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# Divide and Privatize:
# Firms Break-up and Performance

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## Abstract

We analyze the long-term effects of divesture and ownership change on corporate performance. We employ a unique data set for a large number of Czech firms spanning the period 1996–2005. We employ a propensity score matching procedure to deal with endogeneity problems. Our results, which are generally in line with the positive effects of divestiture found in the developed-market literature, show that the initial effects of divestiture are positive but after a certain point they quickly diminish over time.

# 1 Introduction

The literature on corporate divesture in developed countries has provided considerable evidence of their positive effects. Research on financial outcomes has documented increases in firm value and returns after divestiture (e.g. Hite and Owers, 1983; Miles and Rosenfeld, 1983; Schipper and Smith, 1983; Cusatis, Miles, and Woolridge, 1993; Montgomery, Thomas, and Kamath, 1984; Borde and Aigbe Akhibe, 1998), while the literature analyzing economic performance finds that divestiture improves firm performance and produces various positive distributional effects (e.g. Hausman, Tardiff, and Belinfante, 1993; Slade, 1998; Woo, Willard, and Daelenbach, 1992; Daley, Mehrotra, and Sivakumar, 1997; Cho and Cohen, 1997; Hanson and Song, 2003; Dittmar and Shivdasani, 2003). Still, there are some gaps in the current research. First, the results of much of the existing literature are based on analyses that often do not account for ensuing changes in ownership structure and the potential endogeneity of divestiture and privatization (ownership) with respect to post-divestiture performance. Second, the majority of the existing research looks at developed economies while the effects of divestitures in emerging markets are largely under-researched (e.g. Makhija, 2004; Omran, 2004; Bartel and Harrison, 2005; Shin, 2008; Hanousek, Kočenda and Svejnar, 2009). In the present paper we aim to tackle both of these issues.

Specifically, in this paper we contribute to the literature in two ways. First, we answer the question of how divestitures affect the long-term economic performance of firms in an emerging market. Second, we answer this question while accounting for endogeneity issues by employing propensity score matching.[1] Propensity score matching and DID estimation complement the classical instrumental variables (IV) approach that cannot be used to study medium- and long-term effects because of the lack of proper instrumental variables. An identification strategy using p-score matching during the pre-privatization and pre-divestiture periods is better equipped to address endogeneity issues along with the attrition problem.

Moschieri and Mair (2008) argue that our understanding of divestiture is still limited: it is not clear whether divestitures are undertaken to correct past development, to affect future course, or as a response to the business cycle. Despite this, recent history shows that divestitures in emerging markets occur on a larger scale as they are often connected with subsequent privatization, restructuring and changes in ownership structure. D'Souza, Megginson, and Nash (2007) show that restructuring and changes in corporate governance are important determinants of post-privatization performance. In this respect divestitures create economy-wide phenomena, producing very large data sets ideal for empirical research. In this paper, we use a large firm-level data set from an emerging market economy that in 2004 became a member of the European Union (EU). A wave of divestitures that were followed by privatizations occurred in the Czech Republic in a way resembling a natural experiment. Firms without any divestitures existed during the

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[1] In our approach we consider firm divestiture as the "treatment" variable and by estimating the medium- and long-term effects of divestiture we study the average treatment effect on the treated subject (ATT).

same period and constitute a control group. In our analysis we estimate the effects of divestitures on corporate performance and contrast the results with the control group.

We exploit this set-up and analyze the rich data set from this new European Union member state (the Czech Republic). We analyze the effect of divestitures and subsequent changes in ownership structure, a feature that is frequently missing in the literature. However, ownership changes were shown by Cusatis, Miles, and Woolridge (1993) and Bartel and Harrison (2005) to be important. We also investigate the short- versus long-term effects of divestitures as these have been documented to be important (Cho and Cohen, 1997) but they have not been thoroughly researched yet (Moschieri and Mair, 2008). Finally, we contribute to the debate on methodology by employing propensity score matching estimators.

Divestures became important in European emerging markets in the early 1990's because they became a way to restructure large state-owned conglomerates. In this sense divestitures served as a first step of restructuring done by the government in the spirit of Roland (1994), who discussed restructuring and privatization policies along with their pace and sequencing.[2] Following privatization, further restructuring of firms was left to the new private owners. In this context, it may be hypothesized that divestitures improve corporate performance as the new firms strive to establish themselves on the market and to improve corporate governance. Further, as the originally underdeveloped legal and institutional framework improves in emerging market economies, divestitures and certain types of corporate ownership may enhance performance by eliminating diseconomies of scale and by serving as a disciplining device for management.[3] Alternatively, divestitures may have a negative effect on the performance of the divested units because of substandard corporate governance, weak government coordination and regulation, unclear property rights, and the underdeveloped legal and institutional framework that existed in emerging market economies.

Although divestiture is an important phenomena in emerging market economies, surprisingly little research has been produced in the context of the new EU members. A recent contribution by Hanousek, Kočenda, and Svejnar (2009) provides evidence of generally positive effects in divested Czech firms, but detailed results vary across the new owners. The limitation to this contribution is that it covers only the two-year period following the privatization of divested firms. Thus, a key value-added of the present paper is that we cover the whole decade, a long enough period to uncover the medium- as well as long-term effects of divestiture. In the paper we show that even more than five years after the divestiture, the effects of divestiture were still positive. However, the effects in subsequent years turned out to be negative and later insignificant as the number of observations was reduced substantially by the end of our sample in 2005.

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[2] Roland (1994) voiced his restructuring and privatization arguments in the early stage of the economic transformation in Europe but only now we are able to assess the implications.

[3] The theoretical model developed by Chemmanur and Yan (2004) is relevant in this setting because it shows how divestitures might increase the probability of a takeover by value-improving management that enhances operating performance after the divestiture.

The paper is structured as follows. In Section 2 we outline the institutional setting underlying our analysis. In Section 3 we present our data, variables and the method for identifying divestitures. Section 4 describes our estimating framework. We present our empirical results in Section 5 and conclude in Section 6.

