BANKRUPTCY, INVESTMENT, AND FINANCIAL CONSTRAINTS: EVIDENCE FROM AN UNDERDEVELOPED FINANCIAL MARKET*

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This paper studies the relations between investment, bankruptcy and financial constraints in a post-transition country with underdeveloped financial market. We link Czech firms' balance sheets with original data on bankruptcy to show that companies going bankrupt invest significantly less, have higher bank loans, and worse cash flow than healthy companies. We show that cash flow positively affects investment rates but investment-cash flow sensitivity has not increased after decline in credit provisions in 2008. Using endogenous switching regression methodology with unknown sample separation we identified two investment regimes. Older and bigger companies with lower leverage have a higher probability of being in unconstrained regime. On the other hand, companies close to bankruptcy are more likely to be in the constrained investment regime.

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I. Statement of the problem

The understanding of the link between bankruptcy, investment, and financial constraints is crucial, especially in countries with underdeveloped financial markets. On these markets, firms have a limited access to capital and often banks remain the only source of credit. When banks' credit provisions decline, companies can not invest and go bankrupt.

Generally, investment is the most volatile part of GDP growth and is very much linked to credit provisions as an investors usually do not have enough funds for the project they want to undertake. Financial constraints influence investment and industrial development to a varying degree within the business cycle and changing institutional environment. Financially constrained firms underinvest, they forgo good investment opportunities due to the lack of financial resources and the economy can be Pareto constrained.

On an underdeveloped stock market, firms use bank credit extensively as their principal form of external financing. Therefore, as there are not many other options for firms to get credit, a significant decline in bank loans, such as the one experienced after September 2008, characterized by severely contracted liquidity in the global credit markets and insolvency threats to investment banks and other institutions, constraints the whole economy.

In this paper, we focus on the link between investment, bankruptcy and financial constraints. Linking balance sheet data with original data on bankruptcy and using endogenous switching regression with unknown sample separation - we offer a new perspective on this important relationship in the economy.

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We choose the Czech Republic for several reasons. First, the Czech Republic belongs to countries with underdeveloped financial markets. Figure VII plots stock market capitalisation to GDP of OECD countries. The figure also shows that the already low Czech stock market capitalisation was further reduced after 2008. Therefore, banks' credit provisions are crucial for investment and growth in the country. Second, the Czech Republic is a small and open economy with the experience with the Czech banking crisis of 1997.[1] Third, Czech companies had to face the decline in credit provision after the fall of Lehman Brothers in 2008 (see Figure 12).[2] The 2008 crisis had an impact on the number of bankrupted companies in the Czech Republic. One of the reasons for companies going bankrupt was often mentioned difficult access to finance during the time of economic distress. However, a detailed analysis of this link was so far limited due to unavailable firm-level data in the post 2008 period. Today, when the data is finally available we are able to link balance-sheet data with an original dataset on bankrupted companies to study firms' investment behavior in relation to financial constraints and bankruptcy in the Czech Republic.

Our research is interesting for several reasons. we contribute not only empirically but methodologically to the existing literature on financial constraints. We show empirically the link between cash flow, investment, and bankruptcy. We test whether the commonly used methodology relying on investment-cash flow sensitivities is sufficient to test for financial constraints in the economy. Knowing more about the link between finance, investment, and bankruptcy can help policy-makers understand how to mitigate the consequence of a similar type of credit crunch[3]. For instance, strong financial constraints (high credit rationing) in times of economic decline can support the need for some policy intervention

[1] The Czech banking crisis of 1997 and following privatisation of Czech banks to Western global banking groups helped Czech banks to learn how to assess risk and therefore it is believed that the Czech banking sector weathered the crisis relatively well.

[2] The 2008 crisis affected firms in the Czech Republic harshly. For example, Czech firms were complaining in 2009 that they were being hit by the credit crunch with banks reluctant to lend money. http://www.radio.cz/en/section/curraffrs/czech-companies-complain-credit-crunch-has-begun It was observed that the decline in credit after the events of 2008 was due to higher economic uncertainty, more prudent lending because of pressure of mother banks from abroad and lower demand for credit in general due to low aggregate demand.

[3] As Bernanke, Gertler, and Gilchrist [1999] note, already Fisher [1933] argued that the severity of the Great Depression was due to a heavy burden of debt and financial constraints.

(loan provision, guarantees) on the credit market[4].

The remainder of the paper is organized as follows: the next section reviews the related literature, next we define our research methodology, we analyse available surveys on financial constraints, then we describe our econometric specification, we show and comment on the results we got and then we conclude.

II. Literature Review

Financial constraints and credit rationing[5] concepts were first theoretically well analysed by Stiglitz and Weiss [1981].[6] The outcome of their research is that under financial imperfections, the Modigliani-Miller theorem[7] does not hold, firms can be constrained, and the overall economic growth may slow.

Over time, credit rationing theory has become extensively important especially as a part of macroeconomic models with financial frictions.[8] The logic of credit rationing is that there is no linear relationship between interest rate on loans and a bank's profitability. Beyond a certain (optimal) interest rate, any higher rate is considered too risky from the perspective of the bank and therefore the credit market does not clear.

Bernanke and Gertler [1995] were then one of the firsts to claim that the credit view approach aims to identify the propagation mechanism of the conventional interest rate effect. As Chatelain, Ehrmann, Generale, Martnez-Pags, Vermeulen, and Worms [2003] note, however, standard macro-models usually do not include balance sheet information on firms' behaviour and are, therefore, not good enough to test for the broad-credit-channel effects and imperfections.

But it is difficult to identify credit rationing from the aggregate data. For example, decline of credit provisions can be driven by the unwillingness of lenders

[4] As Oliner and Rudebusch [1996] note, the research on credit channel stresses that central bank actions affect output, in part, by causing shifts in the supply of loans

[5] In this paper the terms credit constraints and financial constraints are used interchangeably.

[6] Stiglitz and Weiss [1981] describe the loans market: As lenders cannot distinguish between good and bad borrowers, when the interest rate increases, relatively good borrowers drop out of the market. Lenders' profits can then decrease since this "drop out" can lead to an increase in the default probability on loans made.

[7] The Modigliani-Miller theorem in its basic form states that, under a certain market price process, in the absence of taxes, bankruptcy costs, agency costs, and asymmetric information, and in an efficient market, the value of a firm is unaffected by how that firm is financed.

[8] Bernanke et al. [1999] show how credit-market frictions can significantly amplify both real and nominal shocks in the economy. Other economists who stand outside the standard macroeconomic models and focus on the importance of credit in the economy are for example Keynes, Minsky, or Stiglitz.

to lend or by low demand for new loans (Bernanke [1993]). In order to be able to correctly estimate the severity of financial constraints, one has to distinguish the credit supply from credit demand shifts. A decrease (no matter how strong) of aggregate credit provisions per se does not say anything about a credit crunch as this sharp decline can be caused by a strong decrease of the demand for credit.

Recognizing that, there has been a recent shift in economics from aggregate data towards the use of micro-level, balance-sheet data to test for the effects of financial constraints. For example, Bernanke and Blinder [1992] show how the credit rationing concept is related to the balance sheet effect. Good evidence on how financial constraints impact economic growth is provided by Love [2003], for example. Several other studies (e.g. Oliner and Rudebusch [1996], Gertler and Hubbard [1989], Agca and Mozumdar [2008], or Kashyap, Lamont, and Stein [1994]) confirm the robustness of variation in the severity of financial constraints over time. At the same time, financial constraints are empirically unobservable and there is no balance sheet item that would suggest financial constraints.

To test for financial constraints, several authors use the presence of investment–cash flow sensitivity as an indication for being credit constrained (e.g. Fazzari, Hubbard, and Petersen [1988], Hobdari, Jones, and Mygind [2009]). Other authors use survey data to get firm-level information on credit denial (e.g. Gaiotti [2011], Holton, Lawless, and McCann [2012]). But as Campello, Graham, and Harvey [2010] point out, survey-based analysis is strongly limited by the ability of surveyed personnel to correctly assess credit constraints. Also, their analysis reveals that the differences between constrained and unconstrained firms become more significant during the 2008 crisis. Mach and Wolken [2012], again based on survey data on credit experiences, report that there is a link between credit access and likelihood of bankruptcy, even though the authors themselves admit that their data on bankruptcy are not fully reliable. Similar result is obtained also by Keasey and Watson [1991] or Musso and Schiavo [2008].

Literature on investment behaviour and credit constraints of firms countries with developed financial markets is therefore rich (e.g. Chava and Roberts [2008], Whited [2001], or Hovakimian and Titman [2006]). In a recent paper focused on Italy, Gaiotti [2011] finds that the elasticity of a firm's investment to the availability of bank credit has been significant in periods of economic distress

but not in other periods. Credit crunch therefore strongly affects investment and the whole economy. Recently, Clarke, Cull, and Kisunko [2012] focused on how country and firm characteristics affected firms' financial constraints and their likelihood of survival during the early phase of the recent global financial crisis in Eastern Europe and Central Asia.

On the other hand, there is a scarce empirical literature on financial constraints in countries with underdeveloped financial markets.[9] Gersl and Jakubik [2010] focus on the question of how Czech firms obtain financing from domestic banks. Their results show that the vast majority of non-financial corporations from from just one lender. Carpenter and Guariglia [2008] show that finance constrains the firm's investment decisions after controlling for investment opportunities and distinguishing between internal and external constraints.

To conclude, studies predicting bankruptcy as well as papers analysing financial constraints focus on publicly traded companies and make heavy use of various market value measures. This approach is unfortunately an unusable one for countries with underdeveloped stock market, where a very small share of publicly traded companies makes this kind of information unavailable. As a consequence, we have to rely solely on balance-sheet data. There are only a few papers on these topics that use Czech panel data (e.g. Fidrmuc, Horvath, and Horvathova [2010], Pruteanu [2004], Lizal and Svejnar [2002]) and most of them use investment-cash flow sensitivities to identify financial constraints. Finally, very few studies try to find the relationship between bankruptcy, investment, and cash flow using endogenous switching regression, which allows firms to switch from a constrained to unconstrained regimes and vice versa.

III. Research Methodology

Research on financial development usually can not rely on experiments to verify its hypothesis. The 2008 financial crisis, however, can be perceived as an experiment with respect to financial constraints in the Czech Republic. There is a clearly identified change in the economy (2008 crisis), we have pre- and post-crisis data, and with respect to Czech firms, this crisis is assumed to be exogenous.

[9] E.g. Wei and Zhang [2008] focusing on East Asia, or Lizal and Svejnar [2002] who focus on a similar topic in the Czech Republic.

As noted, financial constraints are empirically, unobservable. Therefore, we use a combination of surveys and econometric techniques.

A. Research hypotheses

In our paper, we analyse the following questions:

- How has the investment behaviour of companies in the Czech Republic changed over the past ten years with respect to financial constraints? Is this path different for healthy and bankrupt companies?
- Has the investment-cash flow sensitivity (as a proxy for financial constraints) increased after 2008? Has it changed for companies going bankrupt?
- Can we identify constrained and unconstrained invesment regimes? What determines the selection into these regimes?

B. Investment–cash flow sensitivity

The core belief in the financial growth literature is investment should be determined by future investment opportunities rather than firm's internal funds (net worth). There is a strong discussion, however, over how much does cash flow matter. The standard empirical approaches recognize not only the importance of liquidity constraints but also the fact that they are not evenly distributed across firms. Some firms simply face higher costs of raising capital. Financially constrained firms should, therefore, prefer internal financing to external financing. To test this hypothesis, authors usually look for the presence and scope of investment–cash flow sensitivity as an indication for being credit constrained. Poncet, Steingress, and Vandenbussche [2010] argue that the larger the sensitivity of investment to cash flow, the more constrained the firm is because it has to rely on its internal funds to finance investment.

Moreno Badia and Slootmaekers [2009] argue that if a firm is financially constrained, the impact of cash flow on the intertemporal allocation decision will be positive. The more financially constrained a firm is, the larger will be the impact of its available cash stock on the cost of capital. In other words, an increase in cash stock will lower the implied cost of capital, making investment today more attractive than investment tomorrow. Although cash stock may be a proxy for

future profit opportunities, it has been argued that this would only be the case in the presence of financial constraints (see, for example, Love [2003]) since holding liquid assets is costly. Therefore, a firm, anticipating profitable investment opportunities, will accumulate liquid assets only if it expects to be financially constrained.

At the same time, Kaplan and Zingales [1997] are skeptical about the usability of investment–cash flow sensitivities in this context, while Fazzari, Hubbard, and Petersen [2000] counter-argue that these sensitivities matter.[10] for example, Empirically, Agca and Mozumdar [2008] or Chen and Chen [2011] showed a significant decline in the investment-cash flow sensitivity over time. This investment–cash flow bias is a central point in the corporate finance literature. As mentioned, the exogenous shock of 2008 presents a unique opportunity to test the validity of investment–cash flow sensitivities. If financial constraints increased after 2008, investment-cash flow sensitivities need to increase as well. Our paper therefore contributes to the existing methodology on financial constraints. If we can not identify an increase in investment-cash flow sensitivities after 2008, we will argue that this relationship is not sufficient for the identification of financial constraints.

C. Basic framework: the Q model

To empirically test for financial constraints, one can use the Q model derived from the Euler equation[11] and an investment-cash flow relation. Under the assumption of perfect competition, capital as the only input, constant returns to scale, and conditional on average Q,[12] no other variable should matter for investment. Under quadratic adjustment costs, the investment equation can be written as (i stands for firm index and t stands for time index):

[10] For a discussion about this so called monotonicity hypothesis see the original paper by Fazzari et al. [1988], the Kaplan and Zingales critique emanating from Kaplan and Zingales [1997], a reply by Fazzari et al. [2000] and the answer by Kaplan and Zingales [2000]. Kaplan and Zingales [1997] theoretically show that even in a one period model, investment–cash flow sensitivities do not have to increase with the degree of financial constraints. They also claim that in a multi-period case, for example, precautionary savings make it even more difficult to justify this relationship. They finally argue that this relationship can be more complicated with overly risk-averse firms preferring to invest their own cash flow.

