of the data, the former comparison is carried out in a straightforward way and is discussed in Section 3.4. The second comparison requires the use of more complex techniques which we describe in this section.

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:

$$cme_i \; = \; \beta' X_i \; + \; \alpha df_i \; + \; e_{2i} \; , \qquad \textbf{(1)}$$

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 occured 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

$$E(e_{2i}|df_i) \; \neq 0 \; . \qquad \textbf{(2)}$$

The error term in equation (4.1) 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) or Heckman & Singer (1985)), 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

$$df_i^* = \gamma^{/} W_i + e_{1i} \quad and$$

$$df_i = df_i^* \quad if \quad df_i^* \geq 0,$$
$$df_i = 0 \quad if \quad df_i^* < 0, \qquad \textbf{(3)}$$

where $\mathbf{df}_i^*$ is the unobserved and $\mathbf{df}_i$ 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 $(\mathbf{e}_{1i},\mathbf{e}_{2i})$' and develop the appropriate estimator.[5]

The success of the above two-step method hinges on obtaining a consistent estimate of γ in the first step and adding into equation (4.1) another variable that represents a consistent estimate of $E(e_{1i}|df_i,\ W_i)$. In the case of a joint normal distribution of $(\mathbf{e}_{1i},\mathbf{e}_{2i})$', γ could be estimated via a standard tobit equation. However, if we are willing to assume normality in errors and known forms of equations (4.3), then under identical assumptions one can estimate equations (4.1) and (4.3) more efficiently by a maximum likelihood estimator (MLE). The likelihood function of our set of equation may be written as

$$L = \prod_0 Prob(''Observation\ without\ split'') \times \times \prod_1 Prob(''Observation\ with\ split'')\ , \qquad \textbf{(4)}$$

where **0** in the product denotes the set of observations for which the split was not observed and **1** denotes the observations with the split. Using equations (4.1) and (4.3), the likelihood can be written as

$$L = \prod_0 Prob(\gamma^{/} W_i + e_{1i} < 0,\ \ cme_i = \beta^{/} X_i + e_{2i}) \times \times \prod_1 Prob(df_i = \gamma^{/} W_i + e_{1i},\ cme_i = \beta^{/} X_i + \alpha df_i + e_{2i}). \qquad \textbf{(5)}$$

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5 The above equations do not reflect particular structural forms. The second equation does not for instance contain important variables such as Π^S, and we view these equations as reduced form equations that contain variables influencing Π^S and P in the theoretical model.

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

$$L = \prod_0 Prob(e_{1i} < -\gamma' W_i, \quad e_{2i} = cme_i - \beta' X_i) \times \times \prod_1 Prob(e_{1i} = df_i - \gamma' W_i, e_{2i} = cme_i - \beta' X_i - \alpha df_i) \; . \qquad \textbf{(6)}$$

Note however that **Prob(.)** stays 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 $\mathbf{e}_{2i}$ and obtain

$$L = \prod_0 Prob(e_{1i} < -\gamma' W_i | \; e_{2i} = cme_i - \beta' X_i) \times \times \prod_0 Prob(e_{2i} = cme_i - \beta' X_i) \times \times \prod_1 Prob(e_{1i} = df_i - \gamma' W_i, \; e_{2i} = cme_i - \beta' X_i - \alpha df_i). \qquad \textbf{(7)}$$

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

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

we can reexpress our likelihood with the help of a joint normal density $\mathbf{f}_{12}$**(.)**, normal density $\mathbf{f}_2$**(.)** and cumulative normal conditional density $\mathbf{F}_{1.2}$**(.)** as

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

For the normally distributed errors of equation (4.1) 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 $\mathbf{e}_{1.2}$ could be evaluated with the help of standard normal cumulative distribution function $\Phi(.)$, since