## 2 The Institutional Setting

In this section we outline the main features of the institutional setting underlying the surge of divestiture in our data set. The divestitures took place during the period 1991–1992, prior to the launch of the mass privatization scheme, also known as voucher privatization.[4] Hence, in the early 1990's the government managed a wave of swift divestitures, rapid privatization of divested units, and ownership transfer to new private owners. At the same time the country progressed at a remarkable pace with macroeconomic liberalization in every aspect. The process of divestiture and subsequent privatization was unexpected, rapid, and exogenous because the decisions to privatize and even the specific design of the programs were dictated by politics and not performance criteria (Boycko, Shleifer, and Vishny, 1994).

Divestitures are the primary issue in our paper, while the privatization process itself forms a backdrop and is of secondary importance. The privatization process was very fast and homogenous in that all important large and medium firms were privatized without primary concern for what the gains for the state might be. Privatization was to eradicate in the quickest possible way public ownership as this was associated with a communist ideology.[5]

The decisions on divestitures were taken by the relevant government ministries in conjunction with the government privatization authority.[6] The decision for each firm was based on the winning privatization project that outlined the proposed framework for the divestiture(s). On average almost 9 projects were submitted per firm (the median was 5); the projects were approved at an average rate of close to 3 per firm (the median was 2). Since management was required to submit a privatization proposal, about 25% of all projects came from this source. Independent bidders that wanted to privatize by purchasing (a part of) a firm submitted two-fifths (39%) of all projects.[7] All proposals were to be considered on an equal footing by the privatization authorities, which

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[4] A detailed description of the privatization mechanism is to a large extent irrelevant with respect to our analysis. In the present paper we describe only the features essential to our analysis. For more details on the privatization process see e.g., Kočenda (1999), Hanousek and Kočenda (2008), and Estrin et al. (2009), among others.

[5] Shleifer and Treisman (2005) show that privatization was very successful from the political point of view almost from the outset. However, Hanousek and Kočenda (2008) and Kočenda and Hanousek (2009) show that state control over privatized firms was considerable and persisted well beyond the completion of privatization.

[6] Privatization of each state-owned firm was decided on the basis of an officially accepted privatization project. According to the law, all state-owned enterprises were selected either for the first or the second privatization wave or they were temporarily exempted. Each selected firm had to submit an official privatization proposal that was usually crafted by the firm's management under the tutelage (and responsibility) of its sectoral ministry. Any domestic or foreign corporate body or individual was allowed to present a competing project that was to be considered on an equal footing with the official one.

[7] Further details are beyond the scope relevant for this paper. They are available in Hanousek, Kočenda, and Svejnar (2009).

worked with the investors to ensure that the final submitted proposals reflected at least in part government objectives in terms of ownership structure and other characteristics.

Following the surge of divestitures, the divested firms, at that time transformed into joint-stock companies, were privatized during 1992–1993 in the voucher scheme. The voucher scheme was part of the large-scale privatization process and two waves of voucher privatization took place in 1992–93 and 1993–94. The early post-privatization ownership structure emerged as shares from the first and second wave were distributed in 1993 and early 1995, respectively. There was also significant post-privatization share trading (often off the official stock market) among large shareholders during 1995–1996 (for details see Hanousek and Němeček, 2001).

## 3 Data, Identification of Divestitures, and

### Definitions of Variables

We deviate from the standard sequencing and introduce our data prior to describing our model: this set-up enables a better flow of exposition. The data originate from the wave of corporate divestitures orchestrated by the Czech government in the early 1990's. The data were compiled by Aspekt, a commercial database, and from the archives of the Ministry of Privatization and the National Property Fund of the Czech Republic; their pre-divestiture descriptive statistics are presented in Table 1 later in this section. The data allow us to identify unambiguously the parent enterprises and all new units related to a surge of divestitures that occurred in 1991–1992. Altogether 44 large enterprises were broken up into 130 new firms, the result of the numerous divestitures.[8] Along with these 130 newly created firms, we also have data on 780 firms that did not experience any divestiture and constitute our control group. The firms in both groups were subsequently privatized in the first wave of the voucher scheme.[9]

The institutional setting described in Section 2 has strong implications for data quality. Boycko, Shleifer, and Vishny (1994) showed that the decision to pursue mass privatization and even the specific design of the programs were largely dictated by politics. This is also consistent with the imperative of politicians losing control in privatized firms voiced by Roland (1994) and Boycko, Shleifer, and Vishny (1996). Hence, the early wave of divestitures followed by the subsequent privatization of divested units were primarily a tool to prevent the revival of communist economic ideas rather than a profit-making enterprise for the state. Later privatizations of the residual state property in the 2000's were more directed towards maximizing gains. Finally, based on the subsequent identified ownership structure available from our data, we assign each firm with an ownership corresponding to the following categories of owner: the state, an industrial firm, an individual owner, or a financial company.

For each firm in our data set, we have detailed information derived from all the proposed privatization projects that were submitted to the government before privatization. This includes the relevant information about the divestiture, the links between the parent company and divested units, the privatization scheme, and information on assets, liabilities, profit, sales, and number of employees in 1990. Table 1 displays pre-divestiture economic indicators in 1990 for the new units, parent firms and firms in the control group. A key observation is that divested firms were more capital-intensive and less labor-intensive than non-divested firms. A striking difference can also be observed in the number of privatization projects submitted for divested firms, which greatly ex-

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[8] These new firms received new tax identification numbers and had the same rights to use the brand and/or trade name of the former parent enterprise. Originally there were 131 new firms but we use only 130 of them since for one divested firm no relevant data covering the period under research are available.