[11] Derivation of the Euler equation is in the Annex

[12] Ratio of the market value of existing capital to its replacement cost. Usually, we can only observe average Q (even this can be difficult, especially for non-listed companies). Marginal Q, on the other hand, is the ratio of market value of an additional unit of capital to its replacement costs. Average Q, in most of empirical work, serves for the proxy for marginal Q.

$$(1) \qquad \frac{I_{it}}{K_{it}} = \beta_0 + \beta_1 Q_{it} + \beta_2 \frac{CF_{it-1}}{K_{it-1}} + e_{it}$$

where $\frac{I_{it}}{K_{it}}$ denotes the investment rate, β_0 is the non-stochastic additive parameter, β_1 is the multiplicator in the adjustment-cost function, Tobin's Q_{it} is a proxy for the availability of investment opportunities and can be proxied with end-of-period debt and equity over capital,[13] and e_{it} is the stochastic additive component (assumed *i.i.d.* process).

As noted however, we focus on a post-transition country with an underdeveloped financial market, where large information asymmetry is still assumed. Under such market imperfections, the basic Q model will be less informative. Therefore, our baseline equation is:

$$(2) \qquad \frac{I_{it}}{K_{it}} = \beta_0 + \beta_1 \frac{I_{it-1}}{K_{it-1}} + \beta_2 \frac{turnover_{it}}{K_{it}} + \beta_3 GDPgrowthforecast + \beta_4 \frac{CF_{it}}{K_{it}} + \mu_{kt} + e_{it}$$

where I_{it} is investment, K_{it} is beginning-of-period fixed assets[14], $turnover$ and $GDPgrowthforecast$ proxy for investment opportunities,[15] μ_{kt} is sector-time specific effect, and CF_{it} is cash flow.[16] Coefficient β_4 is of our interest because for credit-rationed firms, internal cash flow should be relevant in the investment rate equation. This implies that a firm is considered to be financially constrained if the cash flow coefficient is estimated to be positive. The idea behind this equation is that the larger the sensitivity of investment to cash stock (or cash flow), the

[13] This approach has been used by Hu and Schiantarelli [1998], for example.

[14] Therefore, a lagged observation.

[15] As we need to proxy for investment opportunities in the investment equation, we use (together with for example Hanousek and Shamshur [2011]) GDP growth as the proxy for the growth opportunities of the firm. As a proxy investment opportunities we use forecasted GDP for the next year. Data come from previous years' EBRD Transition Reports.For example, for 2008 we use 2007 Transition report's GDP growth estimate (4.1), which is different from the actual GDP growth in 2008 (2.7). We believe that economic forecasts have stronger explanatory power for investment behaviour. The logic of using GDP growth forecast as a proxy for investment opportunities follows Beck, Kunt, and Maksimovic [2005] who claim that if investment opportunities in a country are correlated, there should be a relation between the growth rate of individual firms and the growth rate of the economy. They face the same problem as they do not have a measure of firm-level investment, opportunities, such as Tobin's Q. They use firm ownership, industry, market structure, and size as firm-level contrast, together with industry dummies. Alternative measures of investment opportunities can be: the growth of firms (profits) within the sector of the firm-excluding the particular firm, up-to-current year growth of sales, expected GDP growth for the next year, or managerial expectations for the next year

[16] In our dataset, cash flow is defined as profit (loss) from current year + depreciation of tangible and intangible fixed assets.

more constrained the firm is because it has to rely on its internal funds to finance investment projects.

D. *Endogenous switching regression*

Investment–cash flow sensitivities are often criticized as being too simple to test for investment behavior and credit rationing. Moreover, in their linear form they are is subject to the Kaplan and Zingales [1997] critique of the (implicitly assumed) *monotonicity hypothesis* that the sensitivity of investment to internal cash flow monotonically increases with the wedge between the internal and external funds costs.

As mentioned, not all firms have to be financially constrained. But the linear model is not able to identify the two groups. Even if we exogenously split the sample, a simple model can not take into account the possibility of migration between financially constrained and unconstrained firms (or this migration also has to be imposed a priori). To face this drawback we apply endogenous switching regression[17] with unknown sample separation.[18] Because financial constraints are firm and time specific, such methodology allows a firm to move from one regime to another.

Together with for example Hu and Schiantarelli [1998] or Hobdari et al. [2009] we investigate different investment behaviour of firms by allowing them to be in either of the two regimes. One is assumed to be a regime with high premium on external financing (we call it the constrained regime) and the other regime with low premium on external financing (unconstrained). The selection equation then decides in which of the two regimes (constrained and unconstrained regime) the firm is.

This method has the advantage that we do not need to have any a priori knowl-

[17] Switching regression is basically an extension of the baseline Heckman self-selection model. We avoid the problem of arbitrary a priori assignment of constrained and unconstrained groups econometrically by using endogenous switching regression with unknown sample separation. Such a technique has not been applied to our specification on Czech data, although it has been used for example in family economics Arunachalam and Logan [2006] or or Kopczuk and Lupton [2007]. In financial economics, it has been used by Hu and Schiantarelli [1998].
Together with Hovakimian and Titman [2006] we argue that this approach can address the issue raised by the exogenous classification of firms into constrained and unconstrained groups.

[18] An alternative way how to incorporate endogeneity in the model of financial constraints is presented in Badia and Slootmaekers [2009] who construct a score of cash flow sensitivity based on a firm characteristics (they include a similar set of explanatory variables: total assets, current assets, age, leverage, and dummy for foreign ownership).

edge of whether or not a firm is credit constrained.[19] Eberly, Rebelo, and Vincent [2009] even argue that switching can improve the performance of the investment regression.[20]

We control for multiple factors that jointly determine the constrained or unconstrained regime. We determine the selection of being constrained using balance sheet and bankruptcy characteristics. The goal is therefore to estimate the investment equations for constrained and unconstrained companies. We have two investment equations[21] and a system of three equations:

$$Y_{Cit} = \beta_C X_{it} + \varepsilon_{Cit} \tag{3}$$

$$Y_{Uit} = \beta_U X_{it} + \varepsilon_{Uit} \tag{4}$$

$$y^*_{it} = \delta Z_{it} + u_{it} \tag{5}$$

where $Y_{it} = \frac{I_{it}}{K_{it}}$ and X_{it} are determinants of investment rate as described previously. We assume that u_{it} and ε_{1it} (or ε_{2it}) are bivariate normal. The covariance between u_{it}, ε^C_{it} ε^U_{it} is assumed to be non-zero and therefore shocks to investment can be correlated with balance sheet data.

X_{it} is a vector of individual characteristics that is thought to influence a firm's investment policy. y^*_{it} is a latent variable that determines whether the firm is constrained or not. Z_{it} is a vector of characteristics that influence the selection into constrained or unconstrained regimes.

If y^* reaches a certain threshold (unknown) value, then an unconstrained firm becomes constrained. As this switch is endogenous, we calculate the probabilities

[19] Similar approach was used, for example, by Hovakimian and Titman [2006] on the subset of US firms in the 1980s and 1990s. Using a similar methodology, Hanousek and Shamshur [2011] focus on the stability of the leverage rations in the CEE.

[20] Endogenous switching regression and credit constraints was used for example by Hu and Schiantarelli [1998] or Carter and Olinto [2003]. Eberly et al. [2009] also claim that in a single regime model we can not have a role for the lagged investment in the investment regression.

[21] That is also the reason why in the equations 3 and 4, the β's differ.

of switching[22]:

$$(6) \qquad \begin{aligned} prob\{(\frac{I}{K})^i_{it} = (\frac{I}{A})^C_{it}\} &= prob(\delta Z_{it} + u_{it} \geq 0) = \phi(\delta Z_{it} + u_{it} \geq 0) \\ &= \Phi(-\delta Z_{it}) \end{aligned}$$

$$(7) \qquad \begin{aligned} prob\{(\frac{I}{K})^i_{it} = (\frac{I}{A})^U_{it}\} &= prob(\delta Z_{it} + u_{it} < 0) = \phi(\delta Z_{it} + u_{it} < 0) \\ &= 1 - \Phi(-\delta Z_{it}) + u_{it} \end{aligned}$$

where $\phi(.)$ and $\Phi(.)$ are pdf and Cdf with a normal distribution. Superscripts C and U denote constrained and unconstrained regimes.

We then establish the likelihood density function for our model:

$$(8) \qquad l_{it} = \Phi(-\delta Z_{it})\phi(\varepsilon_{1it}|u_{it} < -\delta Z_{it}) + [1 - \Phi(-\delta Z_{it})\phi(\varepsilon_{2it}|u_{it} > -\delta Z_{it})$$

and maximize its log:

$$(9) \qquad \log l_{it} = \sum_{i=1}^{N}\sum_{t=1}^{T} \log\{\Phi(\frac{-\delta Z_{it} - \frac{\sigma_{1u}}{\sigma^2_{1u}}\varepsilon_{1it}}{\sqrt{1 - \frac{\sigma^2_{1u}}{\sigma^2_1}}})\phi(\varepsilon_{1it}, \sigma_1) + (1 - \Phi(\frac{-\delta Z_{it} - \frac{\sigma_{1u}}{\sigma^2_{1u}}\varepsilon_{1it}}{\sqrt{1 - \frac{\sigma^2_{2u}}{\sigma^2_2}}}))\phi(\varepsilon_{2it}, \sigma_2)\}$$

Regressing 3, 4, and 5 simultaneously allows us to use all the available information. Then, we get the estimates of, β_1, β_2, and δ. We can also test for the existence of two different investment regimes,[23] where we use a likelihood ratio

[22] We also assume that vector of errors in the investment and switching functions $\begin{pmatrix} \varepsilon_{1it} \\ \varepsilon_{2it} \\ u_{it} \end{pmatrix}$ is jointly $i.i.d \sim N\left(0, \begin{bmatrix} \sigma^2_1 & \sigma_{12} & \sigma_{1u} \\ \sigma_{21} & \sigma^2_2 & \sigma_{2u} \\ \sigma_{u1} & \sigma_{u1} & \sigma^2_u \end{bmatrix}\right)$.

[23] Endogenous switching models can be estimated one equation at a time either by maximum likelihood (ML) or two-step least square (2SLS). However, as Lokshin and Sajaia [2004] note, both of these estimation methods are inefficient and require adjustments to get consistency of the standard errors. To face this problem , we use the *movestay* command in Stata 11, to use the full information maximum likelihood method (FIML). Therefore, we simultaneously estimate binary and continuous parts of the model in order to yield consistent standard errors. For that we have to assume joint normality of the error terms in the binary and continuous equations.

test with a log-likelihood values of the OLS and the switching regression models.[24]

E. Criteria for sample separation

In the switching regression, the Z_{it} vector includes the criteria for sample separation in the endogenous switching. We describe our theoretical priors to characterize the variables that affect the financial constraints.[25] We also argue together with the corporate finance literature Devereux and Schiantarelli [1990] or Oliner and Rudebusch [1996], that small and younger firms are more financially constrained.[26] To control for this, we include the *size* variable in the separation regression. We measure firm size with total assets. Age is also sometimes considered as a proxy for the wedge between external and internal financing.[27] We include information on bankruptcy in the selection equation because we are interested in what effect bankruptcy has on the selection into one of the regimes. To summarize, the vectors of interest are:

(10)
$$X_{it} = [(Investmentrate)_{it-1}, GDPgrowthforecast, (\frac{turnover}{fixedassets})_{it}, (\frac{cashflow}{fixedassets})_{it}]$$

and

(11)
$$Z_{it} = [size, age, age^2, leverage, bankruptcy]$$

If investment-cash flow sensitivities are a good measure of financial constraints, we should be able to identify two regimes with different cash flow coefficients. The unconstrained regime should have a low investment-cash flow sensitivity, while the constrained regime should have a high investment-cash flow sensitivity. If we can

[24] As Hovakimian and Titman [2006] note, if β_1 is equal to β_2 and σ_{1u} equals to σ_{2u}, then ε_{1t} is equal to ε_{2t} and the likelihood function can be estimated using a standard normal density.

[25] Hu and Schiantarelli [1998] include in the set of balance sheet variables lagged values of the debt-to-market-value ratio $\left(\frac{D}{V}\right)_{it-1}$, interest rate to operating income ratio $\left(\frac{Int}{Y}\right)_{it-1}$, and liquid financial assets to capital $\left(\frac{liq}{Y}\right)_{it-1}$.

[26] SMEs are usually considered as the most vulnerable to credit constraints.

[27] Gersl and Jakubik [2010] find that in the Czech Republic small and young firms in technology- and knowledge-intensive industries tend to concentrate their credit needs in a single bank, whereas less creditworthy firms and firms in cyclical industries tend to borrow from more than one bank.

not identify these two regime, this is not a good measure of financial constraints.

IV. Data and data management

A. *Balance-sheet data*

We take the firms' balance-sheet data from the Albertina database.[28] This is a Czech database, containing financial and ownership structure information on major public and private companies in all sectors of economy in the Czech Republic.

The database is monthly updated and each version features only currently registered (existing) subjects, i.e. if any subject went successfully through the process of bankruptcy or liquidation concluded with the act of deregistration in the past, it will no longer be available in the most recent version of the database. Even though it is not unusual that the bankruptcy process takes several years, ignoring enterprises which went through a swift bankruptcy and already left the dataset can bias our results. In order to overcome the issue of entry and exit we obtained and combined historical versions of the database to capture the state of enterprises at the beginning of 2008, 2009, 2010, and 2011. Together with the data available at the beginning of 2013, these versions form the data source used in this study. The period covered by our dataset differs and depends on the particular firm.