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

Now we can maximize the likelihood respectively with respect to its parameters α, β, γ and the elements of the variance-covariance matrix of $(\mathbf{e}_1,\mathbf{e}_2)$' 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 (4.1) 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,

$$h = \frac{(\hat{\alpha}^{IV} - \hat{\alpha}^{MLE})^2}{V\hat{a}r(\hat{\alpha}^{IV}) - V\hat{a}r(\hat{\alpha}^{MLE})}\quad ,$$

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

3.3. The Empirical Specifications

The specification of equations (4.1) and (4.2) is given by the availability of variables and the requirements of the numerical maximization of our likelihood. We use the following six variables as the "common measures of efficiency":

1) Profit/Labor,
2) Log(Output/Labor),
3) Profit/Net Capital[6],
4) Log(Output/Net Capital),
5) Log(Exported Output/Total Output),
6) Log(Turnover/Total Cost).

The variables are based on 1991 annual data and reflect various aspects of enterprise performance. The use of 1991 rather than 1992 or 1993 data is justified not only by data availability but also by the fact that when the process of breakups started in 1990, managers were likely to discount future heavily. In particular, the overall privatization program was just being formulated and managers had little idea about their future and the future of their enterprise. Another consideration is of course that longer term performance may be influenced by other factors than the breakup itself.

All variables are expressed in thousands of Czechoslovak crowns and we used the logarithmic transformation to induce normality and homogeneity in the dependent variables. To keep the model simple, we used a simple but flexible additive form that controls for the scale of the labor input of each enterprise, its level of net capital, and the technical level of its machinery. In addition, we included industry effects on the right hand side of equation (4.1). Our $\mathbf{X}_i$ variables hence are: labor, labor squared, net capital, net capital squared, net capital per labor, net capital per labor squared, and industry dummies for seven industries (heavy industry; machinery; production of building materials; production of pulp, wood processing and paper; glass and ceramics; food and beverages; and textile and leather). A more detailed data description may be found in the Appendix.

In standard neoclassical theory, some of these right-hand side variables would of course be regarded as endogenous. In order to get around this problem,

6 Net capital = Gross capital - Depreciation we used data for 1990, when the values of these variables were still predermined by the centrally planned system.

We experimented with various specifications, all of which yielded reasonable results except for equations with profit and output per net capital as dependent variables. Equations with the latter two variables invariably yielded insignificant coefficients on all right-hand side variables. As a result, we only report two sets of results for these two measures of efficiency: one with labor, capital and relative capital equipment of labor variables and the second one without them, including just industrial dummies.

The instruments for the $\mathbf{df}_i$ variable and the regression for the share of split in MLE estimation could also be specified in a number of ways. We adopted an additive form equation containing the following variables: log(output), share of export to CMEA countries, share of export to capitalist countries, log(gross capital), $\log^2$(gross capital), log(net capital),$\log^2$(net capital), $\log^4$(net capital), net capital, net capital/labor, $(\text{net capital/labor})^2$, $(\text{net capital/labor})^4$, profit, and dummy variables for the supervisory ministries that made the final decisions about individual spinoffs (Federal Ministry of Economy, Czech Ministries of Industry, Machinery, and Building, and the Slovak Ministries of Economy and Industry). Variables whose coefficients were very insignificant (t statistics below 0.6) in the initial runs were dropped from estimation in order to reduce the dimension of maximization as well as to achieve higher efficiency of estimation. Needless to say that the formulation of these equations is rather ad hoc, but the parameters of these equations were not our parameters of interest and the variables were selected primarily for their role as instruments.

The numerical maximization of the likelihood function was carried out in TSP, which enabled us to make use of its symbolic derivatives. The likelihood was not very well-behaved and we hence divided the computation into three steps:

1. Computation of IV (consistent) estimates of β and α and OLS (inconsistent) estimates of γ.
2. Fixing the values of α and β at the levels obtained from the consistent IV estimation and maximizing the likelihood using OLS values of γ and σ^2 as the starting values for maximization and setting σ_{12} to 0.01 of ρ_{12}.
3. After obtaining the maximum in step 2 we allowed the likelihood to be maximized in all its dimensions.

