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Depreciation Rates in a Transition Economy:

Evidence from Czech Panel Data

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Abstract

This paper examines industrial differences in depreciation rates and the suitability of financial data for a microeconomic analysis. Depreciation is a main source of enterprise investment and serves as a source for replacement of obsolete or used-up capital. The findings on capital structure in this paper are consistent with the common view that heavy industry firms have long-life capital while firms operating in electronics, or light industry as a whole, have a capital structure containing a higher portion of a short-life capital. Also, larger firms are more likely to have a higher portion of long-life capital, like real estate. The last conclusion drawn from this analysis is that certain types of financial data might be highly influenced by seasonal effects which could operate as a measurement error and therefore distort estimates which are sensitive to measurement error.

Abstrakt

Tento článek se zabývá rozdíly v průměrných odpisových sazbách v různých průmyslových odvětvích a posuzuje vhodnos finančních dat pro mikroekonomickou analýzu. Odpisy jsou hlavní zdroj pro investice a slouží zejména pro náhradu starého nebo vyřazeného kapitálu. Zjištění o kapitálové struktuře na základě velikosti odpisů, presentovaná v této studii, jsou v souladu s obecnými poznatky, že těžký průmysl má kapitál s dlouhou životností zatímco firmy podnikající zejména v oblasti elektroniky, případně celém lehkém strojírenství, mají kapitálovou strukturu s vysokým podílem rychle odpisovaného vybavení. Navíc velké podniky mají vyšší podíl dlouhodobého kapitálu, jako jsou například nemovitosti. Poslední závěr, který lze učinit na základě této analýzy, je, že finanční data mohou být silně ovlivněna sezóními efekty se stejným potenciálním vlivem na regresní odhady jako chyby měření. Odhady regresních koeficientů metodami citlivými právě na chyby měření pak mohou být vychýlené a zcela zavádějící.

Keywords: Measurement error, depreciation, investment, financial data, transition.

JEL Classification: C23, D21, G31, K34, M4, P11

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1. Introduction

As the transition from central planning to a market system started to unfold in the 1990s, it became clear that the transition economies needed to invest heavily in order to modernize their obsolete capital stock and become competitive on world markets. Depreciation is the main source of financial resources for investment in any economic system where depreciation funds stay available to the enterprise, unlike in the Soviet-type economic system, where depreciation funds were centrally redistributed.

Recent investment literature (for example Fazzari et al. (1988), Galeotti et al. (1994) or Whited (1992)) places a great deal of importance on the financial part of the investment process, since the overall financial situation of the enterprise affects its ability to substitute external sources for internal ones. This so-called "cash flow approach" focuses on the limited substitutability of different financial resources which arises from the (partial) inefficiency of capital markets. The lower the substitutability (i.e., the enterprise has limited or no access to the capital market), the more the firm depends on internal sources of investment. These internal sources of investment consist of depreciation, as a source of capital replacement, and retained profits, as a source of new (net) investment. Therefore, depreciation funds should cover the replacement part of gross investment.

Depreciation in the Czech Republic has been governed by laws (mainly by the Income Tax Act — Zákon 586/1992 Sb.) and regulations (issued mainly by the former Federal Statistical Office and the Ministry of Finance) that permit firms to carry out linear depreciation for book value capital up to the maximum defined for various categories of capital goods (capital purchased prior to 1992) and accelerated or linear depreciation at a prescribed rate for recent purchases. However, the firm cannot switch between these two systems once it starts depreciating. From the taxable profit standpoint, depreciation is treated as a cost of production. Assuming that a firm generates enough revenue to cover accounting costs, it also generates replacement funds, since the replacement costs of capital - depreciation - are considered a part of the production costs in the Czech accounting system, or more rigorously, of the tax deductible costs. In this analysis estimates of the average depreciation rate of capital are provided for different types of industrial firms.

The use of micro panel data enables us to eliminate bias introduced by aggregation (see e.g., Abel and Blanchard (1986)), reduce measurement error resulting from aggregation over firms and take into account heterogeneity across firms and over time (see e.g., Bond and Meghir (1994)). In contrast to many western researchers, we are fortunate to have data on both depreciation and investment, which allows the use of different methods of estimation, and also allows a comparison of their performance and an assessment of the consistency of the results within a legal framework.

In particular, we focus on the consistency of the financial accounting data with the capital accumulation constraint on the microeconomic level and also on industry differences in the average depreciation rate.

2. Theoretical Background

According to accounting and tax laws, depreciation costs are defined as a certain percentage of the book value of capital each year. The scheme is strictly linear, for example, 20% of capital depreciates each year, so after 5 years the capital is fully depreciated and financial resources to replace it should be available in the replacement fund. In the Czech Republic, the country from which the analyzed data originates, the life span of capital varies from 4 years (for most electronics) up to 50 years (for real estate like buildings)[1)]. This translates into a depreciation rate ranging from 2.0% per annum (0.5% quarterly) for long-life capital to 25% per annum (6.25% quarterly) for computers. Moreover, for the newly purchased capital, i.e., in the fiscal year of purchase, the depreciation rate is reduced by one half. In order to avoid any cost manipulations, only a firm which has capital in files on December 31 (the last day of the fiscal year) can claim the depreciation costs[2)].

An accelerated depreciation method can be chosen only for new capital acquisitions, then the capital depreciates non-linearly starting at the same rate of depreciation as in the linear case, rising to its peak in the second year of purchase and then the rate

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1) There are five categories of capital. Capital depreciates for 4, 8, 15, 30 or 50 years, depending upon the categorization.