For the needs of this analysis, the most relevant variables are book value of firm's total and fixed assets, employment, total liabilities, fixed assets, cash flow.

B. *Bankruptcy data*

We have also assembled original data on bankruptcy in the Czech Republic. This data is available only from 200. Therefore the part of our work with bankruptcy variable focuses on the subset of 2006-2010, while when we don't use bankruptcy, we analyse 2000-2010.

It is not a simple task to create a reliable measure of bankruptcy. The legal status provided in the Albertina database for every subject indicates whether the subject is healthy, is going (or went) through the bankruptcy process or is in

[28] Operated by Bisnode Ceska republika, a.s., www.albertina.cz. We would like to thank the Czech National Bank for access to this dataset.

liquidation. This attribute is supplemented with the date of the status change. However, in a number of cases no date was provided. Therefore, in order to fill in the missing observations, we extracted the date from a record from the Insolvency Register which is attached in the database to each subject having the bankruptcy status set. In cases when there were multiple dates of insolvency declaration in the Register, we used the most recent one. Such situation can arise if for example a declaration of insolvency was cancelled by a court due to some deficiencies in the insolvency proposal, and then followed by a revised proposal. The date extracted from the Register is given priority over the one provided in the database.

In a significant number of cases this process revealed serious inconsistencies. Sometimes, for example, bankruptcy was not declared by a court in the end, but it still appeared in the legal status of a firm in the database. Going through the details in the Insolvency Register allowed us to cleanse the data and remove all incorrect observations.

To get consistency in the data, the following subject are not used: Subjects in liquidation, subjects having no property when declaring insolvency, subjects with uncertain insolvency status, and subjects with unknown date of insolvency declaration.

Observations of subjects with insolvency status are included in the data set only before the declaration of insolvency. The result is an unbalanced panel.

C. Types of companies

We distinguish between three types of companies:

- "Healthy" companies did not go bankrupt during the studied period
- "Ever going bankrupt" companies go bankrupt during the studied period
- "Next year going bankrupt" companies go formally bankrupt during the next year[29]

D. Dependent variable

As a dependent variable, we have four measures of investment rate:

[29] As noted due to the lenght of the bankruptcy process, it makes more sense to assign the bankruptcy to the year just proceeding the year when a firm goes formally bankrupt

1) CAPEX[30] divided by beginning of period fixed assets

2) Percentage change of net fixed assets

3) Percentage change of net tangible assets[31]

4) Percentage change of net total assets

Therefore, to control for the fact that large firms invest more in absolute numbers, all measures of investment rate are in relative terms.

E. Data management

Our data management follows previous work in this field. We drop all companies, which do not have the fiscal year in line with the calendar year and all observations with missing employment data. Due to the source of the data (in majority the source are forms filled in by hand by employees of individual companies), we also exclude all zero observations. Evidence confirms that sometimes zero in fact means "no data". There is no way we can discriminate between these two possibilities. We also winsorise[32] large firms in top 1 percentile of employment. We drop the bottom and top percentile of year-on-year changes in investment rate and assets to avoid the influence of mergers and acquisitions, spin-offs etc. We exclude firms with less than 1000 CZK in total assets and drop all observations for which the balance sheet equation does not hold (i.e. assets do not equal liabilities and shareholders' funds). In some cases financial data for one year were provided from several sources for one subject. In order to remove these duplicities, the source with more filled-in information has been chosen.

We deflate all financial variables by respective producer price indices taken from EBRD.

[30] CAPEX can be defined as an expenditure to purchase or repair a fixed asset. These fixed assets have multi-year depreciation and are not expensed in a single tax year. CAPEX is what companies spend purchasing or upgrading fixed assets for future business benefit. We define CAPEX as the change of assets minus the change of liabilities.

[31] Change in tangible assets plus depreciation divided by previous period tangible assets

[32] Winsor takes the non-missing values of a variable and generates a new variable identical except that the n highest and n lowest values are replaced by the next value counting inwards from the extremes.

F. *Summary statistics*

This part summarizes the most important variables in our sample. Table 1 shows cross-correlations of our dependent variables. The correlation is always positive and statistically significant. From Figure IV.F we can see that after 2007 all measures of investment rate started to decline. This is in line with Figure 12, which depicts the gross capital formation in the country. We also present the distribution of observations, entities, and bankrupt entities according to NACE sector. We see that most bankruptcies happen in wholesale, retail trade, repair of motor vehicles. On the other hand firms in the following sectors: electricity, gas, steam supply, public administrations, health, social work activities did not go bankrupt at all. We can see a distinct behaviour in the investment of bankrupt and not bankrupt firms in the Czech Republic. Bankrupt firms in all years and for all measures of investment invest less than non-bankrupt. Moreover, next-year bankrupt companies also disinvest in all years (e.g. their investment rate is below zero). After the year 2007 we see a gradual decline of investment rate.

Table 1—Cross-correlations of dependent variables (2000-2010)

Variables	1.	2.	3.	4.
1. CAPEX over fixed assets	1.00			
2. % change in net fixed assets	0.23	1.00		
3. % change in net tangible assets	0.22	0.89	1.00	
4. % change in net total assets	0.46	0.41	0.38	1.00

Note: Number of observations: 314573. Significance of each correlation is printed under the cross-correlations in parentheses.

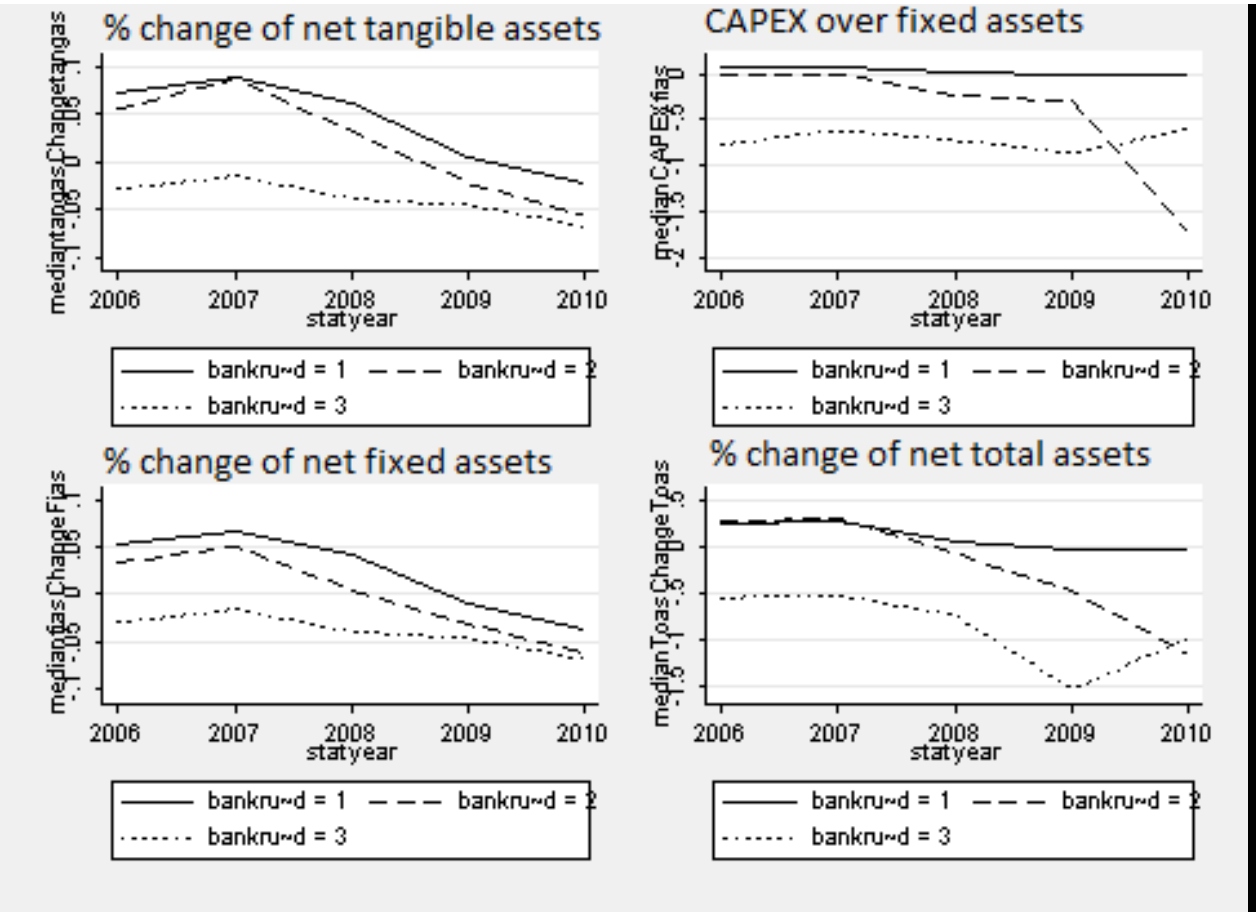

Figure 1. Evolution of investment rate for healthy and bankrupt companies

Note: This figure depicts medians of investment rates for all 3 types of firms. Bankruptcy dummy refers to: bankru d=1 - healthy companies, bankru d=2 - ever bankrupt companies, bankru d=3 - the next year bankrupt companies. We can see a distinct behaviour in the investment of bankrupt and not bankrupt firms in the Czech Republic. Bankrupt firms in all years and for all measures of investment invest less than non-bankrupt. Moreover, next-year bankrupt companies also disinvest in all years (e.g. their investment rate is below zero). After the year 2007 we see a gradual decline of investment rate.
Source: Amadeus, authors' calculations.

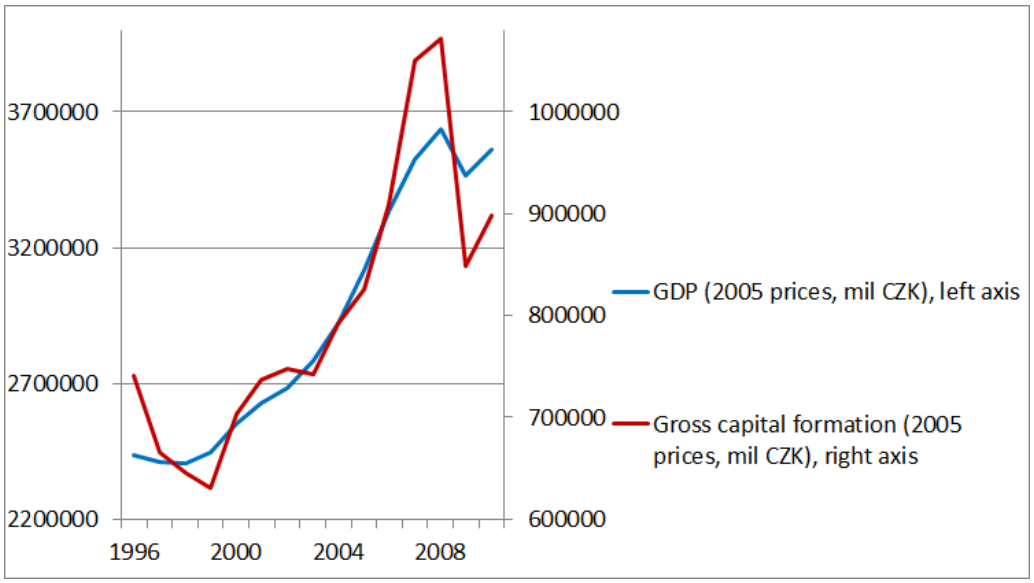

FIGURE 2. GROSS CAPITAL FORMATION AND GDP IN THE CZECH REPUBLIC

Note: We see a sharp decline in gross capital formation after 2008, which is clearly related to the financial crisis and related events.

Source: Czech Statistical Office. authors' calculation.

TABLE 2—SUMMARY STATISTICS: NUMBER OF OBSERVATIONS AND NUMBER OF BANKRUPTCIES

	observations		**bankruptcies in $t+1$**	
	No.	%	No.	%
2000	7,485	1.11		
2001	10,307	1.52		
2002	27,316	4.04		
2003	48,306	7.14		
2004	62,216	9.19		
2005	62,977	9.31		
2006	79,079	11.68	58	9.43
2007	94,471	13.96	101	16.42
2008	100,806	14.9	169	27.48
2009	102,584	15.16	161	26.18
2010	81,215	12	126	20.49
Total	676,762	100	615	100

Table 3—Summary statistics according to NACE Sector

NACE Sector	observations		entities		bankrupt entities	
	No.	%	No.	%	No.	%
Agriculture, forestry and fishing	21,042	3.11	3,988	2.59	17	2.76
Mining and quarrying	1,004	0.15	178	0.12	2	0.33
Manufacturing	101,307	14.97	19,670	12.78	160	26.02
Electricity, gas, steam and air-conditioning supply	2,973	0.44	648	0.42	0	0.00
Water supply, sewerage, waste management and remediation	5,265	0.78	1,098	0.71	5	0.81
Construction	58,581	8.66	13,272	8.62	78	12.68
Wholesale and retail trade, repair of motor vehicles and motorcycles	204,093	30.16	46,203	30.01	184	29.92
Transportation and storage	18,358	2.71	4,003	2.60	35	5.69
Accommodation and food service activities	22,598	3.34	5,744	3.73	32	5.20
Information and communication	22,716	3.36	5,219	3.39	16	2.60
Financial and insurance activities	4,371	0.65	906	0.59	4	0.65
Real estate activities	86,204	12.74	23,727	15.41	21	3.41
Professional, scientific and technical activities	86,337	12.76	19,676	12.78	43	6.99
Administrative and support service activities	17,797	2.63	3,981	2.59	9	1.46
Public administration and defence, compulsory social security	57	0.01	9	0.01	0	0.00
Education	6,174	0.91	1,431	0.93	2	0.33
Human health and social work activities	6,031	0.89	1,467	0.95	0	0.00
Arts, entertainment and recreation	7,752	1.15	1,717	1.12	3	0.49
Other services	4,102	0.61	1,038	0.67	4	0.65
Total	676,762	100	153,975	100	615	100

Table 4 summarizes balance sheet items of our interest in the final dataset. We show that basic statistics for the whole sample (2000-2010), healthy and bankrupt companies (2006-2010). We see structural difference between companies going bankrupt. For example, next-year going bankrupt companies have negative cash flow, smaller fixed assets, and are older than an overage company in the sample. Bankrupt companies also have higher bank loans. Healthy companies are smaller, with positive cash flow and lower bank loans.