Using this procedure, we achieved convergence to the maximum from consistent starting values. We also used several other sets of starting values but convergence was either not achieved or the maxima displayed lower log(likelihood) values. Finally, it should be noted that 28 out of the 373 sampled enterprises did not export. To account properly for the tobit character of this variable would have required the rather complicated process of formulating a likelihood based on trivariate normal and numerically integrating. Since these observations constituted less than 10% of the sample, we discarded them on the assumption that the resulting bias is minimal. The full results of the estimation will be provided upon request.

3.4. Empirical Results

We start our discussion of empirical results by comparing basic performance indicators of the subsidiaries and their master enterprises in a 30 firm subsample in which we could identify these firms. We then examine performance indicators of the 30 master enterprises that experienced splits and 307 that did not. Finally, we report the results of our regression analysis.

3.4.1 Subsidiaries v. Masters

An ideal way to see whether subsidiaries that broke away from master enterprises were better or worse performing than the masters would be to compare the performance of subsidiaries and masters before the split. The data are unfortunately unavailable for the two units before the split occured. Moreover, we were able to identify only 30 cases where we could match the subsidiary and the master after the split. The post-split data of course reflect not only the pre-split differences but also the possible effects of (a) the split itself, (b) the exogenous shocks that took place during the year of the split and (c) internal (e.g., managerial) reorganizations in the spun off subsidiaries and the surviving master enterprises. In addition, there is of course the question as to whether the 30 subsidiaries and masters provide an unbiased sample of the universe. Our findings therefore provide only a rough estimate of the relative performance of the two types of units before the split.

The summary statistics, presented in Table 3, suggest that the master enterprises were not doing significantly better than the spun-off subsidiaries. In particular, while the mean values of most performance indicators are higher for

the master firms than for the subsidiaries, the corresponding standard deviations are high and the formal test reported in
Table 3 does not allow us to reject the hyptheses of equal performnce in the two sets of firms.

Table 3 - Performance of Subsidiaries v. Masters (30 observations)

Variable	Masters		Subsidiaries		Num. of Subsid. < < Mast.	z Stat. for H_0 vs. H_1 *
	Mean	Std. Dev.	Mean	Std. Dev.		
Prof/Lab	39.88	72.77	28.94	93.04	15	0.507
Out/lab	418.2	375.2	357.1	272.1	19	0.722
Prof/Net Cap	0.179	0.237	0.126	1.319	15	0.220
Out/Net Cap	1.792	1.009	0.408	11.24	15	0.672
Exp/Out	0.196	0.202	0.137	0.173	21	1.217
Turn/Cost	1.068	0.139	1.097	0.167	17	-0.728

* The critical value for the asymptotically normal test is 1.96.

3.4.2 Splitting v. Non-splitting Master Enterprises

The second prong of our analysis examines the relative performance of the splitting and non-splitting master enterprises. In Table 4 we present means and standard deviations of the performance indicators for each set of firms. These statistics were taken for non-split enterprises from the sample used for estimation, while for the split enterprises they were computed by adding the numerator and denominator values of the subsidiary and master enterprises, as if no split had occured.

The statistics reported in Table 4 indicate that on average the non-splitting firms had higher profit/labor, profit/capital, output/capital, and turnover/cost ratios than the splitting enterprises. The statistics also show that the two sets of firms had similar labor productivity (output/labor) and export/output ratios, although even here the means for non-splitting firms were higher than for the splitting ones. As in Table 3, however, the mean statistics in Table 4 display high variances in both samples and the differences in the means of the two sets of firms are hence statistically insignificant.