2) There are several exceptions to this rule, for example, a firm can claim half of the regular depreciation costs for a piece of capital which is not in its ownership on the last day of the fiscal year.

gradually declines below the linear rate.[3)] As was pointed out by Fisher (1987) and also by Fisher and McGowan (1983), American firms tend to select a depreciation scheme which leads to the maximization of discounted future profits, i.e., tax system distortions also transfer into depreciation. This phenomenon can be observed in the Czech Republic as well, mainly when the firms tend to invest in the last quarter of the fiscal year, however the scope of other distortions is definitely smaller since the Czech tax system is extremely rigid and does not allow for any other "tax evasions" like changes in the selected method or rate or re-evaluation of capital.

In neither the linear nor the accelerated scheme is inflation taken into account, so in the case of a high inflation rate, depreciation cannot cover replacement costs. Therefore, under a high inflation rate, the same type of capital purchased in the sufficiently remote past generates depreciation which is considerably lower than the same capital purchased recently. In this case, depreciation cannot cover replacement. In addition, land does not depreciate at all in the Czech Republic and therefore it is not included in the capital stock.

The basic relationship between capital and depreciation used in the literature is an idealization of an accounting identity on an aggregate (firm or industrial) level. In the case of Czech enterprises, $Dep_t = \delta K_t + \varepsilon_t$, where *Dep* is depreciation in nominal terms, *K* is the book value of the capital at the time of purchase, δ is the depreciation rate and subscript *t* denotes time. Since the linear relationship holds exactly only for one piece of physical capital bought at the beginning of the fiscal period and the capital assets of all firms consist of different types of capital purchased at different times (i.e., the capital is from different depreciation categories and of different ages), a stochastic error term is added. This random disturbance should then reflect the different capital composition within, and also across, firms, as well as possible non-linearities if tax laws allow for an accelerated depreciation scheme.

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3) The exact formula for accelerated depreciation rate δ for a particular piece of capital at fiscal year t calculated from the time of the purchase is defined as

$$\delta_t = \frac{2}{T - t + 2} \quad if\ t > 1,$$

$$\delta_t = \frac{1}{2T} \quad if\ t = 1,$$

T is the total lifetime of the capital in the category as specified by the law.

The common view is that the larger the firm, the more real estate and other long-life capital it owns. Since, by definition, long-life capital depreciates at a lower rate than short-life capital, the relationship between depreciation and capital stock might not be linear at the aggregate level, even if each separable piece of capital in the firm depreciates linearly. In order to verify this possibility, the depreciation function might include higher powers of the explanatory variable (i.e., depreciating capital) like

$$Dep_t = \delta K_t + \delta_2 K_t^2 + \varepsilon_t \quad , \qquad \textbf{(1)}$$

where coefficient δ_2 is expected to be negative if the hypothesis of the capital composition of large firms reflects reality. Indeed, as we will show later, the coefficient associated with the second power of capital is negative, as the common view suggests, and is also very significant.

We also took to industrial differences into account, since the composition of capital in heavy industry should be quite different from the composition in, for example, textiles or electronics. The estimation of the depreciation rate was thus primarily carried on a panel with specification, which allowed for such differences:

$$Dep_{i,t} = \delta K_{i,t} + \delta_2 K_{i,t}^2 + \sum_{g \in G} \delta_g D_{g,i} K_{i,t} + \varepsilon_{i,t} \quad , \qquad \textbf{(2)}$$

where subscript *g* refers to a particular production industry, subscript *i* denotes the firm, *G* is the set of all production industries excluding machinery (machinery was selected as a comparison base). Dummy variable D_g takes the value one if the enterprise is in group *g* and zero otherwise[4)]. Therefore, coefficients δ_g should be interpreted as a difference from the base (machinery) industry.

In macro and micro literature, whenever investment or production is considered, the so-called capital accumulation constraint is imposed or used for further derivation in

4) We also worked with specifications which allowed for industry differences in the coefficient δ_2. Although the results were statistically different from the restricted version presented in this paper, the coefficients had higher standard errors and were much harder to interpret in terms of industrial differences. One should also keep in mind that large samples (like the one we are using) tend to over-reject imposed restrictions. Therefore, we decided to use the simpler form where the size-control coefficient δ_2 is the same for all industries and where it is a straightforward interpretation of industry differences.

the form of $K_t = K_{t-1} - Dep_{t-1} + I_{t-1}$ (individual firm indices are omitted).[5)] More frequently, the capital accumulation constraint utilizes the assumption of linear dependency of depreciation on the capital and takes the form $K_t = (1 - \delta) K_{t-1} + I_{t-1}$, where I stands for gross investment. The former relationship between capital, depreciation and investment can be rearranged so that depreciation is separated on one side of the equation and the other terms are collected on the other side:

$$K_{t-1} + I_{t-1} - K_t = Dep_{t-1} \quad . \qquad \textbf{(3)}$$

A stochastic disturbance term might be added to reflect that this relationship does not hold absolutely, since investment can vary substantially over time for many reasons. This can be illustrated by Figure 1 (see also the data in Table A5), which plots the quarterly share of investment in GDP in the Czech Republic. While the yearly share of investment in GDP varies only slightly, around 30%, the quarterly values follow a clear seasonal pattern. We can substitute for Dep_{t-1} from formula (3) into the capital accumulation constraint (1) and let the stochastic term represent not only capital differences but also the stochastic variation in the investment. The result is an alternative estimable equation of depreciation, which generally takes the form:

$$K_{t-1} + I_{t-1} - K_t = \delta K_{t-1} + \delta_2 K_{t-1}^2 + \varepsilon_{t-1} \quad . \qquad \textbf{(4)}$$

