Capital Market Imperfections, Uncertainty and Corporate Investment in the Czech Republic

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September 1998

1 Introduction

Since 1991 the Czech Republic is in the process of reforming the domestic economy into a market economy.[1] The reform strategy is characterized by a ”big bang”program, consisting e.g. of a full liberalization of consumer and producer prices, a considerable decrease in government subsidies, a liberalization of trade, a drastic depreciation of the koruna, and a rapid privatization program for enterprises (see Aghevli et al, 1992). In 1992 the privatization of small enterprises has been completed, whereas the liberalization of large enterprises, which took place in two steps, has come to an end in the beginning of 1995. Nowadays more than 80 percent of the assets are privately owned.

In addition to the rapid reform program the Council for Mutual Economic Assistance (CMEA) has been dismantled. It may not come as a surprise that initially the reform program, in combination with the dismantling of the CMEA, has brought about a strong decline in domestic output. However, after some time, it seems as if the reform program starts to become successful. As compared to many other transition economies, the Czech Republic faces favorable macroeconomic developments in the sense that inflation has go down dramatically, the unemployment rate is relatively low, and the external position seems to be healthy.

One of the most important ingredients for a continuing successful economic development is the behavior of private enterprises. Due to the dismantling of the CMEA and the launching of the far reaching reform measures, the economic environment of enterprises in the Czech Republic drastically changed. Moreover, the privatization programs changed the corporate control of enterprises. One of the consequences of the rapid privatizations is that the average size of enterprises became much smaller. During the period of central planning, enterprises with less than 100 employees were rare, and about one third of the enterprises had more than 1000 employees. In 1994 not more than 6 percent of the enterprises had more than 1000 employees (Banerjee et al, 1995). The reform program also had an important effect on the profitability of the enterprises: the profit rate for the enterprise sector as a whole declined from 8 percent in 1992 to 4 percent in 1993 (Banerjee et al, 1995, p. 9).

The begin period of structural reforms is characterized by a decline in investment activity. However, an ongoing process of economic growth requires an increase in private investment. In order to be able to stimulate private investment, more insights into investment behavior of Czech private firms is indispensable. Unfortunately, data

[1]This research was undertaken with support from the European Union’s PHARE ACE Programme 1996.

availability made it until recently impossible to perform a firm level investment study for the Czech Republic. Recently some investment studies using firm level data for the Czech Republic came to the fore. Lízal (1996) uses the CSO data for 1992 and 1993. He focuses on two aspects of investment behavior. First, it might be so that firms are investing less than the optimum of minimum adjustment costs. The economic reason is that firms are in the process of labour managed firms (LMF) into market-oriented firm. Lízal mentions capital market imperfections as a second argument for underinvestment. A second element in this study is the idea that the Czech republic is a small open transition economy, where firms might be multi-focused on both export and domestic markets. There is no evidence in the panel data however. Lizal and Svejnar (1997) find that there is no evidence for the hypothesis that privately owned firms perform better than state owned firms (contrary to earlier findings. Anderson and Kegels (1997) estimate accelerator models using annual data for 1993 and 1994. Their focus is on the legal status of the firm. State-owned firms that were privatized during 1994 were found to be less financially constrained than early privatized (de novo) firms. This conclusion is in line with a pattern that state-owned enterprises were placed under financial discipline relatively early in transition.

While the studies mentioned above do give important information about investment behavior of private enterprises, it is remarkable that none of these studies formally assess how private investment in the Czech Republic is affected by the increase in uncertainty in recent years. Some studies discuss the effects of the introduction of the reform programs on private investment. In these studies it is mostly taken for granted that the introduction of the reform programs initially made the economic environment for firms more uncertain, and hence has led to a decrease in private investment. Implicitly these studies e.g. assume that firms are risk averse. However, the process of reforming the Czech Republic has also developed some profit making opportunities for risk taking firms. For instance, during the program of rapid privatization, bankruptcy laws protected enterprises from bankruptcy proceedings until the transfer of property to new owners has been completed. This not only prevent firms from bankruptcy, it may also induce tremendous risk taking by the old owners, hoping to make big profits before selling the enterprise. Moreover, the government of the Czech Republic implicitly insured many enterprises from going bankrupt. Especially for those enterprises which closing down would lead to big social costs, such as a rise in unemployment, the government rescued enterprises from bankruptcy. The measures taken include credit guarantees by the National Property Fund, participation in debt-equity swaps and restructuring arrangements with the major creditors (Banerjee, 1995, p. 29). Also banks may implicitly have stimulated risk loving behavior

of firms. Many banks suffer from insufficient loan-loss provisions for the bad loans in their portfolios, which made them very reluctant to start bankruptcy proceedings. This induces limited liabilities for firms, which may induce firms to take more risk It is interesting to know how private investment behavior is affected by changes in uncertainty.