[9] In this scheme altogether 988 firms were privatized. This means that there are only 77 firms (8% of the total) for which the data are dubious due to legal problems associated with privatization and we do not include them in our sample. Due to the high percentage of firms not experiencing divestiture and a complete set of firms with divestitures there is virtually no truncation involved in our case.

ceeds that for non-divested firms. This difference points to greater interest in divested firms and bigger expectations for them on the part of potential investors. For many enterprises there were several privatization projects submitted and their number was directly and primarily related to the number of divisions within each firm or the number of units into which a firm could be naturally divided. Each privatization project reflected the structure of the firm, managers' motives, degree of investor interest, and expected future performance of the firm. However, prior to divestiture and privatization, the non-divested firms exhibit better performance measured by scaled profit and sales than divested firms.[10]

Finally, we illustrate in Figure 1 performance developments in both divested as well as non-divested firms after divestitures and privatization were put into effect. We present four indicators of corporate performance: operating profit per share to show unit performance from the shareholders' perspective, operating profit per equity to allow for changes in capital structure, profit over staff costs to provide a perspective on differences in cost effectiveness among firms, and finally a value-added as a complementary standard productivity measure. All performance indicators introduced above are recorded on a yearly frequency. In Figure 1 we present graphically the development of the four indicators during the post-divestiture and post-privatization period (1996–2005) for all firms for which data are available in a given year in our sample. In this figure we also contrast the average development of the four indicators between divested and non-divested firms. In terms of profit indicators, we observe a stable upward trend that is most pronounced for profit per share and staff costs and less pronounced in the case of profit per equity. In both upward trends divested firms also record higher performance than non-divested firms, especially in terms of the labor productivity measure. All the profit measures exhibit some degree of seasonality with a sharp drop in 1999 that echoes the poor economic performance and the country's negative aggregate growth in 1998. Other ups and downs are likely to reflect less-than-complete reporting by firms rather than economic reasons. Primarily, in later years we observe a sizeable drop in the number of observations for both divested and non-divested firms. The fact that some firms are not recorded in our panel data set in later years are: a) because of being acquired, b) due to bankruptcy procedure, or c) simply because those firms were no longer required to regularly publish their annual income statements by law and thus failed to do so. Unfortunately, we were not able to fully distinguish those reasons. Finally, the value-added indicator shows consistently better performance of divested firms over non-divested ones, albeit with a considerable drop during the period 2001–2005.

To conclude, a series of positive performance findings at first glance show the superior position of the divested firms during the whole period under research. This observation should be viewed with great caution, though. Developments of the performance indicators are presented for all firms for which data were available in a given year. Hence, these are raw data that have no way to present a true picture in

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[10] Let us note that domestic accounting standards in early years of transition reflected more the production side of business activities rather than corporate profits. However, since we compare firms within the same industrial sector the possible discrepancies are minimized.

which the endogeneity of divestiture and ownership change with respect to perform-ance could be properly processed and accounted for. This task will be performed in the next step. First we introduce our methodology (Section 4) and then empirical find-ings (Section 5).

# 4 The Estimating Framework

## 4.1 General Outline

From the methodology perspective a divestiture represents a treatment that is present in a group of divested firms but that is absent in a control group of firms without a divestiture history.[11] Since divestitures and subsequent changes in ownership structure may be correlated with firms' unobserved characteristics, the explanatory variables related to divestiture and ownership have to be treated as endogenous. The endogeneity issue related to this very surge of divestitures has been dealt with by Hanousek, Kočenda, and Svejnar (2009), who modeled corporate performance as a function of the presence or absence of a divestiture and the type of ownership structure. Since the explanatory variables related to divestiture and ownership structure were found to be endogenous, they used instrumental variables in their estimation.[12] In particular, they used a logit equation to model the divestiture of a company and subsequent changes in its ownership structure, with the explanatory variables being predetermined and exogenous with respect to the divestiture and privatization. This regression-based approach is suitable provided adequate instruments are available and the time span is adequate.

However, as the time span of the data sample grows longer and the time distance from divestiture becomes longer, many new effects come into play on top of the divestiture itself (e.g. new owners, restructuring, change of corporate focus or even change of core competence). This means that with the time elapsed the original IVs become less accurate to correctly account for the endogeneity of divestiture. Further, the estimation set-up may also become more complicated due to potential data attrition. As time goes on some firms may fail to report data or even completely disappear. Then, it is natural that as less data becomes available, the estimation and identification of the desired effects becomes less accurate and meaningful.

For the reasons articulated above we use in our analysis propensity score matching and DID estimation instead of the classical IV approach. This allows us to correctly study the medium- and long-term effects of divestiture on corporate performance. Further, an identification strategy using p-score matching during the pre-privatization and pre-divestiture period can also better address endogeneity issues together with the data attrition problem when compared with the IV technique. This is because we are inter-

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[11] In a similar fashion Jurajda and Stancik (2009) consider foreign takeover of the Czech firms as a treatment and analyze its effect on firm performance.

[12] Hanousek, Kočenda, and Svejnar (2009) used the following IVs: the number of privatization projects submitted to the government in 1991, the extent of how much the size of each firm deviates in 1990 from the standard size of a firm in a specific industry in the OECD economies, the ownership structure proposed in 1991 in the winning privatization project (expressed in percentage intended for a particular ownership type), the profitability of the parent firm prior to privatization and divestiture (in 1990), and the total number of shares per parent firm in 1990 (eg. total assets). The effects of variables such as the firm's distance from the mean OECD size, profitability, and total number of shares may be nonlinear and a Taylor series expansion of the second and third orders were used to formulate a specification that took into account potential nonlinearities.

ested in the effect of divestiture; other influences are of secondary interest but we still control for them. In the case of p-score matching the proper evaluation of the impact of divestiture on the performance of a firm involves speculation about how this firm would have performed if it was not divested (see Roy, 1951 and Rubin, 1974 for earlier references). The matching approach in the context of our research is based on the idea of comparing the performance of treated versus non-treated firms (e.g. divested versus non-divested ones) based on characteristics common to them. Specifically, matching estimators are based on pairing divested firms with those that did not experience divestiture and that have similar observable characteristics. Pairs of treated and non-treated firms with similar characteristics are then used to interpret the difference in their post-treatment performance as the divestiture (and subsequent ownership) effect.