With industry specific rates the estimable formulation is similar to the formula used above, with variables defined as in (2); the time subscript t is shifted one period ahead in order to keep the formula lucid and to have the same right-hand sides in both formulae (2) and (5):

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5) Aggregating the data, we arrived at the following relationship for an average firm, which illustrates that the capital accumulation constraint is satisfied at the macroeconomic level (standard errors in parentheses):

K_{t-1}	348681	(1598588)
− Dep_{t-1}	4858	(24451)
+ I_{t-1}	7169	(45494)
Computed K_t	350912	(1605597)
True K_t	350577	(1595865)
Difference	414	(103445)

$$K_{i,t} + I_{i,t} - K_{i,t+1} = \delta K_{i,t} + \delta_2 K_{i,t}^2 + \sum_{g \in G} \delta_g D_{g,i} K_{i,t} + \varepsilon_{i,t} \quad , \qquad \textbf{(5)}$$

There is one very appealing phenomenon concerning the capital accumulation constraint as formulated above. If the estimated depreciation rates obtained using the definition and accounting data differ substantially from estimates received from the capital accumulation constraint, one can question the simplifying assumptions which lead to the well-known simple form of the capital accumulation constraint or the suitability of the accounting data.

3. Data Description

Two different data sets are used. The first data set is based on regular questionnaires collected quarterly by the Czech Statistical Office (CSO)[6)] from industrial firms. The second one, collected by Aspect Killcunen Ltd., contains only public financial information which is revealed yearly by firms listed on the Prague Stock Exchange. The latter data set includes all types of firms while the former includes only industrial firms.

Let me first briefly describe the latter set, which is comprised of either complete or excerpted balance sheets and income statements as required by accounting law. In contrast to the CSO data, the Aspect data does not contain information on investments. Therefore, it is not possible to estimate the depreciation rate using the alternative specification of the capital accumulation constraint since this requires the inclusion of (unknown) investment expenditures. The industrial firms in the Aspect data compose an unidentifiable subset of the CSO data (i.e., the CSO and Aspect data cannot be linked).

The means and standard deviations of the Aspect data are listed in the Appendix in Table A3, and the relationship between capital and depreciation is depicted by using raw data points in Figure 2. Please note the logarithmic transformation used in the graph. The frequency distribution across sectors as quoted on the Prague Stock Exchange can be found in Table A4.

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6) The CSO was formerly, before the split of Czechoslovakia, a part of the Federal Statistical Office.

The principal data set used in the present analysis was collected by the Czech Statistical Office (CSO) and covers all industrial firms having more than 25 employees in the 1992-94 period and more than 100 employees in 1995. While the CSO was careful in collecting the data, the data set contains a number of errors and inconsistencies. Moreover, when coding data the CSO does not distinguish between missing values and zeroes. In an attempt to assemble a reliable data set (approximately 50,700 quarterly observations), we used the following nine consistency checks:

1) The firm's capital at the start and end of each quarter should be positive;
2) The average labor force in a given quarter should be more than 20 employees (sample definition);
3) Investment should be non-negative;
4) Production should be positive;
5) Depreciation should be positive and less than the total capital value;
6) Investment should be smaller than capital stock at the end of the period;
7) The average wage should be higher than 2000Kc/month (minimum wage in 1992);
8) Sales should be non-negative;
9) One-year lagged production, sales and labor should be non-negative or missing.

In imposing these consistency criteria, about 10% of the observations had to be discarded, leaving us with a sample comprising about 90 percent of all industrial firms in the Czech Republic. Since the panel was created from two files (one containing the capital, the other the depreciation) and not all firms were present in both files, capital and/or depreciation contain missing values for about another 10% of the original sample. The regression is carried out on 37797 observations at best[7)].

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7) A sample selection problem might arise here since about 20% of the sample was discarded either because of missing values or because of the inconsistency of the data. The χ^2 test signals that there is no difference in the industry distribution of the discarded firms and the remaining sample (the test value χ^2_{16}=0.98 is well below the critical value). Since there is a data consistency problem with the eliminated observations, the usual Heckman two-step method correcting for the sample selection cannot be used.

The summary statistics of variables that are relevant to this analysis are presented in Table A1. As may be seen from the table, while investment shows a seasonal pattern with a fourth quarter peak that was observed in the aggregate data, this clear pattern is missing in the depreciation. The average size of the firm is shown in the column labelled "Capital." The size decreases over time in the 1992-1994 period as new smaller firms enter the market (this corresponds to an increasing number of observations in the final column). In 1995 the CSO changed the sample composition (only firms with more than 100 employees are included); the number of firms then drops by almost half and remains stable thereafter[8)]. Fortunately, this size variation does not influence the capital-depreciation relationship. In order to check for this possibility, we have also included time dummies in the regression, but they turn out to be jointly insignificant.

4. Estimation Results

We carried out a standard unbalanced panel estimation of the depreciation rate under the assumption of equal depreciation rates across industries, firstly, as a linear function of capital[9)] (Table 1a) and secondly, as a quadratic function (Table 1b). As Tables 1a and 1b show, the quarterly depreciation rate ranges from 1.2% to 1.26%[10)]. All methods applicable to panel data give the same result for the linear case[11)]. Controlling for non-linearity (Table 1b) shifts the linear coefficient up slightly,

8) The same pattern can be seen in the labor force. The average firm starts with more than 600 employees in 1992; then the size of the firm again continuously decreases over time to 300 employees in 1994. In 1995 the average size stays in the range of 450-500 employees.