Another issue which is not taken into account in the existing studies on private investment in the Czech Republic is the effect of capital market imperfections (except for the Anderson-Kegels study). Before the reform program started, loans to enterprises were entirely determined by government policies. The government decided how the available amount of credit was distributed over the enterprises. Nowadays, the situation has been changed drastically. The reform of the banking sector is an important element of the adjustment program in the Czech Republic. This has an important effect on the distribution of credit over different enterprises. Moreover, it appears that private banks, due to the concentration of bank deposits in short-term maturities, are very reluctant to provide long-term credit in order to avoid a strong mismatch between the maturity structure of assets and liabilities. As a result, the share of long-term credit declined from about 50 percent in the beginning of 1991 to about 30 percent from 1993 onwards (Banerjee, 1995, p. 31). This of course may have an important effect on private investment. More in general, it is expected that in the Czech Republic where bad loans and lack of credit-worthiness of firms is still one of the main problems in the financial system, capital market imperfections may have an important impact on investment behavior.

In this study we examine private investment behavior of enterprises in the Czech Republic. A special feature of the study is that the investment equations include variables which may give some more insights into the role of capital market imperfections as well as the effect of uncertainty. The paper is organized as follows. Section 2 presents a survey of the recent literature on investment. Section 3 describes the data set we use for the estimates. The regression results are described in Section 4. Section 5 concludes.

2 Investment theories

In the last decade, due to the limited success of existing econometric models in explaining corporate investment, considerable intellectual attention has been given to improving the theory of investment. As is very often the case in economics, different routes are followed in the attempt to come up with theoretically more convincing explanations of corporate investment behavior. One branch of the profession em-

phasizes the importance of costly reversibility and uncertainty, while capital market imperfections are the core of analyses of another group of economists.[2] This section pays attention to both types of investment studies.

A company can finance its investments by issuing either equity or debt. However, the return characteristics of both types of finance are totally different. Equity represents ownership in a company, and therefore receives an uncertain share of the future profit stream of the company. Debt represents a fixed payment to the lender. An equity contract has limited liability, implying that shareholders do not have to pay the firms debt if the earnings of the firm are insufficient to cover the payments of the debt, i.e. if the firm goes bankrupt. Hence, the dividend stream is constrained to be non-negative. Due to the different return characteristics of both types of finance one would expect that there is an optimal level of the leverage ratio (debt to equity ratio), which would lead to a maximization of the value of the firm. However, surprisingly, this does not have to be the case in a neoclassical world, as is shown by Modigliani and Miller (1958). They show that a firm's financial policy is irrelevant. More precisely, they prove that the market value of a firm depends only on its profit stream and is invariant to whether the firm finances itself through bonds or equities, i.e. it's capital structure. The basic argument underlying their statement is that arbitrage precludes the market value of a firm to be altered by a change in firm's financial policy when the profit stream is given. In the case where investors have the same financial opportunities than firms, investors can always undo whatever firms do on the financial markets.

The MM invariance proposition has been of great importance for the literature on corporate investment. Using the MM theory as a theoretical underpinning, the neo-classical investment theory, mostly associated with scholars like Jorgenson (see Jorgenson, 1963 and 1971), argues that financial variables, like cash flow, profits etc, should not be included in investment equations. According to this theory, firms derive investment decisions by maximizing its market value or equivalently optimizing profits, in a tax-free certain world with perfect capital markets. In this setting, the firm's desired capital stock, and hence also investment, only depends on factor prices and technology, without any role for financial variables. The reason is simple: if financial policy does not affect the market value, it also implies that if firms want to maximize its market value financial variables do not matter and hence only real decisions are important. The real activity of the firm then is independent of its financing choice.

[2] that there are virtually no studies available in which it is tried to combine the abovementioned two new strands of research on investments. The only available empirical studies refer to Western European countries. Scaramozzino (1997) combines irreversibility with capital market imperfections in a model for the U.K., and Peeters (1996) for Belgium and Spain.

For the development of corporate finance and investment theory the MM propositions in it self may not be that important. A clear understanding of the underlying assumptions of the propositions, and related to that the significance of the ”limitations,” is of greater importance, since it shows when finance does matter, and hence under which conditions financial factors become relevant in investment equations. One very important assumption underlying the MM result concerns perfect information.

2.1 Capital market imperfections

One of the most important assumptions underlying the MM propositions is that individuals are not capital constrained and have the same financial opportunities than firms so that *homemade leverage* is possible. In practice this will often not be the case. The MM propositions assume that all market participants have full and equal information concerning the stream of returns (complete information markets). However, in real life market participants are often subject to asymmetric information. Asymmetric information refers to a situation in which one agent has superior information on the characteristics of a good or investment project that another agent does not have. While the problem of asymmetric information can arise in all kind of markets, it is especially important for credit relationships. For instance, a manager of a firm very often has more information about the characteristics of a project than a bank. This will probably lead to capital constraints

Asymmetric information can lead to two problems. The first one is *adverse selection*. This refers to a situation where one agent has prior information about the quality of a good, whereas another agent at most knows the probability distribution function. In a seminal paper, Akerlof, (1970) , by analyzing the working of a car market, provided the first rigorous analysis of the problem of *adverse selection*. He shows that in the case where sellers have more knowledge of the quality of the good or service sold than the buyer, a price adjustment for all the goods may occur. Eventually a situation with no trade may result. This is the so-called *lemon principle* (see Akerlof, 1970). In the case where the buyer is unable to distinguish good and bad products, the price of the goods will drop, as bad goods will drive out the good ones. In credit markets, adverse selection refers to a situation where a rise in the interest rate may lead to a less favorable composition of the group of loan applicants. This may happen because borrowers prepared to pay higher interest rates are usually risk lovers, so that they undertake projects that are characterized by higher profits if they succeed, combined with a high probability of failure. On the other hand, borrowers with the highest probability of success may decide not to undertake their project after

an increase in the lending rate. Hence, more risk averse borrowers may drop out of pool of loan applicants when a lenders increases the interest rate.