We find that firms that firms going bankrupt have a different investment behaviour. Specifically, in all years bankrupt companies invested less, cash flow of bankrupt companies was negative.[33], while bank loans higher than for healthy companies. We can conclude that firms with negative cash flow are on their path to bankruptcy.

[33]Negative cash-flow means that cash inflow from sales is lower that cash outflow of cash payments. The common reasons for negative cash-flow are

Table 4—Summary statistics of relevant variables for the whole sample 2000-2010, healthy and bankrupted firms (2006-2010)

Variable	Sample	Mean	Std. Dev.	N
	whole sample	23518.878	61513.776	676762
Total Assets	healthy	20391.252	55060.971	453684
	ever bankrupted	31123.62	70897.026	4471
	next year bankrupted	18961.745	48753.981	615
	whole sample	20.043	82.67	676762
Employees	healthy	16.317	70.14	453684
	ever bankrupted	29.146	64.357	4471
	next year bankrupted	24.39	62.306	615
	whole sample	9181.716	26788.908	676762
Fixed Assets	healthy	8026.354	24040.527	453684
	ever bankrupted	9296.447	25309.596	4471
	next year bankrupted	7026.84	22051.168	615
	whole sample	2090.451	17519.64	676762
Cash Flow	healthy	1952.514	11203.148	453684
	ever bankrupted	-1927.659	38383.52	4471
	next year bankrupted	-9107.859	98712.209	615
	whole sample	8.141	6.233	676762
Age	healthy	8.552	5.655	453684
	ever bankrupted	8.355	5.311	4471
	next year bankrupted	8.899	5.785	615
	whole sample	1745.292	24880.486	676762
Bank loans	healthy	1446.363	11189.614	453684
	ever bankrupted	4833.636	20415.591	4471
	next year bankrupted	3659.014	19207.703	615

Note: We see structural difference between companies going bankrupt. For example, next-year going bankrupt companies have negative cash flow, smaller fixed assets, and are older than an overage company in the sample. Bankrupt companies also have higher bank loans. Healthy companies are smaller, with positive cash flow and lower bank loans.
Source: Authors' calculations

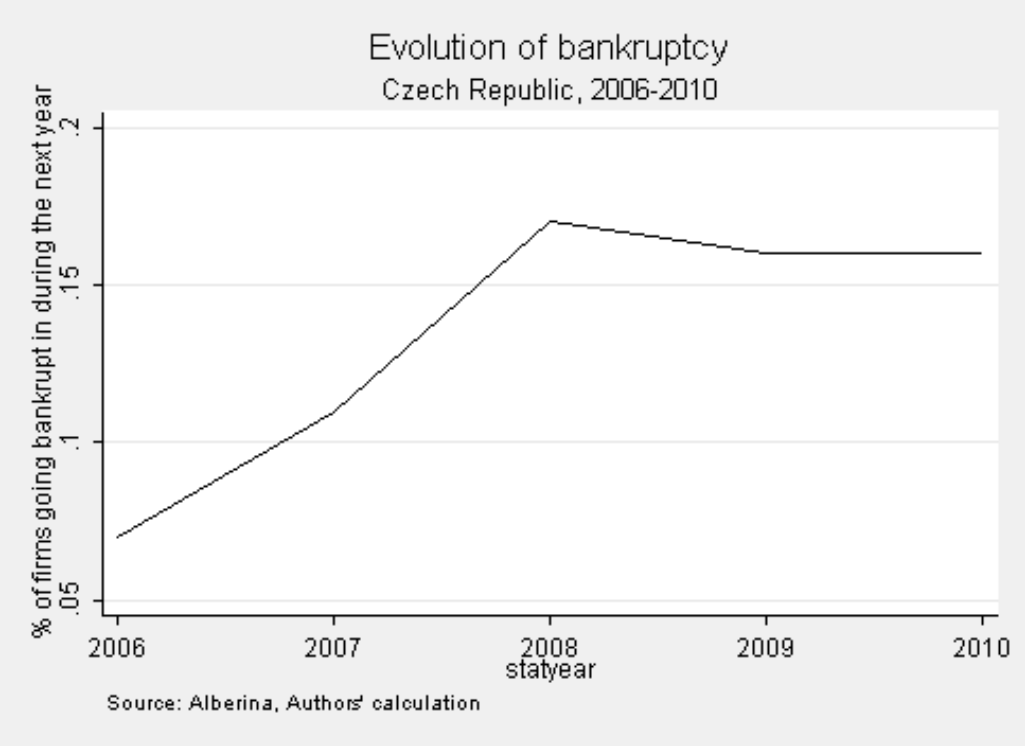

FIGURE 3. EVOLUTION OF BANKRUPTCY IN THE CZECH REPUBLIC

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Note: This figure depicts share of bankrupt companies on total companies in the sample for the particular year. Bankrupt companies go bankrupt during the immediate following year of depicted figure. We see an increase of bankruptcy in 2008, which depicts firms that will go formally bankrupt during 2009. The correlation between credit restriction and bankruptcy is clearly visible (see Figure 12)

Source: Albertina, authors' calculations.

G. Survey data

To assess financial constraints, often, surveys are used as a useful quick and cost-efficient tool.[34] Before we start with the microeconometric analysis, we therefore focus on three surveys to illustrate how much of an obstacle finance is to firms in the Czech Republic.[35]

[34]See for example, the European Central Bank http://www.ecb.int/stats/money/surveys/sme/html/index.en.html, or the European Commission http://ec.europa.eu/enterprise/policies/finance/data/index_en.htm#h2-2 or http://ec.europa.eu/enterprise/policies/finance/data/enterprise-finance-index/sme-access-to-finance-index/index_en.htm

[35]In a similar fashion, Kaplan and Zingales [1997] examine firms' annual reports and read the management's liquidity needs that should describe the needs for funds. From that the Kaplan-Zingales critique

1. Czech Statistical Office Survey

First, we analyse data from the Czech Statistical Office that regularly publishes a report on the barriers to growth in the Czech Republic. This survey takes place every month and focuses on the qualitative self-assessment of companies' barriers in the economy.

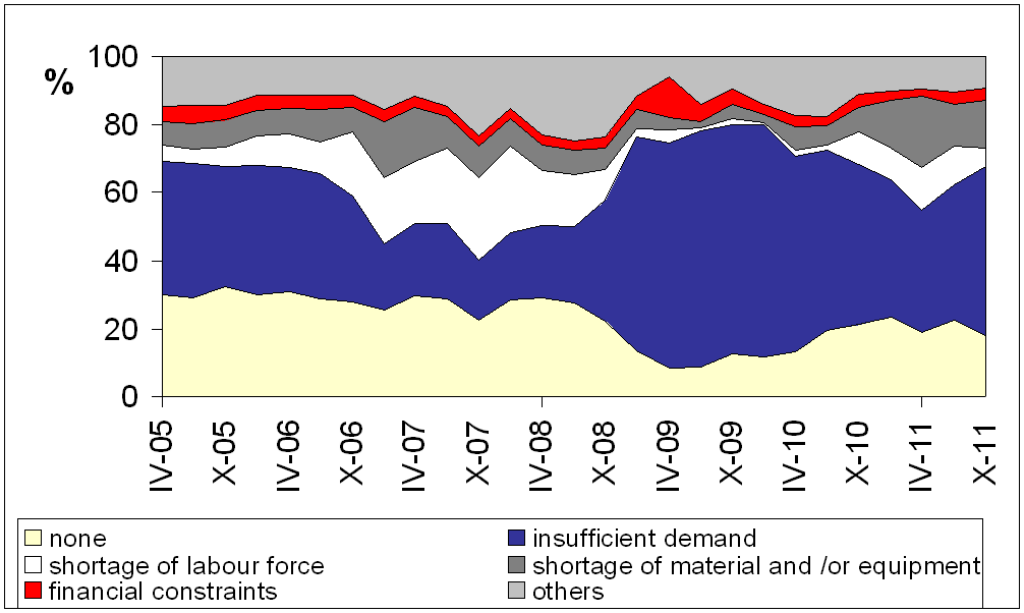

Figure 4. Barriers to growth in industry. Data for the Czech Republic.

Note: The development of the barriers to growth in industry in the Czech Republic. Relative importance of financial constraints has not increased after 2008. There was only temporary increase in financial constraints after the fall of Lehman Brothers in September 2008. We can, however, see that insufficient demand started to play a crucial role as a barrier to growth in industry.

Source: Czech Statistical office, authors' calculations.

We plot the results of this survey in Figure 4 and we see that finance (the red shaded area in the figure) does not appear to constrain companies in their growth.[36] Surprisingly, neither the 2008 crisis seems to make a significant change to the development as there was only a relatively small and temporary increase after summer 2008. But we see a significant increase in the "insufficient demand" barrier (blue shaded area in the figure 4).

emanates.

[36] For the time series for firms in services, see Appendix

This qualitative assessment would support the view that the sharp reduction in credit provision (see Figure 12) was demand rather than supply driven. Respectively, even though there was a dramatic decline of credit, these survey data suggest that the decline was more likely due to insufficient demand on the goods market and not on the credit market. Simply put, as firms went through a period of higher uncertainty on the goods market, they demanded less credit. In that case, we can not speak of a credit crunch. To be more specific, if we observe a large decline in credit, while firms do not increasingly perceive finance as an obstacle to their growth then the credit decline was most likely demand driven (firms demanded less credit, perhaps due to higher uncertainty in the economy and insufficient demand).

On the other hand, we have to interpret these findings with caution because the answers capture only the relative importance of the barriers and not their size. The near-stability of the financial constraints barrier only means that the number of firms perceiving it as one of the two most important barriers to growth did not change. The result does not imply anything about the size of the barrier itself.

2. Czech National Bank Survey

The second survey comes from the Czech National Bank and it was carried out in June 2009 among 399 Czech companies with the goal to shed more light on the issue of size of the constraints. Czech companies were asked to what extent did the 2008 crisis present itself in each of the following areas: decrease of the demand for products or services; difficulties in financing of the activities through the usual channels; difficulties due to the payments from the customers; difficulties in obtaining intermediate goods from the usual suppliers. The share of companies which answered the question about the extent of difficulties in financing with "exceptionally strongly" and "strongly" was 27.2%. Due to the non-existence of a comparable survey in the pre-crisis period, we cannot be sure that these difficulties were truly caused by the crisis. The results indicate that financial constraints did play a considerable role during the crisis.

3. Business Environment and Enterprise Performance Survey (BEEPS)

Third survey we analyse is the Business Environment and Enterprise Performance Survey (BEEPS) published regularly by the World Bank and the European Bank for Reconstruction and Development (EBRD).[37] In this survey, among other topics, managers of businesses report on what the biggest constraints they face are in running their company, including the role finance plays. The data therefore allow for an analysis of subjective financial constraints. The BEEPS data have already been used in a similar context, e.g. by Brown, Jappelli, and Pagano [2009] to analyse credit rationing; however, they have rarely been used in combination with balance sheet data because no data allowing identification of the surveyed companies are published[38]. The survey results show that for 23% of Czech companies, finance was the biggest constraint for their economic growth in 2009 (see Figure 5).[39] In appendix we show that financial constraints remain relatively stable between 2002 and 2009 in the Czech Republic[40].

Analysing the three types of survey, we conclude this part that finance is an obstacle for firms in the Czech Republic. It will be interesting to observe how financial constraints developed in the next wave of the BEEPS data.

V. Regression results

The following part describes the regression results, plots investment-cash flow sensitivities to see whether any change can be observed after the 2008. We show that either there was no increase in financial constraints after 2008 or investment-cash flow sensitivities are not sufficient for their identification. We also show results of the endogenous switching regresssion.

A. Quantile regression

First, we show results of the bootstrapped quantile regression. We use quantile regression especially suitable for heteroskedastic data with significant outliers as

[37] There have already been four rounds of the BEEPS survey (1999, 2002, 2005, and 2009). Data from the next round are expected to be available in late 2013.

[38] BEEPS have the advantage of allowing for the control of heterogeneity at the firm level. The notable exception of linking BEEPS and balance-sheet (Amadeus) data is Kochanova [2012]

[39] It is important to note that BEEPS 2009 was effectively surveyed in 2008 asking about the fiscal year 2007. Therefore, crisis was not yet a part of the survey. First set of post-2008 data is expected to be published in 2013.