9) Since there is only one explanatory variable (capital) present in the linear definition, under the assumption of heteroskedastic disturbances, when the variance of residuals linearly depends on capital, the estimated coefficient would be equal to the average of Dep/K, as given in Table A1.

10) We also included a constant term in the regression although according to theory, there should be none. Since the sample covers only medium and large size firms and there is no information about the really small firms, one can view the estimated equation as a Taylor approximation.

11) The panel methods used are: OLS - pooled regression, Between - OLS on means (between individuals), Within - fixed effect estimation and RE - random effect to 1.57% at most for the within estimation. According to the Hausman test for linear specification, random effect estimation is the best estimation method. In the case of quadratic form, the Hausman test signals that within estimation significantly differs from the random effect (RE) estimation.

However, none of the estimated rates contradicts each other, and the negative coefficient associated with the quadratic term supports the hypothesis mentioned earlier, that enterprises with large capital stock do own capital with a longer lifetime, i.e., capital which depreciates slowly.

An alternative method of estimating the depreciation rate based on the widely-used capital accumulation constraint gives significantly different results for both linear and quadratic functional forms. One should note that in the linear specification these estimates suggest a much higher depreciation rate, and in the case of within estimates, which are considered consistent, the estimated rate of above 8% per quarter is clearly out of the legal range. As noted by Nickell (1981), Matyas and Severstre (1992) and Harris and Matyas (1996), among others, in the case of measurement errors or high noise in the data, the results obtained as within estimates, usually considered to be the best ones, might be completely misleading if valuable information is lost due to high noise.

Moreover, the positive coefficient associated with the quadratic term and the much lower coefficient of the linear term in the quadratic specification contradict the results obtained using depreciation data directly. Therefore, since the results of the alternative method do differ from the norm both for linear and quadratic specifications, it might safely be concluded that, given the nature of the data, the applicability of the alternative method based on the capital accumulation constraint should be seriously questioned.

One possible explanation for the striking difference in the results from the alternative method is that, while depreciation is almost stable over time, investment is highly seasonal (e.g., see Figure 1) and completely distorts the results. Indeed, when time dummies were included in the estimation to reflect the seasonal pattern of investment, they were extremely significant, although the main results were almost exactly the same as the results in Tables 2a and 2b. The most striking aspect of the seasonal

estimation.

pattern is that investment rises continuously from the first to the fourth quarter, and in the fourth quarter it is almost twice as high as in the second and third quarters. The pattern is clearly visible. It exists not only in the Czech and, naturally, Slovak data, but also in the investment series of all four central European countries (data source: CESTAT). As is evident from Tables A1 and A4, the same seasonal pattern observed at the macro level is visible in the Czech quarterly firm-level data. Therefore, there is empirical support for the hypothesis that firms also use investment as a tool to optimize their profitability. This tax optimization process therefore might introduce a measurement error.

A second explanation might be that the accumulation constraint widely used in theory and practice is not satisfied at the accounting level, at least in the short run. Since no other evidence questioning the capital accumulation constraint was found in the literature, we prefer the first explanation of the inadequacy of the financial data because of high measurement error, but more detailed research concerning investment at the micro level using quarterly or even monthly data could bring forth other possible solutions to this puzzle.

Let me briefly discuss the results of industry differences obtained using the depreciation data with quadratic specification in Table 3. We estimated the linear specification, which gave similar results, but we also decided to include the quadratic term as a control for the size of the enterprise and, therefore, the second order coefficient is restricted to being the same for all industries. The machinery industry was chosen as the benchmark for this analysis. Hence, the other coefficients should be interpreted as the difference between the depreciation rate of the given industry and the depreciation rate of the base industry.

All methods provide similar results as far as the sign of the difference from the base industry is concerned; however, there are slight differences among the methods in the magnitude of the coefficient and in the standard errors. The machinery depreciation rate of 1.6% seems to be identical to those for food, medical goods, furniture, recycling and, with the exception of OLS, ceramic production industries. One should mention the extremely low depreciation rate of capital in the water utility industry (only about 0.5%), which signals that water producers’ capital consists mainly of long-life real estate like water dams and pipelines. Also, as expected, heavy industry (mining, chemical production and metal production) has a significant share of long-life capital. A similar situation exists in the wood processing and, surprisingly, textile industries.

One plausible explanation for this could be that the labor-intensive textile industry did not undergo modernization, since production in the Far East is much cheaper. On the other hand, as one would expect, the depreciation rate is higher in the electronic and publishing industries and extremely high in the automotive industry. The auto industry result is driven by Skoda Mlada Boleslav, one of the largest and most productive enterprises in the Czech Republic, which underwent restructuring and high level modernization and which also benefitted from heavy capital investment (more than $1 billion was invested within 2 years) and the firm's production accounts for more than 10% of the total industrial output. The plastics industry has a higher depreciation rate as well, but we do not have a plausible explanation for this fact.[12)]

A similar estimation was carried out using the second (Aspect) data set which covers only shareholder companies listed on the Prague Stock Exchange. Since the data covers only three years so far (data for 1996 is extremely rare), and there are usually two or three observations for each enterprise, the results obtained for the linear specification are listed only in the case of sectoral comparison. The results using quadratic specification were not different from those listed, but the estimates had larger standard errors. It should be noted that the industry specification is different from the one used earlier. Since the companies are listed on the stock exchange, the Prague Stock Exchange sectoral classification is used. The results that do not involve a control for sectors can be found in Table 4a (linear specification) and Table 4b (quadratic specification). Industry comparison appears in Table 6 (linear specification only), with the machinery industry again selected as the base industry.