The second problem related to asymmetric information is *moral hazard*. In the literature it is also known as *adverse incentive* or as the *principal-agent* problem. *Moral hazard* refers to a situation where two parties agree on a contract, but that one party afterwards takes an action that is not observed by the other agent. The *hidden actions* are meant to increase the welfare of the informed agent at the expense of the uninformed agent.

Information asymmetries between buyers and sellers may lead to so-called *equilibrium rationing*. Unlike *disequilibrium* rationing, equilibrium rationing assumes that the price mechanism works. Rationing occurs after full adjustment of the price, whereas in disequilibrium rationing there is slow or no adjustment of the price. Especially in credit markets asymmetric information and hence also *equilibrium rationing* is an important issue.

In many papers, it is shown that asymmetric information with debt finance may lead to sub-optimal investment. The reason is that if lenders are not able to distinguish between projects, all firms have to pay the same lending rate in equilibrium. This implies that firms with good projects subsidize firms with bad projects. If capital markets were perfect, the better firms would be able to raise bank loans against lower costs. In other words, asymmetric information may cause costs of internal and external funds to diverge.

The Stiglitz and Weiss (1981) model provides an explanation of credit rationing in the loan market based on information asymmetries. There are also models which explicitly deal with the equity market. The basic reference here is the Myers and Majluf (1984) model. (see also Greenwald *et al.*, 1984). These models give theoretical underpinning of the *pecking-order* theory: investment is first financed by internal liquidity, next by debt and finally by equity. One of the most important implications is that investment is mainly financed by internal wealth and not by external wealth if capital market imperfections exist.

In many recent empirical investment studies the importance of internal funds as an explanatory variable of annual investment outlays is examined (see *e.g.* Fazzari, Hubbard and Petersen, 1988, and Hubbard, 1997). In these studies, internal wealth is often proxied by cash, liquidity, or retained earnings. Mostly, firms are divided into groups for which it may be expected that differences exist with respect to the severity of information problems. Next, the impact of internal funds on investment of these different groups of firms is compared in order to see whether there is evidence for the hypothesis that measures of internal funds are less important determinants of

investment of those firms for which banks hold more information. If imperfections in capital markets exist, then it is expected that differences occur in financial constraints for different classes of firms; firms for which the information problem is more severe have less access to external finance, revealing itself in a higher level of the coefficient of the internal funds variable in the investment function of these firms. A problem with respect to the examination of the relationship between investment and measures of internal wealth is that the variable for internal sources may also proxy for the profitability of investment. One should expect a positive relationship between internal sources and investment, since firms with more liquidity are doing well and thus have better possibilities to invest. Therefore, in estimating the relation many studies control for the effects of profitability by including Tobin's Q in the equations. However, this procedure is somewhat problematic due to the fact that current profits might be a better approximation of future profits than Q is. Moreover, there exist a lot of problems in measuring Q.

An alternative way to model internal wealth sensitivity is to model explicit external wealth constraints. This approach is taken in the so-called Euler equation models (see Whited, 1992). Euler equations do not need an explicit measurement of Q since they do not estimate actual investment behavior. Euler models compare unrestricted intertemporal investment behavior with restricted intertemporal conditions. However, this method needs a substantial amount of observations to make it useful.

2.2 Investment and uncertainty

The literature on irreversible investment under uncertainty is quite voluminous by now (see Dixit and Pindyck, 1994). It has recently gained importance, not the least because it gives a convincing explanation of the reasons why private investments in reforming and liberalizing economies, both in Eastern Europe as in the more "traditional" developing areas, may be negatively affected by the programs which were primarily intended to increase private investments. Traditionally, investment is modelled as a decision to be taken now or never. However, the theory of irreversible investment under uncertainty emphasizes that it might be profitable to postpone the investment decision in order to wait for more information on the state of the world relevant to the project. The theory makes the analogy of a real investment decision with a financial call option. A call option gives an investor the right, for a certain period, to buy an asset against a pre-determined price (the "exercise" price). Once the asset is bought, the option is "irreversible", implying that the moment at which the option is exercised becomes extremely important. Since future events are uncertain, uncertainty considerations play an very important role in explaining the moment of

”killing” the option. The equivalence with a real investment decision may be clear. An investor, having the opportunity to invest and being uncertain about future developments of key variables affecting the profitability of a project, may decide to wait for more relevant information and hence may decide to delay her investment decision. This implies that the standard net present value rule for investment, stating that investment should go on until the value of capital equals the purchase costs, has to be amended by taking into account that once the investment has been made, the option to invest does not longer exist. Somewhat loosely stated: investors need to be compensated for the loss in value related to the disappearance of the investment option when the investment has been done. Hence, the net present value of investment minus the purchasing and installation costs needs to be above a certain threshold level in order to stimulate real investments.