[40] while they increased dramatically in Russia, for example

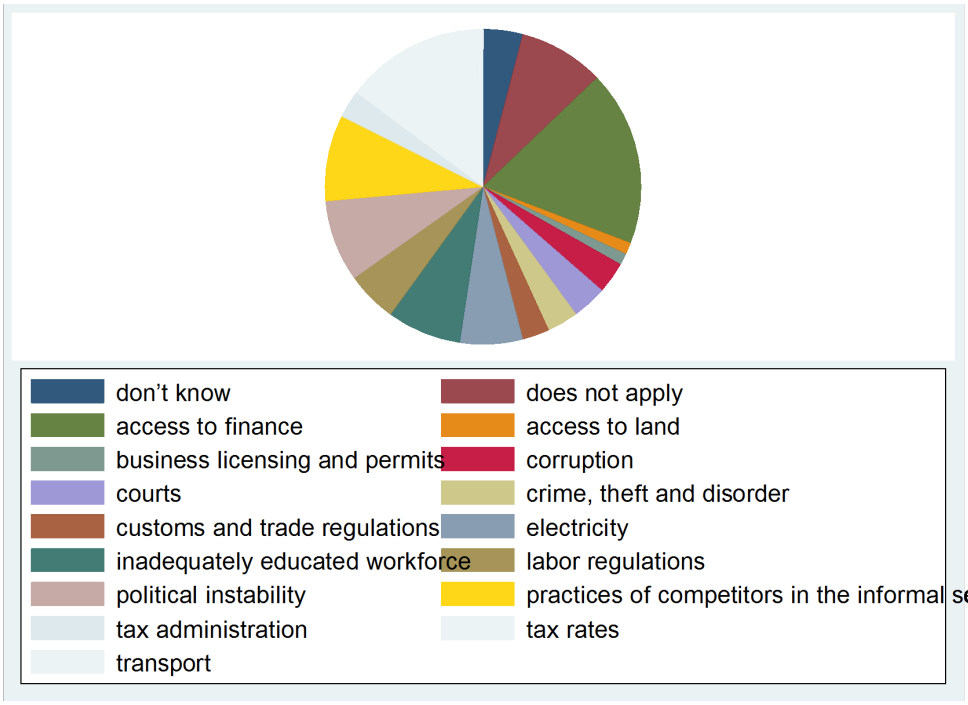

FIGURE 5. BIGGEST OBSTACLES IN RUNNING A BUSINESS. BEEPS DATA FOR THE CZECH REPUBLIC.

Note: For 23% of Czech companies, finance is the biggest constraint for their business growth. The specific question in the survey is 'Which of the following elements of the business environment, if any, currently represents the biggest obstacle faced by this establishment.'
Source: EBRD-World Bank Business Environment and Enterprise Performance Survey (BEEPS), 2009.

it is in our case. Quantile regression estimates are more robust against outliers in the response measurements.

Bootstrapped quantile regressions consistently show that We show that cash flow positively affects investment rates. A part of literature in this field would conclude from this result that there was credit rationing in the Czech Republic. We argue that (assuming there was an increase in financial constraints after 2008) we need to see an increase in investment-cash flow sensitivities. Otherwise, positive cash flow in the investment equation can not lead to a conclusion that there was credit rationing.

From quantile regression results we can see that lagged investment rate is not a strong predictor of investment rate, while turnover and investment opportunities

are positive and stasticically significant in all investment equations.

Both measures of bankruptcy have a negative and significant impact on investment rate. Interestingly, a dummy for being ever going bankrupt has a larger negative effect than a dummy for firms that will go the next year.

B. Plot of Investment-cash flow sensitivities

In this part, we focus on the development of investment-cash flow sensitivities before and after 2008. As mentioned, if we believe that firms have exhibited a severe credit crunch after 2008, we expect the cash-flow sensitivities (as a measure of financial contraints) to increase dramatically after 2008.

We plot our data within a moving 1-year window and we store a specified coefficient from the model for each sample. As we can see from Figure 6 for example, the investment-cash flow sensitivities have not increased after 2008 no matter how we define the investment rate.

Another way to test for the validity of the investment-cash flow sensitivities is to look at the behaviour of companies that will go and that will not go bankrupt Perhaps, investment-cash flow sensitivities increased only for companies going bankrupt. To test this hypothesis we run the same exercise only for companies going bankrupt. Figure 10 and figure 11 plot these sensitivites for both types of bankrupt companies. Again, we do not see an increase in invesment-cash flow elasticities after 2008.

To conclude this part, together with Chen and Chen [2011] we claim that linear investment-cash flow sensitivities in their linear form are not a good way to measure financial constraints.

C. Endogenous switching regression with unknown sample separation

In the previous part we showed that investment-cash flow sensitivities did not increase after 2008. This means that either there was not an increase in financial constraints (which is unlikely) or that investment cash-flow sensitivities in their linear form are not a good measure of financial constraints. In this part, we try to identify two separate investment regimes. If investment-cash flow sensitivities are a good measure of financial constraints we should be able to identify two regimes that differ in investment-cash flow sensitivities.

Table 5—Bootstrapped quantile regression - investment rate: CAPEX over beginning of period fixed assets

	Unbalanced 2000-2010	Unbalanced 2006-2010	Unbalanced 2006-2010
Lagged investment rate	-0.00000129***	0.00000157	0.00000149
	(0.000000132)	(0.00000323)	(0.00000656)
turnover/(fixed assets)	0.0931***	0.0582***	0.0582***
	(0.00337)	(0.0143)	(0.0193)
Cash flow/(fixed assets)	0.0986***	0.0898***	0.0898***
	(0.0172)	(0.0151)	(0.00836)
Investment opportunities	0.00576***	0.00611***	0.00589***
	(0.000141)	(0.0000790)	(0.000193)
Next year going bankrupt		-0.127***	
		(0.00232)	
Ever going bankrupt			-0.592***
			(0.0323)
Constant	-0.0335***	-0.0280***	-0.0288***
	(0.00346)	(0.00245)	(0.00287)
Observations	252805	203561	203561

Note: The table shows results for the bootstrapped quantile regresssion. We use quantile regression estimates because are more robust against outliers in the response measurements. It depicts estimated coefficient on cash-flow in four investment equations for ever going bankrupt companies. A Stata command *qreg* fits quantile (in our case median) regression models, also known as least-absolute-value models. The quantile regression models fit by *qreg* express the quantiles of the conditional distribution as linear functions of the independent variables. We use *bsqreg*, which is a bootstrapped version of *qreg*. We obtain bootstrapped standard errors that assume independence over firms but do not require identical distribution. Dependent variables (investment rate) is depicted in the title. Explanatory variables are: lagged investment rate, turnover over beginning of period fixed assets, and estimated GDP growth as a proxy for investment opportunities. Year and industry fixed effects are included, errors are bootstrapped. The coefficient of cash flow over beginning of period fixed assets is positive and significant. Both types of bankrupt companies have significantly lower investment rate. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6—Bootstrapped quantile regression - investment rate: % change in net fixed assets

	Unbalanced 2000-2010	Unbalanced 2006-2010	Unbalanced 2006-2010
Lagged investment rate	0.000000615	0.000000647*	0.000000675
	(0.000000457)	(0.000000351)	(0.00000151)
turnover/(fixed assets)	0.0662***	0.0662***	0.0662***
	(0.000000411)	(0.0159)	(0.000000385)
Cash flow/(fixed assets)	0.000933***	0.000748***	0.000749***
	(0.0000763)	(0.0000937)	(0.0000260)
Investment opportunities	0.00346***	0.00367***	0.00361***
	(0.000221)	(0.000117)	(0.000169)
Next year going bankrupt		-0.0396***	
		(0.00247)	
Ever going bankrupt			-0.0830***
			(0.00310)
Constant	0.0550***	0.0619***	0.0617***
	(0.000830)	(0.00392)	(0.000735)
Observations	223035	177523	177523

Note: The table shows results for the bootstrapped quantile regresssion. We use quantile regression estimates because are more robust against outliers in the response measurements. It depicts estimated coefficient on cash-flow in four investment equations for ever going bankrupt companies. A Stata command *qreg* fits quantile (in our case median) regression models, also known as least-absolute-value models. The quantile regression models fit by *qreg* express the quantiles of the conditional distribution as linear functions of the independent variables. We use *bsqreg*, which is a bootstrapped version of *qreg*. We obtain bootstrapped standard errors that assume independence over firms but do not require identical distribution. Dependent variables (investment rate) is depicted in the title. Explanatory variables are: lagged investment rate, turnover over beginning of period fixed assets, and estimated GDP growth as a proxy for investment opportunities. Year and industry fixed effects are included, errors are bootstrapped. The coefficient of cash flow over beginning of period fixed assets is positive and significant. Both types of bankrupt companies have significantly lower investment rate. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7—Bootstrapped quantile regression - investment rate: % change in net tangible assets

	Unbalanced 2000-2010	Unbalanced 2006-2010	Unbalanced 2006-2010
Lagged investment rate	-0.00000229***	-0.00000208***	-0.00000207***
	(4.52e-08)	(0.000000251)	(4.86e-09)
turnover/(fixed assets)	0.636***	0.807***	0.806***
	(0.0373)	(0.238)	(0.101)
Cash flow/(fixed assets)	0.00763***	0.00611***	0.00606***
	(0.00226)	(0.00198)	(0.00203)
Investment opportunities	0.00333***	0.00350***	0.00346***
	(0.0000242)	(0.0000321)	(0.000117)
Next year going bankrupt		-0.0386***	
		(0.000340)	
Ever going bankrupt			-0.0705***
			(0.00754)
Constant	0.0605***	0.0670***	0.0668***
	(0.000891)	(0.000511)	(0.00164)
Observations	212745	169192	169192

Note: The table shows results for the bootstrapped quantile regresssion. We use quantile regression estimates because are more robust against outliers in the response measurements. It depicts estimated coefficient on cash-flow in four investment equations for ever going bankrupt companies. A Stata command *qreg* fits quantile (in our case median) regression models, also known as least-absolute-value models. The quantile regression models fit by *qreg* express the quantiles of the conditional distribution as linear functions of the independent variables. We use *bsqreg*, which is a bootstrapped version of *qreg*. We obtain bootstrapped standard errors that assume independence over firms but do not require identical distribution. Dependent variables (investment rate) is depicted in the title. Explanatory variables are: lagged investment rate, turnover over beginning of period fixed assets, and estimated GDP growth as a proxy for investment opportunities. Year and industry fixed effects are included, errors are bootstrapped. The coefficient of cash flow over beginning of period fixed assets is positive and significant. Both types of bankrupt companies have significantly lower investment rate. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8—Bootstrapped quantile regression - investment rate: % change in net total assets

	Unbalanced 2000-2010	Unbalanced 2006-2010	Unbalanced 2006-2010
Lagged investment rate	-0.00000325	-0.00000325	-0.00000320
	(0.0000640)	(0.0000567)	(0.0000201)
turnover/(fixed assets)	0.301***	0.301	0.301***
	(0.0641)	(0.393)	(0.00450)
Cash flow/(fixed assets)	0.109***	0.0994***	0.0994***
	(0.0332)	(0.0221)	(0.00451)
Investment opportunities	0.0190***	0.0197***	0.0195***
	(0.000276)	(0.000614)	(0.000450)
Next year going bankrupt		-0.159***	
		(0.000200)	
Ever going bankrupt			-0.795***
			(0.0941)
Constant	0.0175	0.0283***	0.0276***
	(0.0113)	(0.00696)	(0.00629)
Observations	223035	177523	177523

Note: The table shows results for the bootstrapped quantile regresssion. We use quantile regression estimates because are more robust against outliers in the response measurements. It depicts estimated coefficient on cash-flow in four investment equations for ever going bankrupt companies. A Stata command *qreg* fits quantile (in our case median) regression models, also known as least-absolute-value models. The quantile regression models fit by *qreg* express the quantiles of the conditional distribution as linear functions of the independent variables. We use *bsqreg*, which is a bootstrapped version of *qreg*. We obtain bootstrapped standard errors that assume independence over firms but do not require identical distribution. Dependent variables (investment rate) is depicted in the title. Explanatory variables are: lagged investment rate, turnover over beginning of period fixed assets, and estimated GDP growth as a proxy for investment opportunities. Year and industry fixed effects are included, errors are bootstrapped. The coefficient of cash flow over beginning of period fixed assets is positive and significant. Both types of bankrupt companies have significantly lower investment rate. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

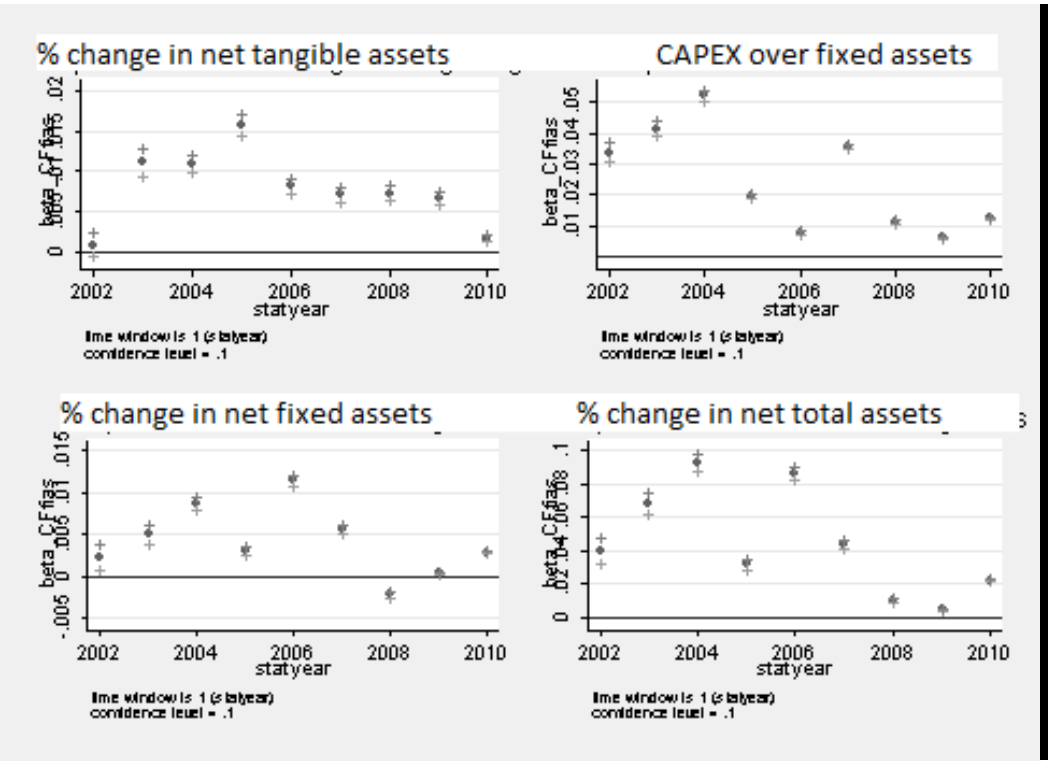

FIGURE 6. PLOT OF ESTIMATED COEFFICIENT OF CASH FLOW IN THE BOOTSTRAPPED QUANTILE REGRESSION, UNBALANCED PANEL 2000-2010

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Note: The figure depicts estimated coefficient on cash-flow in four investment equations for all companies. We use a user-written Stata command $COEFF_TS$ that estimates a sequence of regressions for time series or panel data. Dependent variables are four different measures of investment rate. Explanatory variables are: lagged investment rate, turnover over beginning of period fixed assets, and estimated GDP growth as a proxy for investment opportunities. Year and industry fixed effects are included. The depicted coefficient of cash flow over beginning of period fixed assets has not increased after 2008 for ever going bankrupt companies. Therefore, either there was no increase in financial constraints for bankrupt companies or investment-cash flow sensitivities are not a good measure of financial constraints.[Source] Authors' calculations.
Source: Albertina, authors' calculations.