In a formal way we will use the standard approach to evaluate the treatment effects of a firm's divestiture. As it becomes standard, we employ a binary treatment indicator $DIV_i$ that equals one if firm $i$ was divested and zero otherwise. The potential firm performance is then defined as $Y_i(DIV_i)$ for each firm $i$ in the sample, where $i = 1, \dots N$ and $N$ denotes the total number of observations.

The parameter that has been widely used in the evaluation literature is the so-called *average treatment effect on the treated* (ATT), which is defined as:

$$ATT = E[treatment \mid DIV = 1] = E[Y_1 \mid DIV = 1] - E[Y_1 \mid DIV = 0] \qquad (1)$$

The ATT thus measures the difference in the potential performance of a divested firm in two states of being and not being divested. Because we do not observe the counterfactual mean for divested firms, we have to define an appropriate alternative for it as $E[Y_1 \mid DIV = 0]$ in order to estimate the *ATT*. A widely used strategy is to assume that for a given subset of observable variables $X$ that are not affected by divestiture, the potential firm outcome is independent of treatment indicator $D_i$. In the seminal paper Rosenbaum and Rubin (1983) suggest to use so-called balancing scores to overcome the dimensionality problem in $X$. The independence of a potential outcome given a set of variables $X$ is then transferred to conditional independence on a balancing score $b(X)$.

The propensity score $P(DIV = 1|X) = P(X)$, i.e. the probability for a firm to be divested, given its observed covariates $X$, is the suitable balancing score. The propensity score (p-score) is then formally defined as

$$E\left\{Y_{0,t+k} - Y_{0,t} \mid DIV_t = 1, P(X_{t-1})\right\} = E\left\{Y_{0,t+k} - Y_{0,t} \mid DIV_t = 0, P(X_{t-1})\right\} \qquad (2)$$

Using the propensity score, the p-score estimator for ATT can be written as

$$ATT_{t+k}^{PSM} = E_{P(X)|DIV=1}\left\{E[Y_{1,t+k} \mid DIV_t = 1, P(X_{t-1})] - E[Y_{0,t+k} \mid DIV_t = 0, P(X_{t-1})]\right\},$$

or in simplified notation,

$$ATT^{PSM} = E_{P(X)|DIV=1}\left\{E[Y_1 \mid DIV = 1, P(X)] - E[Y_0 \mid DIV = 0, P(X)]\right\} \qquad (3)$$

The time index $t$ indicates the sequencing and proper variables used: divesture happened at time $t$, conditioning for p-score matching is done on pre-divestiture firm characteristics ($X_{t-1}$) and the evaluation of *ATT* several periods after the divestiture. Basically, the $ATT^{PSM}$ estimator is nothing but the mean difference in firm performance over the common support, appropriately weighted by the propensity score distribution of matched firms. Under such assumptions the matching method results in an unbiased estimate of the treatment impact such as firm divestiture; for more discussion of the treatment effect see Dehejia and Wahba (2002) or Smith and Todd (2005), among others.

Despite the fact that the literature on matching estimators considers several kinds of estimators, the $ATT^{PSM}$ defined in (3) that uses a difference-in-differences (DID) matching technique is considered a superior estimator.[13] The DID matching estimator allows for temporally invariant differences in outcomes between treated and control (non-treated) units that may arise (Smith and Todd, 2005). The property that the DID matching estimator eliminates time-invariant differences in performance between divested and non-divested firms is counterbalanced by the fact that the DID matching estimator is more data-demanding and requires the use of longitudinal data before and after treatment and a suitable set of conditioning variables for pair matching.

Since we employ panel data we greatly benefit from the DID matching estimator's quality. Further, we use a set of conditioning variables—i.e. firm pre-divestiture characteristics such as the size of the firm, industrial sector, pre-split (and pre-privatization) performance indicators, along with some proxies for the future ownership structure—that satisfy the required conditions. Therefore, in the present paper we employ propensity score matching that fully accounts for the outlined endogeneity and is well suited for our purpose due to the longitudinal character of our data.

## 4.2 Our Estimation Approach

As mentioned in the previous section, we estimate the causal average effect of treatment on the treated, i.e. the effect of divesture on divested firms. In the above outline $Y_j$ is a measure of the corporate performance of firms divested during 1991–1992 ($j=1$, $DIV_t = 1$) or firms that were not divested ($j=0$, $DIV_t = 0$). The period when we compare firm performance covers the years 1996–2006; the initial period $t_0$ refers to 1996, after the post-privatization changes in ownership structures were settled. Our estimator of interest *ATT* introduced in (3) therefore reflects the difference in performance between the current ($t_0+k$) and initial period ($t_0$). Similar to other matching studies, we perform the matching of firms within the same industrial sector.

First, it is possible to estimate the causal effect of divestiture on firm performance by assuming that divestiture is as good as random conditional on observed characteristics

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[13] The literature on matching estimators considers several kinds of matching algorithms, which leads to different estimators with particular properties like a) nearest-neighbor matching, b) caliper matching, c) kernel matching, or d) local-linear matching.

among the firms that have a similar predicted probability of being divested $P(X_{t-1}) = P(DIV_t - 1|X_{t-1})$, where $t$ denotes the time of divestiture. Then, the causal effect is defined as the difference between the average performance of firms over $k$ years (denoted as $E\{Y_{1,t+k} - Y_{1,t}|DIV_t = 1\}$) that were divested and the hypothetical counterfactual performance of the same firms had they not been divested (denoted as $E\{Y_{0,t+k} - Y_{0,t}|DIV_t = 1\}$). The probability of being divested (the propensity score) is assumed to depend on a set of pre-divestiture (as well as pre-privatization) observable characteristics. The fact that we are able to use for matching pre-divestiture firm-specific variables, whose values were set by central planners independently of what firms would subsequently do in a market setting, makes them quality-conditioning variables. The variables used in estimating p-scores represent measures of the sizes, industrial sector, and scaled performance of firms. Specifically, we consider the probability of divestiture as the function where we consider various functional forms of size (log of

$$P(divested) = f(size, industry, performance, owners, DE) \tag{4}$$

capital, capital, and capital squared), industrial sectors, and pre-divestiture indicators represented by sales per share (*s_tns*) and profit per share (*p_tns*). To capture the future ownership structure we consider the proxies derived from privatization projects: the proportions of assets held by investment privatization funds (*ipf*) and municipalities (*munic*). With these two variables we control for the initial ownership structure intended for privatized firms. In addition we also employ a relative excess employment variable ($DE_i$) to control for differences in firm size. In logit specification we also use some of these variables squared. In Table 2 we list all the observables introduced above. The financial and economic characteristics are easy to understand and we provide the necessary intuition for the rest of the variables below.