Table 4 - Performance of Splitting v. Non-splitting Firms

Variable	Non-split enterp.		Split enterp.	
	Mean	Std. Dev.	Mean	Std. Dev.
Profit/Labor	52.5	74.6	31.3	60.9
log(Output/lab)	5.91	0.681	5.78	0.566
Prof/Net Cap	1.34	18.7	0.180	0.237
log(Out/Net Cap)	0.686	0.761	0.350	0.696
log(Exp/Out)	-1.97	1.56	-2.11	1.07
log(Turn/Cost)	0.0941	0.173	0.0600	0.136

Multivariate Regression Results

The multivariate regression results, reported in Table 5, provide support for the hypothesis that the splits had negative and in few cases insignificant effects on performance of the remaining master firms. The values presented in the table are the estimated coefficients α of equation (4.1), giving the effect of the split on the common measures of efficiency (of the master enterprise) listed in the left column of the table. The estimates of α in Table 5 were obtained by the three principal methods discussed earlier: OLS, IV and MLE. Our focus is on the efficient and consistent MLE results, followed by the less efficient but consistent and more robust IV estimates. The OLS estimates are probably inconsistent, but they are presented for the sake of comparison as well as for the fact that they are often found to be the most robust ones.

As can be seen from Table 5, most estimates of α are negative. The inefficient OLS and most IV estimates are statistically insignificant, while four MLE estimates and one IV estimate are significantly negative. The only significantly positive estimate of α is obtained by MLE in the case of log(output/labor) but this estimate also displays the lowest Hausman test result.

Table 5 - Estimated Coefficients on df_i (The Effect of the Split on the Common Measures of Efficiency of the Master Enterprise)

Coef. on % diff	IV (dummy)	OLS (share)	IV (share)	MLE (share)	Hausm.
Prof/Lab	0.474 (1.179)	-0.297 (-0.910)	0.005 (0.05)	-0.118* (-1.294)	0.22
log(Out/Lab)	0.267 (0.901)	-0.147 (-0.604)	0.748 (0.983)	2.18** (6.36)	0.06
Prof/Net Cap	-1.307 (-0.150)	-3.530 (-0.481)	-12.72 (-0.57)	6.362 (0.051)	0.39
Prof/Net Cap (without)	-0.770 (-0.113)	-3.478 (-0.481)	-11.506 (-0.539)	14.74 (0.199)	0.10
log(Out/Net Cap)	-0.431 (-1.156)	-0.144 (-0.463)	-0.767 (-0.805)	-0.976* (-1.531)	0.83
log(Out/Net Cap) (without)	-0.520** (-1.730)	-0.138 (-0.442)	-0.669 (-0.723)	-1.071** (-1.824)	0.66
log(Exp/Out)	-2.064** (-2.185)	0.119 (0.179)	-3.41** (-1.72)	-5.568** (-6.500)	0.28
log(Turn/Cost)	-0.274 (-1.166)	-0.075 (-0.984)	-0.273 (-1.166)	-0.517** (-3.408)	0.17

Notes:
- Values in parentheses are t-statistics;
- Hausm. = probability of H_0 - upper tail of χ^2, via Hausman test based on IV and MLE;
- * = significantly different from zero at 10% level of significance;
- ** = significantly different from zero at 5% level of significance.

In view of the regression estimates, it is naturally of interest to compare the results in Tables 4 and 5. The average performance indicators reported in Table 4 are inferior for the split enterprises; yet there appears to be little correlation between the magnitude of these differences and the significance of our estimates of α. In Table 4 the highest average difference between the non-splitting and splitting firms was for instance found in terms of profit per net capital; yet this variable registers low values of the t-statistics and a positive coefficient of the MLE estimate of α in Table 5. Similarly, the lowest relative differences between the two sets of firms were found in Table 4 to be in terms of log(Export/Output) and log(Output/Labor). In the case of log(Export/Output) we found very significant negative effect on the master enterprise. With respect to log(Output/Labor) we found a significant positive effect, although in this case the Hausman test signals the possibility of misspecification. Altogether, given that the differences in the means of the performance variables are insignificant and that we controlled for the initial performance characteristics of firms in the regression analysis, it does not appear that our estimates of α pick up these effects and that the estimated negative effects of splits on performance could simply be attributed to the fact that unprofitable enterprises were split with higher probability.