Also, if there is a link between bankruptcy, cash flow and investment rates, we would expect bankruptcy to play a role in the selection equation and cash flow that would influence investment rates in different magnitudes.

We estimated our endogenous switching regression for 2006-2010, which is a time span for which we have reliable data on bankruptcy. Due to lags in the equation, the initial year is lost for estimation.[41]

Using the endogenous switching regression with unknown sample separation[42].

We identify two regimes, which differ in their determinants of investment rate. In the Unconstrained regime (Regime I or II depending on the investment rate), firms are more responsive to investment opportunities. Older and larger firms, with lower leverage have higher probability of being in the unconstrained regime. In most cases, future bankruptcy reduces the probability of being in unconstrained regime. Next year going bankrupt companies have a lower probability of being in the unconstrained investment regime. Finally, investment-cash flow sensitivities do not correspond to constrained and unconstrained regimes. We conclude that investment-cash flow sensitivity cannot be a good measure of financial constraints.

Switching regressions 1A-4A use different definitions of investment rates. Age, total and current assets, together with leverage and future bankruptcy play a role for the decision in which of the two regimes the firm endogenously switches.[43]

VI. Conclusion

In this paper, we empirically studied the relation between investment, cash flow, and bankruptcy in a post-transition country with underdeveloped financial markets. We looked on the evolution of investment with respect to credit constraints. Our paper is interesting in linking balance sheet microdata with original bankruptcy data, which allows us to study the evolution of firms' behaviour and

[41] We report results after 200 iterations. We account for time-invariant unobserved heterogeneity at the country/industry level, by means of controlling for country and industry fixed effects (not reported).

[42] We use stata command *Switchr*, which calculates switching regression estimates for a two-component model in which observations are drawn from two different regression regimes and separation into the separate regimes is unobserved. Such a situation is also called a mixture model. We are aware of several caveats in using this method. First, switching regressions of this sort are valid only when errors are independent, and identically distributed. The independence of errors across equations can be a strong assumption. Second, standard errors are not exact, and will in general be biased downward. Finally, convergence is not monotonic in the convergence criterion measure (relative change in the coefficient estimates. See `http://fmwww.bc.edu/repec/bocode/s/switchr.hlp`). Therefore, it is prudent to be conservative in the convergence criterion.

[43] Annex presents equations 1B-4B that replace the bankruptcy dummy (=1 if ever go bankrupt) with bankruptcy dummy (=1 next year going bankrupt). The main results remain unchanged.

Table 9—Endogenous Switching Regression with Unknown Sample Separation 1A

Investment rate: Capital expenditure over fixes assets		
	Coefficient	S.E.
Selection equation		
Age	0.0695954***	0.000207
Age square	-0.0017918***	7.81E-06
Total assets	-0.00000684***	1.61E-08
Current assets	0.00000806***	2.18E-08
Leverage	-0.1204358***	0.001826
Ever going bankrupt	0.2358396***	0.010749
Industry FE	YES	
Year FE	YES	
R-squared	**0.7692**	
Number of observations	203560	
Regime I: Unconstrained		
Lagged investment rate	-0.000987	0.001124
Turnover/(fixed assets)	0.1702062***	0.042943
Investment opportunities	0.0995369***	0.014843
Cash flow/(fixed assets)	0.0067873***	0.001453
Industry FE	YES	
Year FE	YES	
R-squared	**0.0776**	
Regime II: Constrained		
Lagged investment rate	-0.00000973	4.33E-05
Turnover/(fixed assets)	-0.0043429	1.81E-02
Investment opportunities	0.0375203***	2.61E-03
Cash flow/(fixed assets)	0.4608444***	3.97E-03
Industry FE	YES	
Year FE	YES	
R-squared	**0.7186**	

Note: The table shows results for endogenous switching regression with unknown sample separation. We use this econometric method to avoid the problem of arbitrary a priori assignment of firms to constrained and unconstrained groups. A Stata command *switchr* calculates switching regression estimates for a two-component model in which observations are drawn from two different regression regimes, but separation into the separate regimes is unobserved. Dependent variables (investment rate) is depicted in the title. Older and bigger companies with lower leverage have a higher probability of being in unconstrained regime. The role of bankruptcy remains unclear.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10—Endogenous Switching Regression with Unknown Sample Separation 1B

Investment rate: % change in net fixed assets		
	Coefficient	S.E.
Selection equation		
Age	0.0105308***	0.000373
Age square	0.0009755***	1.38E-05
Total assets	0.00000142***	2.9E-08
Current assets	0.000000307***	3.91E-08
Leverage	-0.1132906***	0.003562
Ever going bankrupt	1.496216***	0.020921
Industry FE	YES	
Year FE	YES	
R-squared	**0.4982**	
Number of observations	177523	
Regime I: Unconstrained		
Lagged investment rate	-0.0000125	5.93E-06
Turnover/(fixed assets)	0.0372718***	0.012675
Investment opportunities	0.008679***	0.000871
Cash flow/(fixed assets)	0.0002004	0.000144
Industry FE	YES	
Year FE	YES	
R-squared	**0.0199**	
Regime II: Constrained		
Lagged investment rate	-0.0459297***	5.77E-03
Turnover/(fixed assets)	0.3774318***	3.62E-02
Investment opportunities	-0.0487461	3.36E-02
Cash flow/(fixed assets)	-0.0002332	3.31E-04
Industry FE	YES	
Year FE	YES	
R-squared	**0.0811**	

Note: The table shows results for endogenous switching regression with unknown sample separation. We use this econometric method to avoid the problem of arbitrary a priori assignment of firms to constrained and unconstrained groups. A Stata command *switchr* calculates switching regression estimates for a two-component model in which observations are drawn from two different regression regimes, but separation into the separate regimes is unobserved. Dependent variables (investment rate) is depicted in the title. Older and bigger companies with lower leverage have a higher probability of being in unconstrained regime. The role of bankruptcy remains unclear.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11—Endogenous Switching Regression with Unknown Sample Separation 2A

Investment rate: % change in tangible assets		
	Coefficient	S.E.
Selection equation		
Age	-0.0087825***	0.0003906
Age square	-0.0008496***	0.0000143
total assets	-0.00000187***	0.00000003
Current assets	0.000000822***	4.04E-08
Leverage	0.1233217***	0.0039341
Ever going bankrupt	-0.2431837***	0.0236217
Industry FE	YES	
Year FE	YES	
R-squared	**0.4856**	
Number of observations	169191	
Regime I: Constrained		
Lagged investment rate	0.0135841***	0.003808
Turnover/(fixed assets)	0.4421361***	0.0362269
Investment opportunities	0.023723	0.0328341
Cash flow/(fixed assets)	0.0011461***	0.000408
Industry FE	YES	
Year FE	YES	
R-squared	**0.067**	
Regime II: Unconstrained		
Lagged investment rate	-0.0000000577	1.78E-05
Turnover/(fixed assets)	0.2062792***	5.32E-02
Investment opportunities	0.0099367***	9.60E-04
Cash flow/(fixed assets)	0.0018662***	4.94E-04
Industry FE	YES	
Year FE	YES	
R-squared	**0.0445**	

Note: The table shows results for endogenous switching regression with unknown sample separation. We use this econometric method to avoid the problem of arbitrary a priori assignment of firms to constrained and unconstrained groups. A Stata command *switchr* calculates switching regression estimates for a two-component model in which observations are drawn from two different regression regimes, but separation into the separate regimes is unobserved. Dependent variables (investment rate) is depicted in the title. Older and bigger companies with lower leverage have a higher probability of being in unconstrained regime. The role of bankruptcy remains unclear.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12—Endogenous Switching Regression with Unknown Sample Separation 1D

Investment rate: % change in net total assets		
	Coefficient	S.E.
Selection equation		
Age	0.0451656***	0.000205
Age square	-0.0003919***	7.57E-06
Total assets	0.0000000705***	1.59E-08
Current assets	-0.00000171***	2.15E-08
Leverage	-0.4113991***	0.002269
Ever going bankrupt	-0.0241413	0.011478
Industry FE	YES	
Year FE	YES	
R-squared	**0.8012**	
Number of observations	177520	
Regime I: Unconstrained		
Lagged investment rate	-0.0006502***	0.000181
Turnover/(fixed assets)	-0.2827507***	0.099137
Investment opportunities	0.1403489***	0.013497
Cash flow/(fixed assets)	0.0091742	0.003599
Industry FE	YES	
Year FE	YES	
R-squared	**0.0158**	
Regime II: Constrained		
Lagged investment rate	0.0000678	0.000182
Turnover/(fixed assets)	0.7975204***	0.296908
Investment opportunities	0.1985421***	0.01324
Cash flow/(fixed assets)	0.7865068***	0.012522
Industry FE	YES	
Year FE	YES	
R-squared	**0.4818**	

Note: The table shows results for endogenous switching regression with unknown sample separation. We use this econometric method to avoid the problem of arbitrary a priori assignment of firms to constrained and unconstrained groups. A Stata command *switchr* calculates switching regression estimates for a two-component model in which observations are drawn from two different regression regimes, but separation into the separate regimes is unobserved. Dependent variables (investment rate) is depicted in the title. Older and bigger companies with lower leverage have a higher probability of being in unconstrained regime. The role of bankruptcy remains unclear.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

their reaction to the 2008 crisis from a new perspective. We wanted to answer whether the sharp drop of investment after the year 2008 was related to credit rationing. We showed that investment-cash flow sensitivities did not increase after 2008 and in their linear form are not a good measure of financial constraints. Using endogenous switching regression methodology with unknown sample separation we identified two investment regimes. We conclude that: 1) There is a relation between bankruptcy, cash flow, and investment. Bankrupted companies have significantly lower cash flow, lower investment rates, and higher bank loans than healthy companies. 2) Investment-cash flow sensitivities have not increased after 2008. Also, investment-cash flow sensitivities do not correspond to constrained and unconstrained regimes. Investment-cash flow sensitivity cannot be a good measure of financial constraints. 3) Older and bigger companies with lower leverage have a higher probability of being in unconstrained regime. Next year going bankrupt companies have a lower probability of being in the unconstrained investment regime.

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VII. Appendix

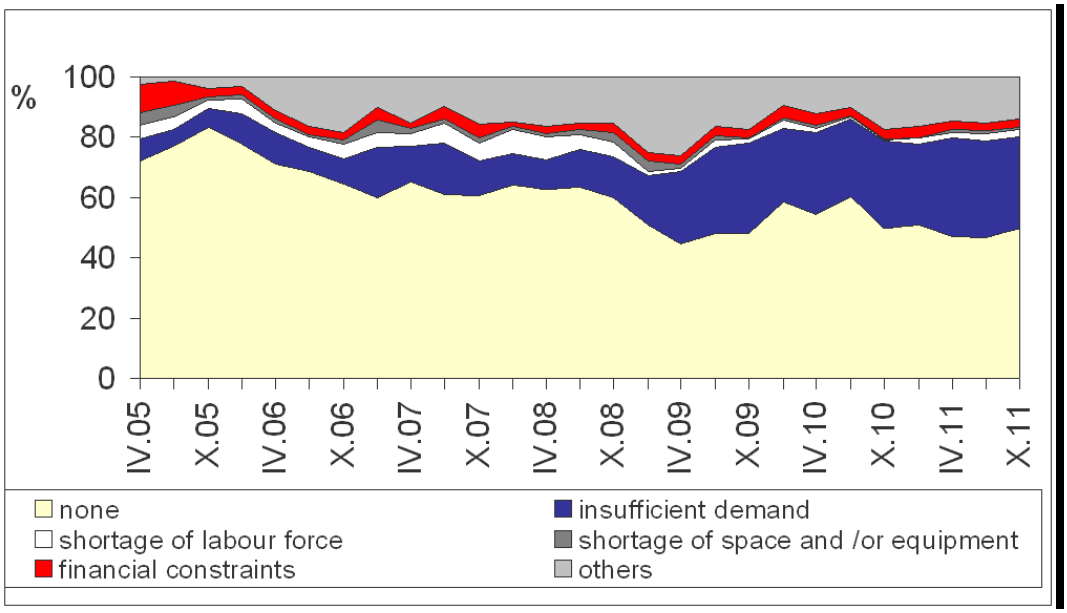

FIGURE 7. BARRIERS TO GROWTH IN SERVICES. DATA FOR THE CZECH REPUBLIC

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Note: The development of the barriers (limits) to growth in services in the Czech Republic. Finance is not among two biggest constraints to business growth.

Source: Czech Statistical office, authors' calculations.

A. *Derivation of the Euler Equation*

Here we derive the Euler Equation of the firm's problem.

Following Poncet et al. [2010], Moreno Badia and Slootmaekers [2009], Gilchrist and Himmelberg [1999], and Harrison, Love, and McMillan [2004][44] we can define the value of the firm as

[44]Our work also draws inspiration from the literature on credit rationing and capital market imperfections (Harrison et al. [2004] for example).
Recently, Janda [2011] modeled credit guarantees and interest rate subsidies in a framework of credit rationing.