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12) The different estimated depreciation rates across categories of firms raises the question of whether these differences are brought about by the particular type of investment carried out recently by the different types of firms, or whether they are due to systematic changes during the transition in firms with certain capital stock. In order to check which hypothesis deserves more support, we estimated the coefficients of the depreciation equation using data from 1993 and 1995, respectively, controlling for ownership and legal form. The 1993 capital data by and large reflects the capital stock inherited from the period of central planning (in 1993 the first wave of privatization ended and new owners took over the enterprises), while the 1995 capital data is affected much more by the investment activity undertaken by the firms since their commercialization and ownership changes in the early 1990s. The year-by-year estimates of the depreciation rate of companies with foreign ownership are growing over time, providing support for the new investment hypothesis. However, the findings indicate that both hypotheses play a role in the difference in depreciation rates across industries.

The results of the estimation of the depreciation rate for the listed companies coincide with the results obtained earlier. One should keep in mind that these enterprises are a partial subset of the previous CSO data comprised of mainly large firms that are eligible to be traded on the stock exchange. These firms are expected to be better performers and have less obsolete capital. This might be an explanation for the slightly higher depreciation rate for these firms.

Since the industry categories (industry divisions) differ from those used by the CSO, the industrial differences are not directly comparable. One cannot draw any straightforward conclusions about the industrial differences, except in the case of glass, transport and trade classifications, where the depreciation rate seems to be significantly lower. Agriculture shows an unreasonably high depreciation and there are two possible reasons for this: Firstly, land is not included in capital stock since it does not depreciate, and secondly and more likely, the majority of enterprises in this group are trade companies (intermediaries), which are not primary food producers, and therefore they resemble a special class of trade company with long-life capital.

5. Concluding Remarks

The findings presented in this paper on industry differences support the common view that heavy industry capital contains a higher portion of long-life capital. There are also differences in light industry, where, for example, publishers and electronics producers have capital with a high replacement rate. Moreover, the larger the firm, the more likely it is to own slowly depreciating capital. This statement is well-supported by the negative and significant coefficient associated with the quadratic term of capital in the estimated depreciation relationship. Both the CSO data set on all industrial firms and the Aspect data set on firms quoted on the Prague Stock Exchange give similar results.

The second conclusion which can be drawn from the analysis of the Czech data is that the capital accumulation constraint is not acceptable on the quarterly financial enterprise level data in the short run. The seasonal differences in investment introduce extremely high noise, which is then, as a measurement error, able to distort the information and produce inconsistent within estimates of the depreciation rate. Another possible source of problems with the capital accumulation constraint is the transfer of distorting effects from tax law to depreciation as shown in Fisher and McGowan

(1983), although Czech law provides almost no opportunity for this type of tax "evasion." This conclusion corresponds to the notion in the literature that within estimates are much more sensitive to measurement error than other applicable methods (i.e., estimates obtained by random effect, or by between or by the widely-used simple OLS methods).

Table 1a Depreciation

$$Dep_{i,t} = \delta K_{i,t} + \varepsilon_{i,t}$$

	OLS	Between	Within	RE
Const.	47868*** (7347)	42093*** (11827)	-	39138** (15859)
δ	1.254*** (.004)	1.202*** (.009)	1.259*** (.020)	1.225*** (.010)
ARsq.	.674	.764	.853	.674

Notes:
Unbalanced panel with a total of 37795 observations and 5130 firms.
Tests p-values:
1) AB=AiBi 0.00
2) AiB=AiBi 0.00
3) AB=AiB 0.00
4) FE vs.RE 0.04

Table 1b Depreciation

$$Dep_{i,t} = \delta K_{i,t} + \delta_2 K^2_{i,t} + \varepsilon_{i,t}$$

	OLS	Between	Within	RE
Const.	-7744 (7525)	29296** (12090)	-	563 (15844)
δ	1.461*** (.008)	1.266*** (.016)	1.570*** (.028)	1.406*** (.016)
δ_2 *10E-9	-6.179*** (.216)	-2.277*** (.468)	-8.643*** (.535)	-5.902*** (.396)
ARsq.	.681	.765	.854	.681

Notes:
Unbalanced panel with a total of 37795 observations and 5130 firms.
Tests p-values:
1) AB=AiBi 0.00
2) AiB=AiBi 1.00
3) AB=AiB 0.00
4) FE vs.RE 0.00

Table 2a Alternative - Capital Accumulation Constraint

$$K_{i,t-1} + I_{i,t} - K_{i,t} = \delta K_{i,t} + \varepsilon_{i,t}$$

	OLS	Between	Within	RE
Const.	-197782*** (53224)	-23556 (39697)	-	-203553*** (69681)
δ	2.075*** (.033)	1.633*** (.031)	8.726*** (.225)	2.148*** (.046)
ARsq.	.097	.346	.050	.097

Notes:
Unbalanced panel with a total of 37757 observations and 5130 firms.
Tests p-values:
1) AB=AiBi 0.00
2) AiB=AiBi 0.00
3) AB=AiB 1.00
4) FE vs.RE 0.00

Table 2b Alternative - Capital Accumulation Constraint

$$K_{i,t-1} + I_{i,t} - K_{i,t} = \delta K_{i,t} + \delta_2 K_{i,t}^2 + \varepsilon_{i,t}$$

	OLS	Between	Within	RE
Const.	137370** (54698)	194174*** (38205)	-	99615 (69117)
δ	.829*** (.061)	.543*** (.051)	7.826*** (.314)	.904*** (.080)
δ_2 *10E-9	37.20*** (1.572)	38.73*** (1.480)	24.56*** (5.963)	38.88*** (2.096)
ARsq.	.111	.423	.051	.111