The relative excess employment ($DE_i$) variable and its construction corresponds to the fact that central planners tended to establish and maintain very large firms, both because it was easier to control a few large (rather than many small) firms and because of the prevailing political philosophy to build large firms under a command regime. Thus, relative excess employment ($DE_i$) is a matching criterion that measures the number of employees in a firm in 1990 minus the number of employees in a (weighted) average firm belonging to the same industrial sector in the OECD economies in the same period (see Kumar, Rajan, and Zingales, 1999).[14]

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[14] We take the mean OECD firm size as a benchmark because the transition countries declared their commitment to move towards a standard market economy and many, including the Czech Republic, succeeded in joining the OECD in 1995, soon after the start of the transition. One of the determining factors for a divestiture is therefore likely to be the size of the firms that emerged from the centrally planned system, relative to the size of firms in established market (OECD) economies. Since the socialist planners preferred large firms, the relative employment variable (*DEi*) captures effectively the excessive size of enterprises under central planning relative to the firm size in market economies and serves as a matching variable.

The *DEi* variable can also be understood as an instrument for divestiture. We run our matching procedure without this variable but the results (available upon request) were not materially different as we primarily control for the size of the company and industrial sector, which indirectly corresponds to the definition of *DEi*.

Finally, the proportions of assets held by investment privatization funds and municipalities are proxies for corporate governance. Investment privatization funds held substantial stakes in privatized firms, pursued profitable opportunities, and were also found to engage in defensive restructuring by reducing employment (Hanousek, Kočenda, and Svejnar, 2007). Hence, they are taken as a proxy for the extent of corporate governance. Municipalities received various ownership stakes as free property transfers and became stakeholders in numerous companies, mainly in utilities and transportation, but being a part of the state ownership structure they did not pursue an overly active role in the companies (Kočenda and Hanousek, 2009). They are then taken as a proxy for weak corporate governance.

For all observables listed in Table 2 we provide marginal effects along with the *p*-value of the marginal effect for each variable. To capture the possible heavier tail distribution we primarily employed a logit model, however, we also checked that a probit model yields very similar results. Since the purpose of estimating equation (4) is classification rather than estimation of underlying structural coefficients, the optimal choice of the underlying functional form is not the issue (Smith, 1997).

The estimated p-scores are later used to control for influential factors in the score matching procedure. We can derive several key observations from the table. The size of the firm measured by the log of capital is a key factor behind divestiture occurrence. The marginal effect shows that the bigger the firm the greater the probability that divestiture will occur.[15] A similar observation can be made for marginal effects associated with other variables. However, in most cases the effect is economically marginal. Finally, based on relatively high values of $R^2$ and stable results across different specifications we conclude that the employed variables adequately characterize firms for the propensity score matching procedure.

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[15] We also include the results of p-score estimation, where we exclude different measures of firm size.

# 5 Empirical Results

We present our results in Tables 3 and 4. For estimation we used STATA 10 and specifically we employ the standard procedure *psmatch2* implemented by Leuven and Sianesi (2003), considering both nearest-neighbor and kernel matching. Standard errors were obtained using bootstrapping methods. An additional STATA procedure, *pstest*, was used for covariate imbalance testing.

First we show performance results measured in terms of operating profit scaled by number of shares issued and operating profit scaled by firm's equity (Table 3). Scaling by shares helps to put the performance indicator into the perspective of gains for money invested by shareholders. The second measure complements the information on performance by accounting for changes in capital structure as equity may change often over time. Further we use profit over staff costs as a measure of labor productivity and finally a value-added as a complementary standard productivity measure (Table 4).

In Tables 3 and 4, after the column with time span, in the first two pairs of columns we present the average treatment effect on treated firms (ATT) along with the statistical significance of the effect. As before, treated firms are those that experienced divestiture. The average treatment effects on treated (divested) firms show time-dependent positive or negative differences in the performance of divested firms with respect to the performance of non-treated (non-divested) firms. For example, in 1996 divested firms recorded a profit over share that was 0.039 times larger than the profits of non-divested firms. In the same year the profit over equity of divested firms was 0.628 times larger when compared with non-divested companies (Table 3). Profit over staff costs were in 1996 1.587 times larger and the value-added was 6.035 times larger when compared with non-divested firms (Table 4). In 1997 the effects related to the profit over share and profit over equity are even larger than in 1996, while the profit over staff costs and value-added are smaller but still positive and statistically significant. The situation changes afterwards.

The observed effects presented in Tables 3 and 4 produce a clear trend. At the beginning of the researched period divested and privatized firms exhibit better performance than non-divested firms. This positive difference gradually increases for a limited period of time and quickly reaches its peak around 1997–1998. During the subsequent stage the positive differences become negative when statistically significant values are available. For the rest of the observed period values become mostly negative, albeit without being statistically significant. Therefore, judgment has to be made carefully as the numbers of observed data for both divested and non-divested firms were dropping considerably in the later years of our sample. In any event, from what we observe, the effect of divestiture rapidly dissipates.