Table 13—Endogenous Switching Regression with Unknown Sample Separation 2A

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Selection equation		
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Total assets	-0.0000068***	1.61E-08
Current assets	0.00000802***	2.18E-08
Leverage	-0.1172743***	0.001829
Next year bankrupt	-0.2028469***	0.004093
Industry FE	YES	
Year FE	YES	
R-squared	**0.7691**	
Number of observations	203560	
Regime I: Unconstrained		
Lagged investment rate	-0.0009865	0.001125
Turnover/(fixed assets)	0.170183***	0.042938
Investment opportunities	0.0993689***	0.014791
Cash flow/(fixed assets)	0.0067871***	0.001453
Industry FE	YES	
Year FE	YES	
R-squared	**0.0776**	
Regime II: Constrained		
Lagged investment rate	-0.00000979	4.33E-05
Turnover/(fixed assets)	-0.0042858	1.81E-02
Investment opportunities	0.0375471***	2.61E-03
Cash flow/(fixed assets)	0.4608754***	3.97E-03
Industry FE	YES	
Year FE	YES	
R-squared	**0.7187**	

Note: The table shows results for endogenous switching regression with unknown sample separation. We use this econometric method to avoid the problem of arbitrary a priori assignment of firms to constrained and unconstrained groups. A Stata command *switchr* calculates switching regression estimates for a two-component model in which observations are drawn from two different regression regimes, but separation into the separate regimes is unobserved. Dependent variables (investment rate) is depicted in the title. Older and bigger companies with lower leverage have a higher probability of being in unconstrained regime. Next year going bankrupt reduces the probability of being in the unconstrained regime. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14—Endogenous Switching Regression with Unknown Sample Separation 2B

Investment rate: % change in net fixed assets		
	Coefficient	S.E.
Selection equation		
Age	0.0105044***	0.000373
Age square	0.0009765***	1.38E-05
Total assets	0.00000142***	2.9E-08
Current assets	0.000000295***	3.91E-08
Leverage	-0.1123498***	0.003568
Next year bankrupt	0.0690264***	0.007564
Industry FE	YES	
Year FE	YES	
R-squared	**0.4912**	
Number of observations	177523	
Regime I: Unconstrained		
Lagged investment rate	-0.0000125	5.93E-06
Turnover/(fixed assets)	0.0372723***	0.012675
Investment opportunities	0.0086806***	0.000871
Cash flow/(fixed assets)	0.0002004	0.000144
Industry FE	YES	
Year FE	YES	
R-squared	**0.0199**	
Regime II: Constrained		
Lagged investment rate	-0.0459333***	5.77E-03
Turnover/(fixed assets)	0.3773979***	3.62E-02
Investment opportunities	-0.0486627	3.36E-02
Cash flow/(fixed assets)	-0.0002332	3.31E-04
Industry FE	YES	
Year FE	YES	
R-squared	**0.0811**	

Note: The table shows results for endogenous switching regression with unknown sample separation. We use this econometric method to avoid the problem of arbitrary a priori assignment of firms to constrained and unconstrained groups. A Stata command *switchr* calculates switching regression estimates for a two-component model in which observations are drawn from two different regression regimes, but separation into the separate regimes is unobserved. Dependent variables (investment rate) is depicted in the title. Older and bigger companies with lower leverage have a higher probability of being in unconstrained regime. The role of bankruptcy remains unclear.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15—Endogenous Switching Regression with Unknown Sample Separation 2C

Investment rate: % change in net tangible assets		
	Coefficient	S.E.
Selection equation		
Age	-0.0087809***	0.000391
Age square	-0.0008494***	1.43E-05
Total assets	-0.00000187***	3E-08
Current assets	0.000000829***	4.05E-08
Leverage	0.1226349***	0.003941
Next year bankrupt	-0.0062643	0.00801
Industry FE	YES	
Year FE	YES	
R-squared	**0.4854**	
Number of observations	169191	
Regime I: Constrained		
Lagged investment rate	0.0135839***	0.003808
Turnover/(fixed assets)	0.4421319***	0.036227
Investment opportunities	0.0237193	0.032834
Cash flow/(fixed assets)	0.0011461***	0.000408
Industry FE	YES	
Year FE	YES	
R-squared	**0.067**	
Regime I: Unconstrained		
Lagged investment rate	-0.000000058	1.78E-05
Turnover/(fixed assets)	0.2062796***	5.32E-02
Investment opportunities	0.0099366***	9.60E-04
Cash flow/(fixed assets)	0.0018662***	4.94E-04
Industry FE	YES	
Year FE	YES	
R-squared	**0.0445**	

Note: The table shows results for endogenous switching regression with unknown sample separation. We use this econometric method to avoid the problem of arbitrary a priori assignment of firms to constrained and unconstrained groups. A Stata command *switchr* calculates switching regression estimates for a two-component model in which observations are drawn from two different regression regimes, but separation into the separate regimes is unobserved. Dependent variables (investment rate) is depicted in the title. Older and bigger companies with lower leverage have a higher probability of being in unconstrained regime. The role of bankruptcy remains unclear.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 16—Endogenous Switching Regression with Unknown Sample Separation 1D

Investment rate: % change in net total assets		
	Coefficient	S.E.
Selection equation		
Age	0.0452235***	0.000205
Age square	-0.00039***	7.57E-06
Total assets	0.000000164***	1.59E-08
Current assets	-0.0000018***	2.15E-08
Leverage	-0.4018572***	0.002273
Next year bankrupt	-0.2600598***	0.00415
Industry FE	YES	
Year FE	YES	
R-squared	**0.802**	
Number of observations	177520	
Regime I: Unconstrained		
Lagged investment rate	-0.0006505***	0.000181
Turnover/(fixed assets)	-0.2828149***	0.09914
Investment opportunities	0.1400305***	0.013445
Cash flow/(fixed assets)	0.0091731	0.003599
Industry FE	YES	
Year FE	YES	
R-squared	**0.0158**	
Regime II: Constrained		
Lagged investment rate	0.0000676	1.82E-04
Turnover/(fixed assets)	0.7976181***	2.97E-01
Investment opportunities	0.1996135***	1.33E-02
Cash flow/(fixed assets)	0.7863527***	1.25E-02
Industry FE	YES	
Year FE	YES	
R-squared	**0.4818**	

Note: The table shows results for endogenous switching regression with unknown sample separation. We use this econometric method to avoid the problem of arbitrary a priori assignment of firms to constrained and unconstrained groups. A Stata command *switchr* calculates switching regression estimates for a two-component model in which observations are drawn from two different regression regimes, but separation into the separate regimes is unobserved. Dependent variables (investment rate) is depicted in the title. Older and bigger companies with lower leverage have a higher probability of being in unconstrained regime. Next year going bankrupt dummy reduces the probability of being in the unconstrained regime. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

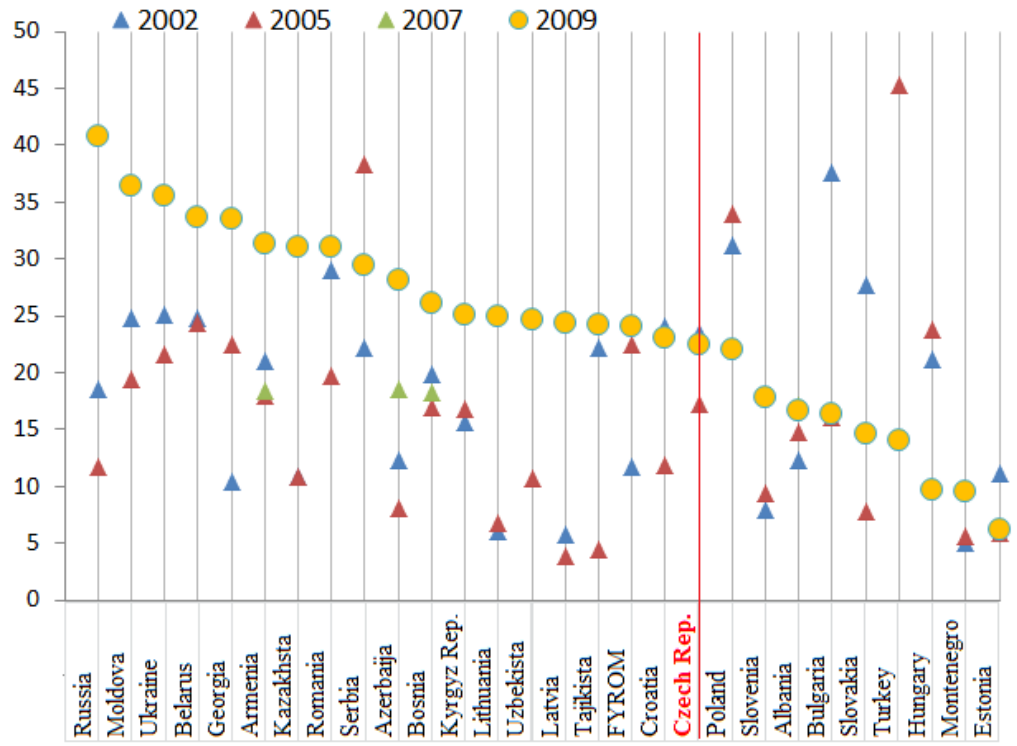

FIGURE 8. FINANCE AS A MAJOR OR SEVERE OBSTACLE.

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Note: The figure depicts the share of companies that assess finance as major or severe obstacle for their business growth. Finance as an obstacle varies significantly across countries: from 6 % in Estonia to 41 % in Russia. In the Czech Republic, 24% of firms noted that finance is a major or severe barrier to their growth. Interestingly, this share is very stable over the 2000s.

Source: BEEPS 2009 data. Authors' calculations

$$V_t(K_t, \xi_t) = \max_{I_t}\{D_t + E_t(\sum_{s=1}^{\infty} \beta_{t+s} D_{t+s})\} \tag{12}$$

subject to

$$D_t = \Pi(K_t, \xi_t) - C(K_t, I_t) - I_t \tag{13}$$

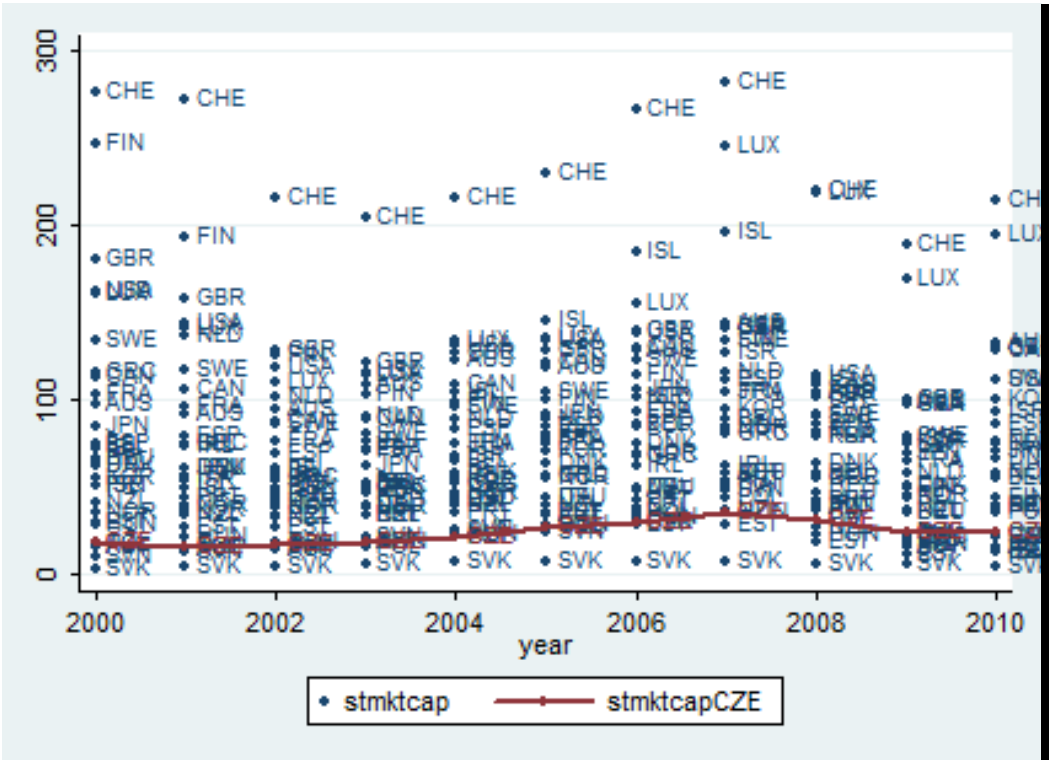

FIGURE 9. STOCK MARKET CAPITALISATION IN OECD COUNTRIES.

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Note: The Czech Republic belongs to OECD countries with the lowest stock market capitalisation. Moreover, stock market capitalisation decreased after 2008. This supports the notion that the financial market is underdeveloped in the Czech Republic.
Source: The World Bank, http://go.worldbank.org/X23UD9QUX0 authors' calculations.