This line of theory predicts a decline in corporate investment if uncertainty increases. It is strongly based on the **irreversibility** assumption of fixed investment. If fixed investment is completely **reversible,** the moment at which the investment is done becomes less relevant, so that uncertainty may not necessarily lead to an increase in the investment hurdle. Although the empirical literature seems to suggest that uncertainty is likely to have a negative impact on investment (for a review, see Leahy and Whited, 1996), there is a line of literature, following Abel (1983), emphasizing the possible positive effects of greater uncertainty on long run investment. This can be explained as follows. If the marginal revenue product of capital is a convex function of some random variable (say the output price), Jensen’s inequality shows that increased uncertainty about the future price of output increases the marginal revenue product of capital and through that investment.

It is outside the scope of this paper to give a detailed overview of the discussion on the relationship between investment and uncertainty. We restrict the discussion by resuming the arguments for convex returns.

1. Risk neutrality. This is the case studied by Hartman (1972).

2. The option to abandon a project. Roberts and Weitzman (1981) show that if a firm has the option to abandon a project, an increase in uncertainty increases the incentive to invest.

3. Costly entry and exit and time to build (see Bar-Ilan and Strange (1996)).

4. Bankruptcy limit downside risk, so uncertain investment projects might be more attractive from an information economics point of view. In this case, firms have limited liabilities. See Stiglitz and Weiss (1981) .

5. Flexibility of labor relative to capital. If labor can adjust to price shocks fluctuations lead the firm to change the labor-capital ratio, so the marginal product of capital changes more than the price change. See Abel (1983).

Finally, we can list arguments for a concave marginal revenue product of capital.

1. Irreversibility combined with some link between current and future investment. The latter link might originate from decreasing returns to scale, downward sloping demand or a limit on firm investment. In case of linearly homogeneous technology and perfectly elastic demand irreversibilities play no role (see Abel, 1983). Irreversibilities make returns to investment asymmetric.[3]

2. CAPM predicts greater uncertainty to make investment less desirable. Uncertainty creates downside risk without creating corresponding upside gains. Large β's should indicate undesirable uncertainty.

3. Term structure theories implied to show risk premia. See Ferderer (1993).

The upshot of this analysis is that uncertainty may have an important impact on the investment decision, but it is unclear at forehand whether uncertainty positively or negatively affects investment.

3 Data

3.1 The Czech economy

The starting point of the transition of the Czech Republic is the elvet Revolution of 1989. Unlike other Visegrad-economies the Czech economy was a real Soviet-type economy until 1990, the year of the first free elections. In countries like Poland and especially Hungary more elements of a market economy were present before 1990. The political division into the Czech Republic and Slovakia is the following landmark in the recent Czech economic history. Czechoslovakia showed negative GDP growth rates in 1990-1992 (up to -15 per cent in 1991). After that the Czech Republic shows GDP growth rates of -0.9 in 1993, 2.6 in 1994, 4.8 in 1995, 5.1 in 1996 and 2.2 in 1997. Inflation fluctuates around 10 per cent. The Czech economy is seen as the former centrally planned economy with the highest potential. Its geographic situation,

[3] Interest rates might be an exception, since present values are a convex function of interest rates, so the sigh might be ambiguous, see Ingersoll and Ross.

close to Germany, and its sectoral economic development are responsible for this suspicion.

A program of fundamental changes to a market economy is implemented from January 1991 onwards. The privitization started with cash sale of 20 thousand retail stores, restaurants and service facilities. This round was finished in 1993. Some 4400 larger manufacturing firms were sold by coupon sales to Czech citizens at 1/30th of the book value of assets in two waves. The first wave was completed at the end of 1992. The firms privatized in this round were considered to be simpler to privatize. The second wave started in October 1992 and the final bidding round was at the end of 1994. In this round firms with a high debt burden were present. The Czech approach to the problem of debt overhang concentrated on recapitalization of the banks rather than debt relief. The National Property Fund (NPF) replaced non-performing loans from the assets of large state-owned banks by bonds issued by the NPF. The bad loans were transferred to the books of the Consolidation Bank (KOB) against corresponding deposits of the Czech National Bank. The privitization led to a market capitalization of 30 per cent of GDP.

The state kept large minority stakes in firms of strategic interest like banks. Most investors operate through mutual funds, which are owned by banks or insurance companies. A majority of stock ownership now runs through these mutual funds.

3.2 Panel data

All Czech firms are obliged to report to the Czech National Office of Statistics (CSO) their balance sheet and income statements. Incomplete or false declarations are subject to penalties. Lizal (1996) doubts whether firms really take care of filling in the right numbers. In his sample a substantial percentage fails consistency checks. The CSO only cares about accounting consistency. Lizal (1996) therefore filters the data for negative labor, average wage, production or sales, exports being higher than total sales and investment exceeding the capital stock.

The data we use in the estimates comes from AMADEUS, a Pan-European financial database, containing information on more than 200,000 nonfinancial firms across Europe[4]. Local bureaus provide the data. AMADEUS only includes a company when it satisfies one of the following size criteria:

1) a turnover greater than 10 Million Euro;

2) a number of employees greater than 150;

3) a total asset sum greater than 10 million Euro.

[4]Note that only about 5000 companies are listed in Europe.