The values of the observed effects in Tables 3 and 4 are based on the large total number of matched observations between treated and non-treated firms, e.g. the total number of firms that were exposed to matching (shown in the column labeled N). Further, we show the number of divested firms used for matching that were successfully matched with non-divested firms based on a set of matching indicators (shown in column N treated matched). Finally, we show the number of non-divested (control) firms

used for matching (shown in column N controls matched). The ratios between the total number of firms used for matching (N) and the number of divested matched firms (N treated matched) vary over time. In the majority of years these ratios exceed 10%. In many years they are well below 50%, though. Thus, the range of these ratios suggests that the common support problem could be a relevant concern in these data. For this reason, we perform a thorough check of the results presented in Tables 3 and 4 to assess how well the propensity score did to balance observables across the matched divested (treated) and non-divested (control) firms. We perform a series of balancing tests, e.g. the two-sample *t*-tests suggested by Rosenbaum and Rubin (1985). The results of the balancing tests are presented in Table 5. The key finding of our balancing tests is shown in the last column, which records the *p*-values of the test for the treated and control groups. Bold *p*-values for matched variables clearly indicate that we cannot reject the null hypothesis of the equality of treated and control groups for all compared variables. Hence, there is no systematic difference in the distribution of covariates after matching. Moreover, the results of our estimations presented above are based on variables that were tested to be exogenous.[16] Our results (Tables 3 and 4) are then based on a correctly specified procedure as well as an appropriate selection of variables.

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[16] Results of the tests are not presented but they are available upon request.

# 6 Conclusions

We analyzed the effects of corporate divestures and ownership changes on firm performance in an emerging European market. We employed a unique data set for a large number of Czech firms over the period 1996–2006. In our analysis we accounted for ensuing changes in ownership structure due to privatization and the endogeneity of performance with respect to divestiture and privatization. Regression-based techniques often suffer from a lack of so-called "common support" when the characteristics of firms divested differ from those that were not broken up. Therefore, we employed a propensity score matching procedure that fully accounted for endogeneity and was well suited for our purpose due to the panel character of our data.

Our results show that five years after the wave of divestitures took place the effects of divestiture are positive. However, later on, after the post-divestiture and post-privatization events settled down, the primarily positive effect of divestiture dissipates very fast and in two to three years (from the beginning of our sample) it becomes negative or statistically indistinguishable (Tables 3 and 4). These results are in contrast to the development of post-divestiture and post-privatization positive performance obtained from raw data (Figure 1). The reason behind this difference centers on the use of a proper procedure that accounts for the endogeneity of divestiture and ownership change with respect to performance. In order to verify our results we performed proper balancing tests to show that our results are based on a sound procedure employing an adequate set of variables.

In general, our results are in line with the positive effects of divestiture found in the literature covering developed markets. However, we show that within five to seven years after divesture and even sooner after subsequent privatization these effects disappear.

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# Appendix

Table 1 **Descriptive Statistics for Selected Pre-divestiture and Pre-privatization Firm Characteristics.**

| Variable | Sub-sample | Number of Observations | Mean | Std. Deviation | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Capital in millions of CZK | Divested | 130 | 640 | 4330 | 15.8 | 49,200 |
| | Not divested | 780 | 301 | 748 | 2.2 | 9,390 |
| | All firms | 910 | 350 | 1770 | 2.2 | 49,200 |
| Number of employees | Divested | 130 | 822 | 1907 | 23 | 17880 |
| | Not divested | 780 | 1156 | 3049 | 3 | 49701 |
| | All firms | 910 | 1108 | 2915 | 3 | 49701 |
| Profit per share | Divested | 129 | 0.89 | 4.28 | -16.94 | 30.95 |
| | Not divested | 778 | 1.05 | 6.29 | -15.59 | 90.38 |
| | All firms | 907 | 1.02 | 6.04 | -16.94 | 90.38 |
| Sales per share | Divested | 130 | 11.73 | 32.97 | 0.01 | 266.17 |
| | Not divested | 779 | 12.10 | 41.52 | 0.00 | 461.36 |
| | All firms | 909 | 12.05 | 40.39 | 0.00 | 461.36 |
| Total number of projects | Divested | 130 | 13.48 | 18.68 | 1.00 | 77.00 |
| | Not divested | 780 | 2.96 | 4.38 | 1.00 | 41.00 |
| | All firms | 910 | 4.46 | 8.92 | 1.00 | 77.00 |

*Source*: Privatization databases, authors' computation.

Table 2                                                                 **P-score Estimation**

| variable | dy/dx | z | P>z | dy/dx | z | P>z | dy/dx | z | P>z | Mean (X) |
|---|---|---|---|---|---|---|---|---|---|---|
| lnc | -5.26E-02 | -2.50[b] | 0.01 | | | | -5.45E-02 | -2.79[a] | 0.01 | 11.75 |
| tns | 4.59E-08 | 1.03 | 0.30 | 4.32E-08 | 0.93 | 0.35 | | | | 3.47E+05 |
| tns2 | -2.72E-15 | -0.69 | 0.49 | -5.80E-15 | -1.43 | 0.15 | | | | 4.10E+12 |
| s_tns | 5.51E-04 | 0.99 | 0.32 | 9.08E-04 | 1.64 | 0.10[c] | 5.62E-04 | 1.10 | 0.31 | 11.37 |
| p_tns | -3.08E-03 | -0.73 | 0.47 | -3.45E-03 | -0.79 | 0.43 | -3.11E-03 | -0.73 | 0.47 | 1.10 |
| ipf | -3.38E-08 | -0.16 | 0.88 | -3.05E-07 | -1.58 | 0.11 | 1.19E-07 | 1.14 | 0.26 | 1.37E+05 |
| excess_e | -2.20E-05 | -1.25 | 0.21 | -2.80E-05 | -1.55 | 0.12 | -2.23E-05 | -1.27 | 0.21 | 388.15 |
| municip | -1.54E-03 | -0.13 | 0.90 | -2.50E-03 | -0.21 | 0.83 | -2.32E-03 | -0.20 | 0.84 | 1.00 |
| (ipf)^2 | 4.13E-14 | 0.59 | 0.56 | 1.18E-13 | 1.65 | 0.10[c] | 5.61E-16 | 0.03 | 0.98 | 2.80E+11 |
| (municip)^2 | 9.98E-04 | 1.30 | 0.19 | 1.04E-03 | 1.28 | 0.20 | 1.02E-03 | 1.35 | 0.18 | 11.51 |
| (excess_e)^2 | 4.11E-10 | 0.67 | 0.51 | 5.66E-10 | 0.91 | 0.36 | 4.22E-10 | 0.69 | 0.49 | 1.20E+07 |
| | R2=0.127 | | | R2=0.117 | | | R2=0.126 | | | |
| Number of observations | 670 | | | 670 | | | 670 | | | |