5. Conclusions

The Czechoslovak enterprise data used in this paper indicate that one cannot reject the hypothesis that the 30 firms which experienced spinoffs of subsidiaries or other units in 1991 had similar labor productivity, capital productivity and profitability as the 307 non-splitting firms. Similarly, a comparison of the 30 spun off units with their master enterprises after the split shows that one cannot reject the hypothesis that these two sets of firms also displayed identical performance indicators.

In order to assess systematically whether spinoffs had significant effects on the performance of firms, 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. The maximum likelihood estimates suggest that for most performance indicators the effect of the split on master's performance was negative. Corresponding instrumental variable and ordinary least squares estimates are also negative but (except for one estimate) they are statistically insignificant. Since these estimates are less efficient than those obtained by the maximum likelihood method, the lesser significance is not surprising.

Since the spun off units were not better performers after the split, the negative impact of the split on post-split performance appears to be due to the spinoff process itself. Our findings hence suggest that the splits resulted in a worse performance of the master enterprises and, given the equality of the means of the post-split performance variables of the masters and subsidiaries, probably also of the spun off subsidiaries. The findings are consistent with the third hypothesis mentioned in the introduction, namely that the motivation of subsidiary managers in initiating splits was not the improved performance of the firm but rather increase in their power and possibly personal welfare.

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Appendix

In this appendix we complement the discussion of data in the main text by providing a more detailed description of the annual and quarterly samples, focusing on their weaknesses. Subpart a) describes the common problems of the annual and quarterly data. Part b) focuses on annual data from 1990, while Part c) examines the quarterly data from 1990 - 1991.

a) **General problems**: The recent Czechoslovak system of statistical reports for industrial enterprise was introduced in the beginning of 1990. The major advantage of the system was the concentration of all readable data in one place (FSO Prague). The enterprises generally reported recent as well as previous year's indicators, some of them monthly, which provides a relatively complete set of quarterly and yearly indicators.

The system contains many weaknesses, the most important one being the fact that the method of recording data in files does not distinguish between zero values and "non-available". This causes considerable uncertainty as to the reliability of reports from particular enterprises.[7] This is further complicated by the fact that the data are divided into three parts: statistical, labor and financial. The statistical and labor indicators are collected and managed by the district statistical offices, the methodology having been determined by the FSO, while the financial part is collected by the district financial offices and the methodology is controlled by the Ministry of Finance. All sets of data were merged at the federal level in FSO.

Both methodologies differ in the definition of the reporting unit, which means that the sample of enterprises reporting the statistical indicators differs significantly from the sample of enterprises reporting the financial indicators. FSO and the Ministry of Finance require different treatment of organizational changes. For the statistical part, the newly independent enterprises[8] report the previous year's indicators reflecting the "appropriate part of the production of larger unit from which the enterprise belongs" (Measures...1990) and indicators such as "Actual Results from Beginning of the Year" are reported similarly. On

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7 Quite common example is reporting the production with zero or "non-available" number of employees.

8 This was often the case in the first half of 1991 due to the reorganization almost thousand of the enterprises was created by breaking up the old concerns.

the other hand, the financial data are simply reported from the foundation of the new organization, and before this date, the enterprise is simply treated as nonexistent.

There is no indicator of an organizational change in the data. This is another major weakness, since any changes in the behavior of an enterprise during the present time cannot be distinguished from those changes produced by merger or breakup of an enterprise forced by authority.

There is no indicator of ownership in the data from 1990 - 1991. However, it is possible to construct less perfect indicators from the reported "Type of organization" indicator that was reported in 1990 and 1991.

b) **Annual data**: The 1990 data set contains data for about 1702 enterprises (1217 are Czech and 485 Slovak), the 1991 set describes 2016 enterprises (1347 are Czech and 669 Slovak). The detailed description of main variables is given later.

There are 5 identifiers of enterprises and 194 and 246 variables in the 1990 - 1991 sets data. The identifiers describe sub-industry classification, identifying code, district, type of enterprise and other less important characteristics of the enterprise.