Uniformity is achieved by standardization of accounting information. Unfortunately, for the Czech Republic, as well as most other Eastern European countries, AMADEUS only contains information for a small sample period, mostly 1993-1996. In order to get some stability in the sample, we do not include firms with less than three years of observations. Due to the limited time period for which data is available on a firm level, we apply a cross-section analysis on the averages of the data. The advantage is that by using averages, data problems are probably less. Moreover, estimating a dynamic investment model using two or three observations can be misleading since adjustment process cannot be identified. We average all original variables prior to any other transformation. All data are denominated in millions of current US dollars. Since US inflation has been moderate in the sample period, this transformation helps to avoid inflation problems.

The following variables are retrieved from AMADEUS:

K: tangible assets. This variable is used to scale all other variables in order to account for heteroskedasticity. The first difference is defined to be net investment I

DEP: depreciation.

SAL: sales. We use this variable in its first difference form, ΔSAL, as the accelerator variable.

CF: cash flow, defined as before-tax profits plus depreciation.

$PROF$: final profit or loss. It is defined as profits after tax and extraordinary payments.

$DEBT$: total short-run debtors.

$LOAN$: short-term loans.

LTD: long-term debt.

CAP: equity capital.

$CRED$: creditors

$CEMP$: costs of employees.

Before testing the different regression models, we carefully scrutinized the data set. In addition to skipping some extreme outliers of all variables taken into account in the regressions, we ignored all firms with negative gross investment (net investment plus depreciation), as well as all firms with a net investment to capital ratio above 0.35. The final data set contains 1284 firms. The estimates are done for three groups of firms, based on the size, as measured by the stock of fixed assets. The arguments to look at firm size are threefold. First, as noted in our discussion on privitization, small firms are privitized in an early stage of the reform. At least this holds for the 20 thousand small firms. We are not sure that these firms coincide with our small firms

in the sample however. But as Anderson and Kegels show, the early privatized firms tend to be the smaller firms. Secondly, there is the idea that smaller firms have less easy access to external capital markets. Finally, small firms are found to be more risk-loving than older mature firms. So, we distinguish between small (S), medium sized (M) and larger (L) firms. The three groups are made by simply dividing the entire group of firms in three sub-groups with the same amount of firms per sub-group. The original group of large firms appeared to contain some extreme outliers, which have been ignored in the estimates. Ultimately, the group of small firms contains 432 enterprises, the group of medium-sized firms contains 434 enterprises and the group of large firms 418 enterprises.

Table 1 gives information on the mean and median of the most important variables used in the estimates. As a measure of uncertainty we use the coefficient of variation, (cv), calculated as the ratio of the standard deviation of a variable to the absolute value of its mean.

Table 1 Mean and median of variables included				
Variable	All firms	Small	Medium	Large
Number	1284	432	434	418
Mean				
K	3.829	0.792	2.729	8.143
$\frac{I}{K}$	0.054	0.023	0.074	0.067
$\frac{\Delta SAL}{K}$	1.753	1.218	1.796	2.088
$\frac{CF}{K}$	0.187	0.027	0.305	0.218
$\frac{cv(PROF)}{K}$	0.249	20.46	0.170	0.322
$\frac{cv(SAL)}{K}$	0.536	1.288	0.228	0.090
$\frac{cv(CF)}{K}$	2.264	6.578	0.148	0.074
$\frac{cv(CEMP)}{K}$	0.215	0.526	0.079	0.040
$\frac{DEBT}{K}$	1.117	0.858	0.939	1.478
$\frac{LOAN}{K}$	0.334	0.319	0.314	0.374
$\frac{LTD}{K}$	0.373	0.483	0.291	0.349
$\frac{CAP}{K}$	1.112	1.761	0.791	0.792
$\frac{CRED}{K}$	1.314	0.940	1.061	1.844
Median				
K	2.619	0.793	2.640	6.998
$\frac{I}{K}$	0.041	0.007	0.059	0.053
$\frac{\Delta SAL}{K}$	0.646	0.461	0.807	0.661
$\frac{CF}{K}$	0.118	0.038	0.187	0.138
$\frac{cv(PROF)}{K}$	0.249	2.586	0.161	0.220
$\frac{cv(SAL)}{K}$	0.191	0.733	0.230	0.071
$\frac{cv(CF)}{K}$	0.103	2.599	0.073	0.063
$\frac{cv(CEMP)}{K}$	0.067	0.200	0.068	0.028
$\frac{DEBT}{K}$	0.389	0.379	0.413	0.366
$\frac{LOAN}{K}$	0.136	0.165	0.119	0.125
$\frac{LTD}{K}$	0.155	0.165	0.131	0.175
$\frac{CAP}{K}$	0.924	1.073	0.850	0.798
$\frac{CRED}{K}$	0.316	0.321	0.322	0.304

The table shows that for all variables the mean is much higher than the median. Hence, the data is characterized by positive skewness. This is a normal phenomenon in panel data firm studies. It signals that in estimating the models one should be cautious about nonnormality of the residuals.

4 Estimation results

Before we turn to estimation we sum up our main hypotheses on Czech firms.

1. Since equity markets are not established yet and the business cycle is a prominent phenomenon, we expect that an accelerator model will describe unrestricted investment plans satisfactorily. We model the accelerator model using the change in sales (see also Anderson and Kegels, 1997).