Notes:
Unbalanced panel with a total of 37757 observations and 5130 firms.
Tests p-values:
1) AB=AiBi 0.00
2) AiB=AiBi 0.00
3) AB=AiB 1.00
4) FE vs.RE 0.00

Table 3 Depreciation - Industry Differences

$$Dep_{i,t} = \delta K_{i,t} + \delta_2 K_{i,t}^2 + \sum_{g \in G} \delta_g D_{g,i} K_{i,t} + \varepsilon_{i,t}$$

	OLS	Between	Within	RE
Const.	-28051*** (6533)	-11254 (9048)	-	-6806 (11746)
δ (Machinery)	1.652*** (.022)	1.649*** (.041)	1.370*** (.061)	1.568*** (.039)
δ_2 *10E-9	-6.014*** (.290)	-5.086*** (.486)	-.052 (1.374)	-8.939*** (.448)
Mining	-.205*** (.026)	-.226*** (.046)	-1.063*** (.149)	-.010 (.044)
Food	.071 (.189)	-.015 (.300)	.974 (.868)	-.164 (.349)
Textiles	-.330*** (.043)	-.364*** (.074)	-.279 (.216)	-.300*** (.08)
Wood	-.396*** (.037)	-.427*** (.062)	.437** (.212)	-.227*** (.070)
Publishing	.428*** (.106)	.520*** (.164)	.315 (.550)	.553*** (.198)
Chemicals	-.335*** (.027)	-.397*** (.049)	-.440*** (.103)	-.313*** (.050)
Plastics	.330*** (.077)	.418*** (.151)	.718*** (.236)	.520*** (.146)
Ceramics	-.100*** (.038)	-.074 (.069)	.228 (.146)	.018 (.072)
Metals	-.447*** (.024)	-.484*** (.044)	-.449*** (.094)	-.316*** (.043)
Electronics	.223*** (.061)	.412*** (.110)	.343* (.180)	.374*** (.109)
Medical	-.029 (.155)	.361 (.261)	-.416 (.466)	.080 (.269)
Vehicles	1.235*** (.026)	1.103*** (.049)	.792*** (.075)	1.057*** (.045)
Furniture	.124 (.102)	.035 (.192)	-.551* (.304)	-.134 (.187)
Recycling	.034 (.199)	-.032 (.368)	.686 (.453)	.275 (.326)
Water Utilities	-1.138*** (.027)	-1.164*** (.045)	-.961*** (.079)	-1.051*** (.046)
ARsq.	.783	.880	.860	.781

Notes:
Unbalanced panel with a total of 37795 observations and 5130 firms.
Tests p-values:
1) AB=AiBi n.a.
2) AiB=AiBi n.a.
3) AB=AiB 0.00
4) FE vs.RE 0.00

Table 4a Depreciation - Aspect Data Set

$$Dep_{i,t} = \delta K_{i,t} + \varepsilon_{i,t}$$

Variable	OLS	Between	Within	RE
constant	511258*** (72196)	400313*** (132643)	-	440518*** (105728)
δ	1.311*** (0.015)	1.472*** (0.038)	1.3580*** (0.021)	1.392*** (0.017)
ARsq.	0.688	0.516	0.974	0.942

Notes:
Unbalanced panel with a total of 3264 observations and 1437 firms.
Tests p-values:
1) AB=AiBi 0.99
2) AiB=AiBi 0.00
3) AB=AiB 0.00
4) FE vs.RE 0.01

Table 4b Depreciation - Aspect Data Set

$$Dep_{i,t} = \delta K_{i,t} + \delta_2 K_{i,t}^2 + \varepsilon_{i,t}$$

	OLS	Between	Within	RE
Const.	-80336 (60613)	343242*** (112294)	-	404348 (85666)
δ	2.563*** (.034)	3.424*** (.080)	1.358*** (.021)	1.560*** (.020)
δ_2 *10E-9	-12.658*** (.315)	-21.188*** (.800)	-0.000 (.045)	-4.005*** (.303)
ARsq.	.791	.674	.974	.929

Notes:
Unbalanced panel with a total of 3264 observations and 1437 firms.
Tests p-values:
1) AB=AiBi 0.00
2) AiB=AiBi 0.95
3) AB=AiB 0.00
4) FE vs.RE 0.00

Table 5 Depreciation - Group Differences - Aspect Data Set

$$Dep_{i,t} = \delta K_{i,t} + \sum_{g \in G} \delta_g D_{g,i} K_{i,t} + \varepsilon_{i,t}$$