Variables are divided (by FSO) to 27 groups. The most important ones are these describing:

1) <u>Output</u>, by figures of gross production, production of goods, shipments[9], investment works and shipments and net production;
2) <u>Capital and investments</u>, by indicators of gross fixed capital, depreciation of fixed capital, average stock of fixed capital and fixed capital obtained through investment process i.e. new investments;
3) <u>Employees</u> (Theoretically divided by groups to three groups:
I. white collar
II. servicemen, white collar in production lines, etc. (middle category)
III. Blue collar,
but in practice these categories are not filled and we can work only with total number of employees which accounts for part-time jobs, and in 1990 - 1991, also with total number of hours worked.
4) <u>Wages and other personal costs</u>

9 Shipments means the deliveries of goods handled out of the enterprise.

5) Exploitation of Working Time (ratio of number of workers times number of hours in period that are available after exclusion of holidays, etc. to number of hours actually worked)
6) Inventories
7) Costs, distinguished into the financial costs, the material costs, the energy consumption etc.
8) Revenues
9) Profit and Loss

The annual data from 1990 are relatively reliable. In the basic checks, only about 20-30% of observations fail.

c) **Quarterly data**, the data set from 1990 contains 260 variables, the 1991 data set was shorter - 177 variables and some parts were missing, and the 1992 set contains only 14 variables, but quite useful ones. We will describe them later. The simple description of the data is given in Table 2.

Table 2 - Quarterly Data

	mean		std.dev.		median	
quarter	I.-90	IV.-91	I.-90	IV.-91	I.-90	IV.91
Net Prod.*	124539	75240	280028	243765	49926	26587
Avg. # of Employees	4591	1162	9058	2820	2192	463
Gross Fix. Capital*	2193409	869745	7310913	3505503	715094	275003
Costs*	377716	197548	827875	606599	155503	173970
Profit(+), Loss(-)*	36842	42988	121741	183609	14433	11764

* Thousands of KČS

It is worth noting that the average size of an enterprise dropped significantly over time. The drop in the size of enterprises is balanced by the increase of their total numbers: at the beginning of 1990 we had 674 enterprises in the sample[10], while at the end of 1991 the set contained 1552 enterprises.

The sets from 1990 - 1991 could be divided to the same groups as annual data; however, what is available annually is not necessarily available quarterly. Thus we have relatively good capital variables in the annual sets, but very poor ones in the quarterly ones.

10 After the initial elimination of fully unreliable reports.

Seemingly the quarterly data sets from 1990 - 1991 contain more information than the annual one, however the opposite is true. The set contains more variables, but it is much less reliable. Approximately 50% of all enterprises in the year 1990 failed in the basic "common sense" tests of reliability. The basic accounting identities do not hold.

The set again does not describe the organization changes of structure of enterprises. This is by no means a minor problem (see Table 1 in section 3.1.2.).

The capital and investment data are not covered sufficiently in quarterly sets. The method of the reports is such that capital changes are fully and reliably covered only in yearly data.

The matching of yearly data from 1990 and the quarterly data from the same year works well in case of the majority of variables, with exception of some output variables, inventory variables and, not surprisingly, in case of capital and investment variables.

The last problem that is worth noting is the possibility that the sets are biased. In general we can expect, especially since many newly founded private firms did not report thoroughly or did not report at all. This theory is verified by 1991 and 1992 data. The private firms showed up at the middle of 1991 in the set, however they account for less than 1% of reliable reporting units in the set: this clearly does not reflect the reality.[11]

11 By the way, FSO reports the figures derived from these data sets in their official bulletins, so in 1991 and 1992 were in Czechoslovakia only tens of private firms employing more than 25 employees according FSO.