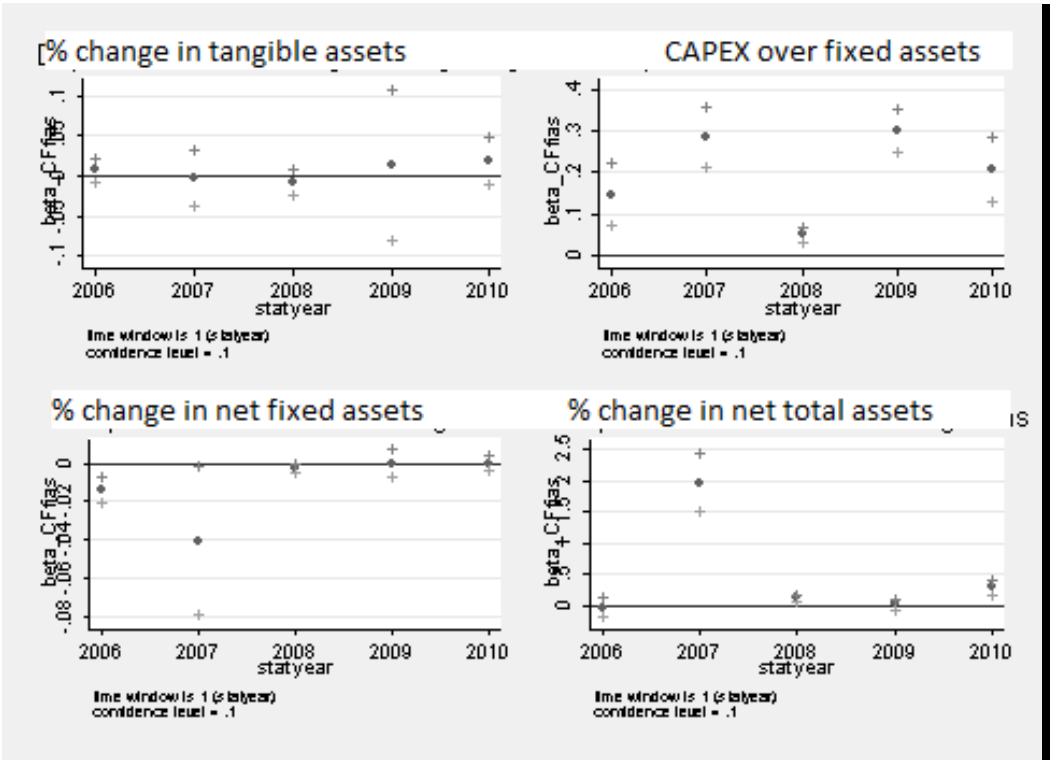

FIGURE 10. PLOT OF ESTIMATED COEFFICIENT OF CASH FLOW IN THE QUANTILE REGRESSION FOR EVER BANKRUPT COMPANIES

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Note: We do not see an increase of investment cash flow sensitivities for ever-going bankrupt companies.

Note: The figure depicts estimated coefficient on cash-flow in four investment equations for ever going bankrupt companies. We use a user-written Stata command $COEFF_TS$ that estimates a sequence of regressions for time series or panel data. Dependent variables are four different measures of investment rate. Explanatory variables are: lagged investment rate, turnover over beginning of period fixed assets, and estimated GDP growth as a proxy for investment opportunities. Year and industry fixed effects are included. The depicted coefficient of cash flow over beginning of period fixed assets has not increased after 2008 for ever going bankrupt companies. Therefore, either there was no increase in financial constraints for bankrupt companies or investment-cash flow sensitivities are not a good measure of financial constraints.
Source: Albertina, authors' calculations.

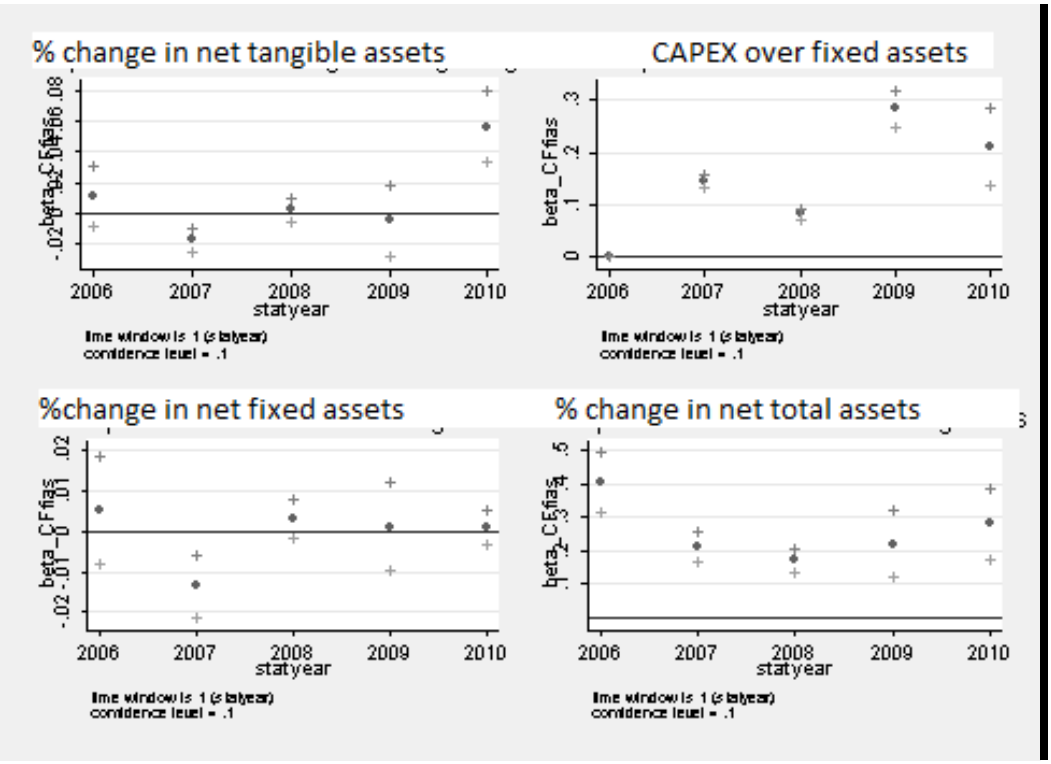

FIGURE 11. PLOT OF ESTIMATED COEFFICIENT OF CASH FLOW IN THE QUANTILE REGRESSION FOR NEXT YEAR BANKRUPT

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Note: The figure depicts estimated coefficient on cash-flow in four investment equations for next year bankrupt companies. We use a user-written Stata command $COEFF_TS$ that estimates a sequence of regressions for time series or panel data. Dependent variables are four different measures of investment rate. Explanatory variables are: lagged investment rate, turnover over beginning of period fixed assets, and estimated GDP growth as a proxy for investment opportunities. Year and industry fixed effects are included. The depicted coefficient of cash flow over beginning of period fixed assets has not increased after 2008 for ever going bankrupt companies. Therefore, either there was no increase in financial constraints for bankrupt companies or investment-cash flow sensitivities are not a good measure of financial constraints.
Source: Albertina, authors' calculations.

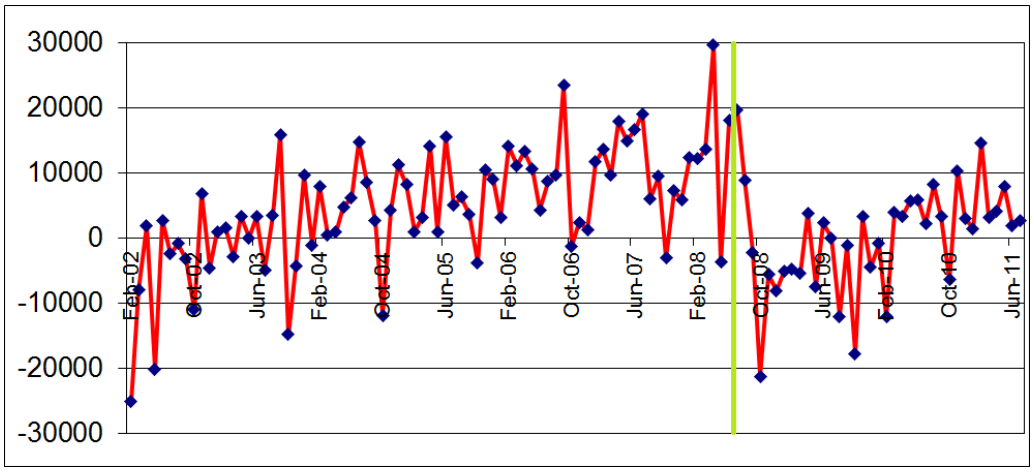

FIGURE 12. EVOLUTION OF CREDIT TO NON-FINANCIAL COMPANIES IN THE CZECH REPUBLIC [MONTHLY FLOWS IN CZK MILLION]

Note: Before the 2008 crisis credit grew significantly. September 2008 marks a significant decline in credit provisions to non-financial companies.

Source: Czech National Bank. authors' calculations.

$$K_{t+1} = (1-\delta)K_t + I_t \tag{14}$$

where ξ_t is the productivity shock, D_t are dividends paid to shareholders, K_t is investment, I_t is capital, $\Pi_t(\cdot,\cdot)$is the profit function, $C_t(\cdot,\cdot)$is the adjustment cost function, $\beta_t$is the discount factor

The Q model of investment's Euler equation is :

$$1 + \frac{\partial C(I_t, K_t)}{\partial I_t} = \beta_t\{\Psi_t \frac{\partial \Pi_{t+1}}{\partial K_{t+1}} + (1-\delta)(1 + \frac{\partial C(I_{t+1}, K_{t+1})}{\partial I_{t+1}})\} \tag{15}$$

where λ_t is Lagrange multiplier, $\Psi_t = \frac{1+\lambda_{t+1}}{1+\lambda_t}$ is the marginal cost of capital, and it also represents the financial constraints. As Poncet et al. [2010] note, firms do not face financial constraints if the shadow cost of investment $\lambda_{t+1} = \lambda_t = 0$ for all time periods. If $\Psi_t > 1$, then firms invest today; if on the other hand $\Psi_t < 1$, a firm invests tomorrow.

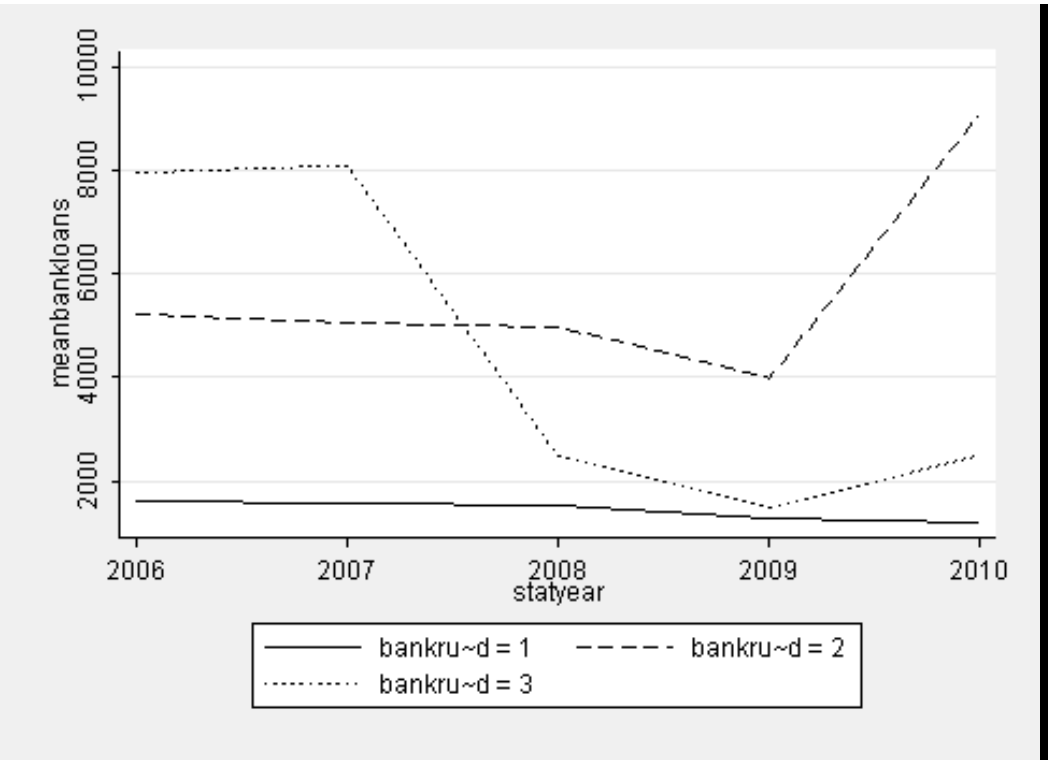

FIGURE 13. PLOT OF ESTIMATED COEFFICIENT OF CASH FLOW IN THE QUANTILE REGRESSION FOR NEXT YEAR BANKRUPT

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Note: This figure depicts means (medians are not depicted as it medians are zero bank loans for healthy companies) of bank loans for all 3 types of firms. Bankruptcy dummy refers to: bankru d=1 - healthy companies, bankru d=2 - ever bankrupt companies, bankru d=3 - the next year bankrupt companies. We can see a distinct patter for bankrupt and healthy firms when it comes to bank loans. Bankrupt firms in all years have higher bank loans. This does not support the notion of a credit crunch.
Source: Albertina, authors' calculations.

From this theoretical derivation, we get an empirical model by proxying Ψ_t with cash flow (assets available for investment).

$$\Psi_t = a_0 + a_1 \frac{Cash}{K} \tag{16}$$

Marginal product of capital can be proxied as:

$$MPK_t = \frac{\partial \pi_t}{\partial K_t} = \theta_i (\frac{Sales}{K})_i \simeq b + \theta_i + \bar{\theta} (\frac{Sales}{K})_i, \tag{17}$$

and

$$\theta_i = \frac{\alpha_k}{\mu} \tag{18}$$

where b is a constant, α_k is a share of capital in the Cobb-Douglass function, μ is a markup, θ_i can be captured using fixed effects and $\bar{\theta}$ can be assumed to be industry average.

$$\frac{\partial C(I_t, K_t)}{\partial I_t} = \frac{1}{\alpha_1} [(\frac{I}{K})_t - \alpha_2 (\frac{I}{K})_{t-1} - \alpha_i + \alpha_t] \tag{19}$$

where α_1, α_2 are constants, α_i is a firm-specific level of investment (fixed effect), and α_t is a time-effect.

To get the empirical equation (2) we linearise the Euler equation and use first-Euler Taylor approximation around the means.