Industry	OLS	Between	Within	RE
constant	144731*** (42449)	74520 (68158)	-	131121** (56969)
δ (Machinery)	2.003*** (0.053)	2.055*** (0.104)	3.044*** (0.766)	2.059*** (0.089)
Agriculture	4.259*** (0.080)	5.836*** (0.137)	-0.861 (0.817)	5.164*** (0.118)
Food Production	-1.062 (0.939)	-0.774 (1.526)	-1.641 (10.778)	-1.067 (1.334)
Tobacco and Beverages	0.470* (0.280)	0.356 (0.511)	-0.697 (0.969)	1.109*** (0.360)
Mining	-0.121 (0.210)	-0.103 (0.388)	-1.884** (0.937)	-0.340 (0.293)
Textiles and Leather	0.073 (0.063)	0.011 (0.123)	-3.341*** (0.798)	-0.139 (0.105)
Wood and Pulp	0.346 (0.418)	0.475 (0.738)	-0.794 (1.485)	0.325 (0.578)
Chemicals	0.025 (0.181)	0.000 (0.381)	-1.161 (0.821)	-0.107 (0.233)
Construction	0.172* (0.090)	0.163 (0.171)	-2.257*** (0.788)	-0.214 (0.134)
Metallurgy	0.043 (0.245)	0.012 (0.414)	-1.794* (0.947)	-0.169 (0.312)
Electronics	0.088 (0.117)	0.044 (0.228)	-0.988 (0.779)	0.018 (0.142)
Energy	0.726 (0.688)	0.871 (1.257)	-2.959 (2.531)	0.424 (0.998)
Transport	-0.995*** (0.053)	-1.041*** (0.106)	-2.130*** (0.766)	-1.078*** (0.090)
Trade	-0.164*** (0.056)	-0.221** (0.113)	-1.155 (0.766)	-0.188** (0.092)
Banking	-0.329 (0.365)	-0.337 (0.661)	-1.250 (0.888)	-0.340 (0.365)
Services	-2.106 (13.299)	-1.387 (24.442)	2.792 (158.011)	-1.917 (21.064)
Glass	-0.961*** (0.188)	-0.956*** (0.349)	-2.224*** (0.797)	-1.120*** (0.197)
Investment Funds	-0.092 (0.212)	-0.071 (0.349)	-2.178** (0.966)	-0.314 (0.278)
Other	-0.181 (1.295)	0.055 (2.105)	-2.162 (4.636)	-0.283 (1.729)
ARsq.	0.920	0.905	0.982	0.959

Note: Unbalanced panel with a total of 3264 observations and 1437 firms.

Tests p-values:
1) AB=AiBi n.a.
2) AiB=AiBi n.a.
3) AB=AiB 0.00
4) FE vs.RE 0.01

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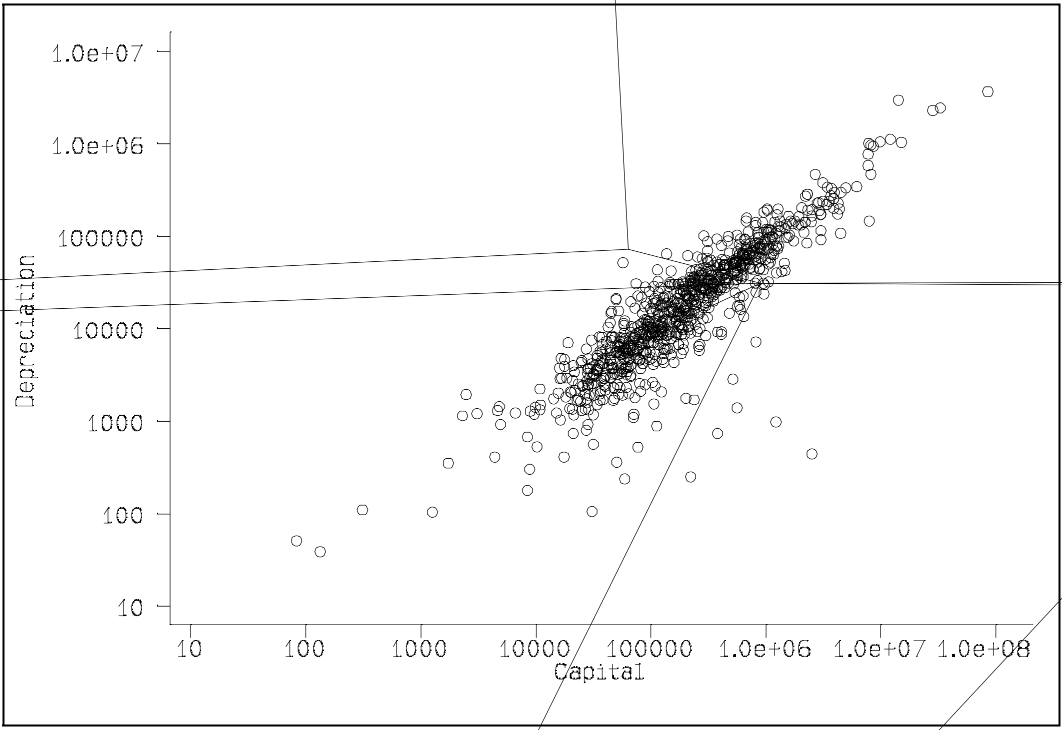

1.0e+07
1.0e+06
100000
10000
1000
100
10
Depreciation
10
100
1000
10000
100000
1.0e+06
1.0e+07
1.0e+08
Capital