Definitions of variables

Labor	Number of employees
Net. Capital	Purchase value of capital - depreciation
Output	Value of invoiced output
Export (to...)	Value of invoiced export
Gross Output	Value of output produced
Profits	Revenue - costs
Turnover	Revenues + costs

<u>Description of Data for MLE estimation</u> (373 observations)

1991 variables

	MEAN	STD.DEV	MINIMUM	MAXIMUM
Labor	2475.43968	5057.80866	127.00	77289.00
Net.Cap.*	849401.19303	3426857.62600	387.00	4.521D+07
Output*	1275295.05898	3907209.03982	20402.00	5.749D+07
Exp./Out	0.23275	0.20186	0.00	0.79347
Profits*	209045.92225	1551856.32541	-958184.	2.339D+07
Costs*	1139572.04826	2728595.03753	29562.00	3.235D+07
Turnover/Costs	1.11139	0.21063	0.12	3.95515

1990 variables

	MEAN	STD.DEV	MINIMUM	MAXIMUM
Labor	2902.54155	5723.77262	154.00	88376.00
Net.Capital*	843740.76139	3356970.00504	6372.00	4.358D+07
Net.Cap./Lab.*	214.37577	238.52416	9.28	2760.54077
Profits*	97014.99464	363625.66485	-1.27556D	4743076.00
Costs*	989301.84450	2194740.04484	33444.00	2.339D+07
Exp. CMEA*	82071.86595	187244.51474	0.00	1503756.00
Exp.Cap.Coun.*	88094.31367	199425.13455	0.00	1965724.00
Gross Out.*	919626.86863	1901111.74967	21D09	2.29D+07
Share of Split	0.050210	0.12647	0.00	0.68247
Ind. Dummies:				
Heavy Mining.	0.085791	0.28043	0.00	1.00000
Machin. Manuf.	0.39142	0.48872	0.00	1.00000
Build. Mat. Prod.	0.072386	0.25947	0.00	1.00000
Wood & Pulp.	0.091153	0.28821	0.00	1.00000
Glas & Ceram.	0.040214	0.19673	0.00	1.00000
Textile Leather	0.15818	0.36540	0.00	1.00000
Food. Beverages	0.096515	0.29569	0.00	1.00000
Superord. Ministries Dummies:				
Fed. Min. Econ.	0.091153	0.28821	0.00	1.00000
Czech Min. Econ.	0.016086	0.12597	0.00	1.00000
Czech Min. Ind.	0.26542	0.44215	0.00	1.00000
Czech Min. Build.	0.021448	0.14507	0.00	1.00000
Czech Min. Machin.	0.24665	0.43164	0.00	1.00000
Slovak Min. Econ.	0.088472	0.28436	0.00	1.00000
Slovak Min. Ind.	0.069705	0.25499	0.00	1.00000
Dummy for Prague	0.091153	0.28821	0.00	1.00000

(* - in thousand of crowns)

Descriptions of Annual Files

1991 file

(From 2016 obs. 186 were excluded by basic consistency checks,1830stayed)

	MEAN	STD.DEV	MINIMUM	MAXIMUM
Labor	1217.773	2874.203	22	77289
Net. Cap.*	395127	1850748	-61124	4.52e+07
Output*	729363	2469970	1637	5.75e+07
Exp./Out	.1554506	.1987706	0	.967096
Profits*	87215.02	729262.3	-1342398	2.34e+07
Costs*	631323.3	2088220	3259	4.20e+07
Turnover/Costs	1.106139	.1813481	.1204345	3.955146

1990 file

(From 1702 obs. 348 were excluded by basic consistency checks, 1354 stayed)

	MEAN	STD.DEV	MINIMUM	MAXIMUM
Labor	1815.731	3894.605	22	88376
Net.Capital*	478551.5	1973798	54	4.45e+07
Net.Cap./Lab.*	223.1242	221.5892	.225	2865.999
Profits*	59611.83	227989.3	-1275562	4743076
Costs*	683414.4	1598653	2004	2.34e+07
Exp.to CMEA*	55675.85	189442.7	0	2589410
Exp. Cap.Count.*	53567.77	179298.6	0	2820795
Gross Out.*	642514.3	1496469	192	2.30e+07

(* - in thousand of crowns)