*Notes:* The table contains the marginal effects for each variable (i.e., derivatives *dy/dx*). The variable *_pscore* denotes p-score matching, *lnc* stands for ln(capital), *tns* and (*tns)^2* denotes the total number of shares and this variable squared, respectively; *s_tns* and *p_tns* stands for sales and profit per share. The variable *ipf* denotes the number of shares held by investment privatization funds; the variable *excess_e* corresponds to the mean excess of the number of employees with respect to similar firms in OECD countries. The percentage of shares originally transferred to municipalities is captured by the variable *Municip*. Finally, variables (*ipf)^2* and (*municip)^2* captures the results for quadratic versions of *ipf* and *municip.*

Table 3 **ATT Results for Operational Profit over Total Assets and Equity**

**Operational Profit over Total Assets**

| Year | ATT | t-stat | N | N treated matched | N controls matched |
|---|---|---|---|---|---|
| 1996 | 0.039 | 1.80[b] | 694 | 87 | 607 |
| 1997 | 0.074 | 2.09[c] | 671 | 79 | 592 |
| 1998 | -0.038 | -3.40[c] | 636 | 78 | 558 |
| 1999 | -0.021 | -1.65[b] | 579 | 71 | 508 |
| 2000 | -0.021 | -0.15 | 197 | 9 | 188 |
| 2001 | -0.013 | -0.07 | 188 | 9 | 179 |
| 2002 | -0.027 | -0.22 | 187 | 9 | 178 |
| 2003 | 0.003 | 0.29 | 179 | 9 | 170 |
| 2004 | -0.021 | -0.06 | 167 | 8 | 159 |
| 2005 | -0.033 | -0.63 | 146 | 6 | 140 |

**Operational Profit over Equity**

| year | ATT | t-stat | N | N treated matched | N controls matched |
|---|---|---|---|---|---|
| 1996 | 0.628 | 1.72[b] | 693 | 87 | 606 |
| 1997 | 0.699 | 2.91[c] | 670 | 79 | 591 |
| 1998 | 0.066 | 0.47 | 634 | 78 | 556 |
| 1999 | -0.060 | -2.16[c] | 579 | 71 | 508 |
| 2000 | -0.122 | -1.81[b] | 197 | 9 | 188 |
| 2001 | -0.202 | -1.50 | 188 | 9 | 179 |
| 2002 | 0.018 | 0.21 | 187 | 9 | 178 |
| 2003 | 0.016 | 0.21 | 179 | 9 | 170 |
| 2004 | -0.022 | -0.21 | 167 | 8 | 159 |
| 2005 | -0.072 | -0.67 | 146 | 6 | 140 |

*Note:* As usual, ATT denotes the average treatment effect on treated, i.e., the effect of the particular variable on divested firms. T-stat is the corresponding t-statistics, N denotes total number of observations, and N treated matched and N controls matched denote the number of matched divested firms and the number of matched non-divested firms, respectively.

The statistical significance of the coefficients is denoted as follows: a (1%), b (5%), and c (10%).

Table 4     **ATT Results for Operational Profit over Staff Costs and Value Added**

**Operational Profit over Staff Costs**

| year | ATT | t-stat | N | N treated matched | N controls matched |
|------|------|--------|-----|-------------------|--------------------|
| 1996 | 1.587 | 2.07$^c$ | 496 | 81 | 415 |
| 1997 | 1.378 | 1.54 | 474 | 76 | 398 |
| 1998 | -0.550 | -0.45 | 442 | 72 | 370 |
| 1999 | -0.717 | -1.98$^c$ | 383 | 68 | 315 |
| 2000 | -9.705 | -8.41$^c$ | 84 | 7 | 77 |
| 2001 | -0.266 | -1.15 | 68 | 2 | 66 |
| 2002 | -2.952 | -0.05 | 77 | 4 | 73 |
| 2003 | 0.016 | 0.09 | 72 | 7 | 65 |
| 2004 | -5.760 | 0.70 | 62 | 5 | 57 |
| 2005 | -5.240 | -0.76 | 46 | 2 | 44 |

**Value Added**

| year | ATT | t-stat | N | N treated matched | N controls matched |
|------|------|--------|-----|-------------------|--------------------|
| 1996 | 6,035 | 0.42 | 501 | 81 | 420 |
| 1997 | 3,210 | 0.20 | 482 | 79 | 403 |
| 1998 | -2,584 | -0.12 | 448 | 73 | 375 |
| 1999 | -2,452 | -0.09 | 384 | 68 | 316 |
| 2000 | -82,848 | -0.56 | 84 | 7 | 77 |
| 2001 | -67,574 | -0.74 | 82 | 4 | 78 |
| 2002 | -45,740 | -0.36 | 80 | 5 | 75 |
| 2003 | -4,693 | -0.04 | 76 | 7 | 69 |
| 2004 | -10,936 | -0.07 | 71 | 8 | 63 |
| 2005 | -15,874 | -0.11 | 48 | 2 | 46 |

*Note:* As usual, ATT denotes the average treatment effect on treated, i.e., the effect of the particular variable on divested firms. T-stat is the corresponding t-statistics, N denotes the total number of observations, and N treated matched and N controls matched denote the number of matched divested firms and number of matched non-divested firms, respectively.

The statistical significance of the coefficients is denoted as follows: a (1%), b (5%), and c (10%).