2. Capital market imperfections will hit Czech firms in general. Since smaller firms are privatized in an early stage of the reform because they had no serious financial problems these firms might not be constrained as much as some of the larger firms. These firms, especially, the ones privatized in the last stage were affected by bad loans.

3. We expect that especially younger Czech firms are more risk-taking than their western brothers. This might be due to limited liability in the early stage of reform.

We estimate a standard accelerator model, extended by some variables which proxy for capital market constraints and variables which proxy for uncertainty. The model we estimate is extremely simple and is formulated as follows:

$$\begin{aligned}\frac{I}{K} &= \alpha_1 + \alpha_2 \frac{\Delta SAL}{K}. + \alpha_3 \frac{CF}{K} + \alpha_4 \frac{cv()}{K} + \alpha_5 \frac{DEBT}{K} + \alpha_6 \frac{CAP}{K} \\ &\quad + \alpha_7 \frac{LTD}{K} + \alpha_8 \frac{LOAN}{K} + \alpha_9 \frac{CRED}{K}\end{aligned}$$

We include $\frac{\Delta SAL}{K}$ in line with the accelerator model of investment. The next variable in the model is cash flow (CF). This variable is introduced in order to test for capital market imperfections. The idea is that firms which have more problems in communicating their position to financial intermediaries should have more problems in receiving external funds, and hence are more dependent on internal funds. For these firms, investment is more sensitive to changes in the measure of internal funds than

for firms with less information problems. In other words, it is expected that firms with more information problems have a relatively high coefficient for CF. In the literature on western financial structures is assumed that larger firms are less confronted with capital market imperfections. It is to be expected that monitoring and screening costs which has to be made before banks decide to lend some amount of money are lower per unit of capital for large firms than for small firms. Opposite to this argument is the argument based on the subgroups of privitization, as presented above. Next, we introduce the coefficient of variation as the proxy for uncertainty. The usual procedure is to calculate on the basis of existing time series, expected time paths of different variables on a firm level basis. Uncertainty is then measured as the difference between the actual outcomes of the variables under consideration and the calculated expected values. However, there are no long-term time series data on a firm level available for the countries under consideration in this study. For most firms, we only have information for about four years. so that the standard method can not be used. Therefore, we simply measure uncertainty by the standard deviation of the variable which should proxy for uncertainty. We scale the standard deviation by its mean, and hence use the coefficient of variation, to account for size effects. In theory, uncertainty can be related to all kind of variables: costs, sales, profits etcetera. Again, we are constrained by the data available. In the data set there are four candidates which can be used to proxy for uncertainty: the coefficient of variation of sales, profits, cash flow and cost of employees ($\frac{cv(SAL)}{K}$, $\frac{cv(PROF)}{K}$, $\frac{cv(CF)}{K}$ and $\frac{cv(CEMP)}{K}$,respectively). These variables proxy for sales or cost uncertainty. Due to high multicollinearity between these four variables we do not add them simultaneously in the model.[5] Instead we estimate the equation four times, using each time one proxy for uncertainty. The final four variables in the equation are included in order to account for effects of the financial structure on private investment. The sign of these variables are ambiguous at forehand.

Table 2 presents the regression results for the group of small firms, Table 3 for medium sized firms and table 3 for large firms. A * denotes insignificant; ** denote significant at the 10% level. All other coefficients are significant at the 5% level. The significance levels in all presented estimates are based on White's heteroskedastic-consistent standard errors.

[5]all independent variables used in this study can be obtained from the authors on request.

Table 2: Regression results for small firms

$const$	0.024	0.028	0.027	0.025
$\frac{CF}{K}$	0.060**	0.064	0.072	0.072
$\frac{\Delta SAL}{K}$	0.005	0.006	0.005	0.005
	$\frac{cv(CEMPL)}{K}$	$\frac{cv(PROF)}{K}$	$\frac{cv(SAL)}{K}$	$\frac{cv(CF)}{K}$
	0.013	0.0001	0.002*	0.0008
$\frac{DEBT}{K}$	-0.037	-0.039	-0.039	-0.041
$\frac{CAP}{K}$	-0.006	-0.006	-0.007	-0.006
$\frac{LTD}{K}$	0.015	0.015	0.015	0.016
$\frac{LOAN}{K}$	0.004*	0.004*	0.005*	0.005*
$\frac{CRED}{K}$	0.020	0.021	0.023	0.022
$adj.R^2$	0.52	0.52	0.52	0.52
F	60.02	59.45	58.62	59.47
$Skewness$	0.73	0.74	0.73	0.69
$Kurtosis$	4.49	4.49	4.44	4.46

Table 3: Regression results for medium-sized firms

$const$	0.070	0.089	0.079	0.086
$\frac{CF}{K}$	0.038	0.040	0.043	0.040
$\frac{\Delta SAL}{K}$	0.001*	0.002*	0.001*	0.002*
	$\frac{cv(CEMPL)}{K}$	$\frac{cv(PROF)}{K}$	$\frac{cv(SAL)}{K}$	$\frac{cv(CF)}{K}$
	0.187	-0.025*	0.030*	-0.008*
$\frac{DEBT}{K}$	-0.012*	-0.012*	-0.012*	-0.012*
$\frac{CAP}{K}$	-0.025	-0.025	-0.026	-0.026*
$\frac{LTD}{K}$	-0.012*	-0.012*	-0.012*	-0.012*
$\frac{LOAN}{K}$	0.003*	0.004*	0.004*	0.004*
$\frac{CRED}{K}$	0.007*	0.007*	0.006*	0.007*
$adj.R^2$	0.10	0.09	0.09	0.09
F	6.92	6.20	6.31	6.39
$Skewness$	0.51	0.52	0.51	0.52
$Kurtosis$	3.20	3.15	3.13	3.18