Appendix

Table A1 Means and Standard Deviations of the Principal Variables

	Investment/ Capital	Deprec./ Capital	Investment	Depre-ciation	Capital *1000	Wage	Max. No. of Obs.[b]
1992/Q1	0.014 (0.031)	0.012 (0.014)	4851 (21288)	4629 (21660)	537 (2475)	4.06 (0.98)	2252
1992/Q2	0.021 (0.069)	0.013 (0.016)	6113 (28147)	4791 (23316)	519 (2361)	4.4 (1.13)	2484
1992/Q3	0.019 (0.082)	0.013 (0.017)	5904 (31109)	4075 (18824)	518 (2309)	4.43 (1.06)	2626
1992/Q4	0.031 (0.184)	0.017 (0.061)	10868 (57006)	4914 (22750)	501 (2208)	5.14 (1.38)	2738
1993/Q1	0.029 (0.094)	0.022 (0.044)	4278 (30115)	4440 (19677)	347 (1522)	5.00 (1.22)	2657
1993/Q2	0.041 (0.118)	0.025 (0.052)	6452 (32831)	4365 (19310)	328 (1469)	5.52 (1.51)	2841
1993/Q3	0.040 (0.110)	0.025 (0.053)	6264 (36822)	4281 (23792)	315 (1447)	5.51 (1.40)	2940
1993/Q4	0.054 (0.132)	0.035 (0.076)	9488 (56153)	5154 (33444)	311 (1451)	6.16 (1.77)	3009
1994/Q1	0.031 (0.096)	0.022 (0.044)	3520 (20835)	3642 (19366)	279 (1350)	5.76 (1.50)	3503
1994/Q2	0.039 (0.101)	0.023 (0.039)	5633 (40038)	3546 (18740)	278 (1352)	6.28 (1.72)	3613
1994/Q3	0.036 (0.098)	0.024 (0.047)	5685 (45034)	3549 (17684)	274 (1331)	6.46 (1.73)	3653
1994/Q4	0.061 (0.132)	0.038 (0.075)	8319 (66621)	3826 (19562)	261 (1329)	7.21 (2.17)	3867
1995/Q1	0.029 (0.097)	0.019 (0.028)	5936 (27955)	6021 (26858)	445 (1759)	6.81 (1.69)	2205
1995/Q2	0.034 (0.09)	0.022 (0.041)	8262 (37561)	6455 (30794)	452 (1803)	7.51 (2.01)	2261
1995/Q3	0.032 (0.081)	0.021 (0.044)	8965 (48508)	6356 (27164)	453 (1784)	7.56 (1.91)	2234
1995/Q4	0.046 (0.100)	0.028 (0.057)	14463 (66746)	7574 (23887)	459 (1815)	8.41 (2.50)	2243
Overall	0.040 (0.107)	0.026 (0.053)	7033 (43544)	4673 (13480)	335 (1509)	6.01 (2.01)	44974
Obs.[a]	37802	37795	44974	44869	37807	44869	44974

Note: [a] The number of observations is the sum of all quarterly observations with non-missing values.
[b] The maximum number of observations is the maximum of all quarterly observations with non-missing values.

Table A2 Frequency Distribution of Firms by Industry

Industry/NACE	Observations	Percent
Unknown/Other	672	1.46
Mining of Coal	220	0.48
Mining of Oil and Gas	64	0.14
Mining of Metal Ores	32	0.07
Other Mining and Quarrying	701	1.53
Food Production	7171	15.96
Textiles	2652	5.80
Apparel Manufacturing	1773	3.88
Leather and Footwear	1128	2.47
Wood Production	1996	4.37
Pulp and Paper	815	1.78
Publishing and Printing	1371	3.00
Chemicals	1124	2.46
Rubber and Plastics	1308	2.86
Non-metallic Minerals	3017	6.60
Manufacture of Basic Metals	1186	2.59
Fabricated Metal Products except Machinery	4903	10.72
Machinery	6103	13.35
Office Machinery and Computers	92	0.20
Electrical Apparatus	1783	3.90
Radio and Television	698	1.53
Medical and Precision Instruments	1043	2.28
Motor Vehicles	805	1.76
Other Transport Equipment	756	1.65
Furniture	3213	7.03
Recycling	336	0.73
Water Utilities	755	1.65
Total	45717	100

Table A3 Means and Standard Deviations - Aspect Data Set

	Depreciation	Capital *1E3	Dep/Capital
Mean	56800	693	0.104
(Standard Dev.)	(296000)	(4619)	(0.737)

Total number of observations is 3264.

Table A4 Frequency Distribution of Firms by Sectors - Aspect Data Set

Industry/NACE	Observations	Percent
Machinery	133	4.07
Agriculture	77	2.36
Food Production	254	7.78
Tobacco and Beverages	207	6.34
Mining	90	2.76
Textiles and Leather	49	1.50
Wood and Pulp	158	4.84
Chemicals	110	3.37
Construction	119	3.65
Metallurgy	390	11.95
Electronics	412	12.62
Energy	100	3.06
Transport	118	3.62
Trade	133	4.07
Banking	364	10.85
Services	3	0.09
Glass	427	13.08
Investment Funds	68	2.08
Other	52	1.59
Total	3264	100.00

Table A5 Macroeconomic Indicators

Date	GDP	I	I/GDP
1992/1	180.7	28.1	0.16
1992/2	293.0	39.8	0.21
1992/3	207.8	40.8	0.20
1992/4	209.5	92.2	0.44
1993/1	211.6	33.3	0.16
1993/2	228.4	58.4	0.26
1993/3	237.1	64.2	0.27
1993/4	233.5	100.2	0.43
1994/1	241.7	40.0	0.17
1994/2	257.1	70.7	0.27
1994/3	270.9	81.4	0.30
1994/4	267.8	126.7	0.47
1995/1	288.9	55.3	0.19
1995/2	310.8	91.5	0.29
1995/3	327.1	101.0	0.31
1995/4	325.3	163.3	0.50
1996/1	326.1	67.5	0.21
1996/2	354.7	113.3	0.32
1996/3	367.2	123.6	0.34
1996/4	366.0	174.3	0.48

Note: All figures in billions of current currency (Czech Crown) as of 1996. Source: CESTAT (former Statistical Bulletin of the Czech, Hungarian, Polish, Slovak and Slovenian Statistical Offices). European System of Accounts (ESA) methodology used. Investment includes intangible fixed assets only. Investment data is for the whole national economy, including also estimates for entities not monitored by statistical offices.