Table 5 **Balancing Test Results**

| Variable | Sub-Sample | Mean Treated | Mean Control | % Bias | % Bias removed | t-test | p-value P>t |
|---|---|---|---|---|---|---|---|
| _pscore | Unmatched | 0.20 | 0.12 | 51.1 | | 35.36 | 0.000 |
| | Matched | 0.14 | 0.13 | 3.9 | 92.4 | 0.35 | **0.730** |
| Lnc | Unmatched | 11.59 | 11.71 | -9.3 | | -4.16 | 0.000 |
| | Matched | 11.54 | 11.65 | -8.9 | 4.2 | -0.58 | **0.562** |
| Tns | Unmatched | 6.40E+05 | 3.00E+05 | 11 | | 8.34 | 0.000 |
| | Matched | 2.80E+05 | 2.80E+05 | 0 | 99.9 | 0.00 | **0.997** |
| (tns)^2 | Unmatched | 1.90E+13 | 6.50E+11 | 12.3 | | 9.98 | 0.000 |
| | Matched | 5.00E+11 | 5.90E+11 | -0.1 | 99.5 | -0.14 | **0.890** |
| s_tns | Unmatched | 11.73 | 12.11 | -1 | | -0.40 | 0.689 |
| | Matched | 11.48 | 10.15 | 3.6 | -258.9 | 0.23 | **0.819** |
| p_tns | Unmatched | 0.89 | 1.05 | -2.9 | | -1.10 | 0.269 |
| | Matched | 0.87 | 0.75 | 2.2 | 22.6 | 0.20 | **0.843** |
| Ipf | Unmatched | 2.10E+05 | 1.30E+05 | 11.3 | | 8.08 | 0.000 |
| | Matched | 1.30E+05 | 1.30E+05 | 0.6 | 94.4 | 0.09 | **0.926** |
| excess_e | Unmatched | -302.94 | 630.86 | -25.6 | | -11.70 | 0.000 |
| | Matched | 285.00 | 31.50 | 6.9 | 72.9 | 0.54 | **0.592** |
| Municip | Unmatched | 2.40 | 0.59 | 42 | | 28.07 | 0.000 |
| | Matched | 1.00 | 0.81 | 4.5 | 89.3 | 0.41 | **0.680** |
| (ipf)^2 | Unmatched | 1.20E+12 | 8.80E+10 | 12.8 | | 10.33 | 0.000 |
| | Matched | 1.50E+11 | 1.00E+11 | 0.5 | 96 | 0.37 | **0.711** |
| (excess_e)^2 | Unmatched | 1.50E+07 | 1.20E+07 | 3.40 | | 1.37 | 0.170 |
| | Matched | 5.50E+07 | 1.60E+06 | 3.60 | -14.6 | 0.88 | **0.382** |
| (municip)^2 | Unmatched | 39.45 | 3.95 | 37.1 | | 28.35 | 0.000 |
| | Matched | 9.95 | 8.16 | 1.9 | 95 | 0.24 | **0.807** |

*Notes*: The variable *_pscore* denotes p-score matching, *lnc* stands for ln(capital), *tns* and *(tns)^2* denotes the total number of shares and this variable squared; *s_tns* and *p_tns* stands for sales and profit per share. The variable *ipf* denotes the number of shares hold by investment privatization funds; the variable *excess_e* corresponds to the mean excess of the number of employees with respect to similar firms in OECD countries. The percentage of shares originally transferred to municipalities is captured by the variable *Municip*. Finally, the variables *(ipf)^2* and *(municip)^2* capture the results for quadratic versions of *ipf* and *municip*, respectively.
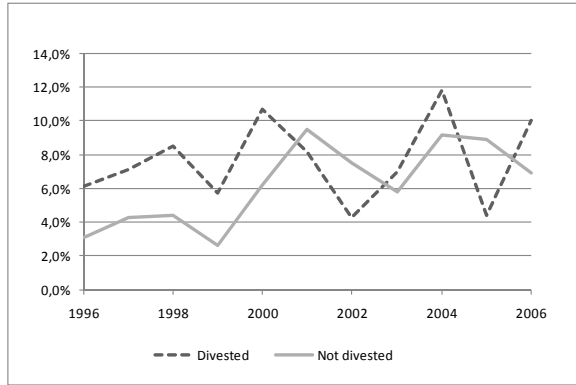
The last column shows the comparisons of treated and control groups; bold-type *p*-values clearly indicate that we cannot reject the null hypothesis of the equality of treated and control groups for all compared variables.

Figure 1 **Prost-divestiture and Post-privatization Performance Trends.**
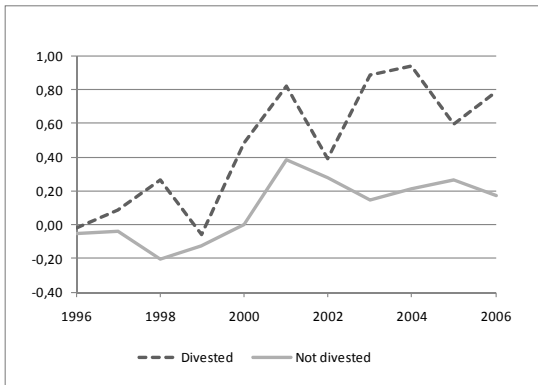
A) Profit over Assets
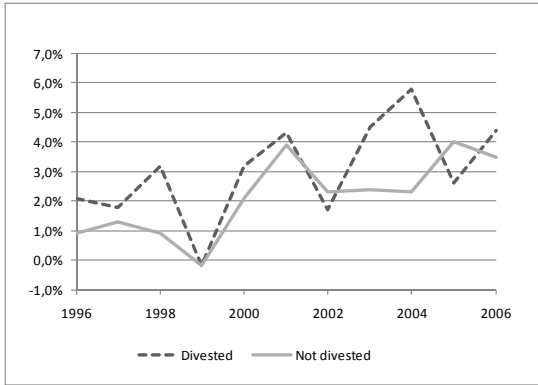


B) Profit over Equity



C) Profit over Staff Costs



D) Value Added