Table 4: Regression results for large firms

$const$	0.053	0.068	0.052	0.055
$\frac{CF}{K}$	0.055	0.054	0.056	0.053
$\frac{\Delta SAL}{K}$	0.003	0.003	0.003	0.003
	$\frac{cv(CEMPL)}{K}$	$\frac{cv(PROF)}{K}$	$\frac{cv(SAL)}{K}$	$\frac{cv(CF)}{K}$
	0.204	-0.024**	0.109**	0.122*
$\frac{DEBT}{K}$	-0.011	-0.011	-0.011	-0.011
$\frac{CAP}{K}$	-0.007*	-0.006*	-0.008*	-0.007*
$\frac{LTD}{K}$	0.003*	0.004*	0.004*	0.002*
$\frac{LOAN}{K}$	-0.005*	-0.005*	-0.005*	-0.006*
$\frac{CRED}{K}$	0.005*	0.005*	0.006**	0.004*
$adj.R^2$	0.10	0.09	0.09	0.09
F	6.83	6.31	6.25	6.39
$Skewness$	0.15	0.15	0.16	0.13
$Kurtosis$	4.15	4.12	4.16	4.28

Before describing the regression results, a word of warning is needed. It appears that in none of the regressions the null hypothesis of normally distributed residuals could be accepted. As can be seen in the last two rows in the tables, the skewness in all regressions is above zero, implying that the distribution of the residuals is skewed to the right. Moreover, the kurtosis is above three, suggesting heavier tails than a normal distribution. By considering the summary Jarque-Bera test (not presented) it appears that the null of normally distributed residuals is rejected in all cases. The calls for some caution with respect to the interpretation of the estimation results.

In all regressions for small and large firms ΔSAL is highly significant and has the right sign. This strongly confirms the relevance of the accelerator model for the firms in our data set. However, for the group of medium-sized firms this appears not to be the case. Anderson and Kegels (1997) find no support for the sales-accelerator model. The argue that Czech firms were undergoing restructuring so that sales might be flat or declining even though there is a strong potential future growth. The cash flow variable is significant in all regressions. This suggests private firms in the Czech Republic do face capital constraints. However, we do not find evidence for the popular "western" believe that small firms are more constrained than large firms. While the coefficient for the medium-sized firms is smaller than that of the small firms, this is not the case for the large firms.[6] A standard critique on the cash flow model is that

[6]has to be noted that some recent studies suggest that the coefficient of cash flow is not a good proxy for the existence of capital market constraints (See Kaplan and Zingales, 1997).

CF may also proxy for the profitability of investment, so that one should be cautious to interpret the coefficient for CF in relation to capital market imperfections. A usual way to account for this critique is to add Tobin's Q to the investment model. This variable is supposed to control for profitability. However, the data set we are using thus not allow for calculating a proxy for Tobin's Q. The only variable, related to the concept of profitability, we could take into account is the profit margin, which is the ratio of net profit in total revenue. We are aware of the fact that this might not be a good candidate for proxiing future profitability. However, given the data set, we do not have much of a choice. The results of the estimates presented in the tables do not change when the profit margin is added to the model. For reasons of space, these outcomes are not presented.

Concerning the financial structure of the firms we find that the results are mixed to some extent. We find a consistent negative impact of debt. This contradicts the finding by Anderson and Kegels, who argue that high debt signals a successful debt program in the past. We find more support for the notion that high leverage is troublesome to ask for new debt. Short-term loans (not necessarily from banks) is weakly significant to small and medium-sized firms. In general financial structure matters more to the smaller firms.

The most interesting outcome concerns the results for the uncertainty measures. For the group of small firms, in three out of four cases the coefficient is highly significant, and has a positive sign. For the medium-sized and large firms a positive and significant coefficient is found for the coefficient of variation based on the costs of employees. The same holds for the coefficient of variation based on sales for the group of large firms. In only one case, at a 10% significance level ($\frac{cv(PROF)}{K}$ for the group of medium-sized firms) a negative relationship between uncertainty and private investment is suggested. Overall, the results suggest that if uncertainty affects investment behavior, the effect is positive. While this outcome is not against theoretical insights, it certainly contrast with most popular ideas. Enterprises in the Czech Republic seems to be risk takers. This behavior may well be stimulated by the weak legal framework for enforcing financial discipline, such as the reluctance to bankruptcy proceedings by commercial banks as well as the government, as described in the introduction of this paper.

5 Conclusion

This paper studies private manufacturing firm investment in the Czech Republic in the years 1992-1996. It presents cross-section estimation results on an accelerator

model using a sample of 1284 firms. A number of problems hinder estimation. Firstly, some of the data might be unreliable. We corrected therefore for inconsistencies and outliers. Secondly, the status of firms might be changed in the sample period. The privitization process ran until the beginning of 1995, so at least the beginning of our sample is hindered by this fact.

Our main interest is in two elements of recent insights in the investment literature. First we include a proxy for capital market imperfections. We know that, opposite to the western experience, larger firms might have a worse reputation on public capital markets, since these are typically hit by the bad loan problems. Secondly, we are interested in the effects of uncertainty on investment. It is known that the sign of the investment-uncertainty relationship is ambiguous. It might be so that risk loving firms are positively affected by uncertainty.

Our results find support for the accelerator model. We find evidence for cash-flow effects on Czech corporate investment. It still might be so that cash flow proxies for future investment though. It is striking that indeed smaller longer privatized firms face relatively less cash flow restrictions. Financial structure doesn't matter as much as we expected. We find that smaller firms react positively to more uncertainty, although our proxies for uncertainty seem to be artificial.

A few warnings are necessary. First, we have to cope with properly taking care of the distributions of the variables. Secondly, a relation between size and legal status could be included ore rigorously. Finally, for those firms listed on the stock exchange it is interesting to use more market information on future profitability.

References

[1] A.B. Abel. Optimal investment under uncertainty. *American Economic Review*, 72:228–233, 1983.

[2] B.B. Aghlevi, E. Borensztein, and T. van der Willigen. Stabilization and structural reform in the Czech and Slovak Federal Republic. IMF Occasional Paper 92, IMF, 1992.

[3] G. Akerlof. The market for lemons: qualitative uncertainty and the market mechanism. *Quarterly Journal of Economics*, 84:488–500, 1970.

[4] R. Anderson and C. Kegels. Finance and investment in transition: Czech enterprises, 1993-1994. Mimeo, Center for Economic Research and Graduate Education, 1997.

[5] B. Banerjee. The transformation path in the Czech Republic. IMF Occasional Paper 127, IMF, 1995.

[6] B. Banerjee, R. Teja, W. Jack, and S. Meehan. Czech Republic - selected background studies. IMF Staff Country Report 95/85, IMF, 1995.

[7] A. Bar-Ilan and W.C. Strange. Investment lags. *American Economic Review*, 86:610–622, 1996.

[8] A.K. Dixit and R.S. Pindyck. *Investment under uncertainty*. Princeton University Press, 1994.

[9] S.M. Fazzari, R.G. Hubbard, and B.C. Petersen. Financing constraints and corporate investment. *Brookings Papers on Economic Activity*, pages 141–195, 1988.

[10] J. Ferderer. The impact of uncertainty on aggregate investment spending: an empirical analysis. *Journal of Money, Credit, and Banking*, 25:30–48, 1993.

[11] B. Greenwald, J.E. Stiglitz, and A. Weiss. Information imperfections in the capital market and macroeconomic fluctuations. *American Economic Review, Papers and Proceedings*, 74:194–199, 1984.

[12] R. Hartman. The effects of price and cost uncertainty on investment. *Journal of Economic Theory*, 5:258–266, 1972.

[13] R.G. Hubbard. Capital market imperfections and investment. Working Paper Series 5996, National Bureau of Economic Research, 1997.

[14] J.E. Ingersoll and S.A. Ross. Waiting to invest: investment and uncertainty. *Journal of Money, Credit, and Banking*, 25:30–48, 1993.

[15] D.W Jorgenson. Capital theory and investment behavior. *American Economic Review*, 53:247–259, 1963.

[16] D.W Jorgenson. Econometric studies of investment behaviour. *Journal of Economic Literature*, 9:1111–1147, 1971.

[17] S.N. Kaplan and L. Zingales. Do financing constraints explain why investment is correlated with cash flow? *Quarterly Journal of Economics*, 112:35–70, 1997.

[18] J. Leahy and T.M. Whited. The effects of uncertainty on investment: some stylized facts. *Journal of Money, Credit, and Banking*, 28:64–83, 1996.

[19] L. Lízal. The dynamics of enterprise investment and export behavior in transition period. Mimeograph, CERGE, 1996.

[20] L. Lízal and J. Svejnar. Enterprise investment during the transition: evidence from Czech panel data. Working paper 60a, The William Davidson Institute, 1997.

[21] F. Modigliani and M.H. Miller. The cost of capital, corporate finance, and the theory of investment. *American Economic Review*, 48:178–197, 1958.

[22] S.C. Myers and S. Majluf. Corporate financing decisions when firms have investment information that investors do not. *Journal of Financial Economics*, 13:187–220, 1984.

[23] M. Peeters. Does demand and price uncertainty affect Belgian and Spanish corporate investment? Working paper, ESCR Macroeconomic Modelling Bureau, 1996.

[24] K. Roberts and L. Weitzman. Funding criteria for research, development, and exploration projects. *Econometrica*, 49:1261–1288, 1981.

[25] P. Scaramozzino. Investment irreversibility and finance constraint. *Oxford Bulletin of Economics and Statistics*, 59:89–108, 1997.

[26] J.E. Stiglitz and A. Weiss. Credit rationing in markets with imperfect information. *American Economic Review*, 71:393–410, 1981.

[27] T.M. Whited. Debt, liquidity constraints, and corporate investment: evidence from panel data. *Journal of Finance*, 47:1425–1460, 1992.