

# WORKING PAPER SERIES 1

Martin Pospíšil, Jiří Schwarz:  
Bankruptcy, Investment, and Financial Constraints:  
Evidence from a Post-Transition Economy

2014



# **WORKING PAPER SERIES**

## **Bankruptcy, Investment, and Financial Constraints: Evidence from a Post-Transition Economy**

Martin Pospíšil  
Jiří Schwarz

1/2014

## **CNB WORKING PAPER SERIES**

The Working Paper Series of the Czech National Bank (CNB) is intended to disseminate the results of the CNB's research projects as well as the other research activities of both the staff of the CNB and collaborating outside contributors, including invited speakers. The Series aims to present original research contributions relevant to central banks. It is refereed internationally. The referee process is managed by the CNB Research Department. The working papers are circulated to stimulate discussion. The views expressed are those of the authors and do not necessarily reflect the official views of the CNB.

Distributed by the Czech National Bank. Available at <http://www.cnb.cz>.

Reviewed by: Olexander Talavera (University of Sheffield)  
Jan Hanousek (CERGE-EI)  
Miroslav Plašil (Czech National Bank)

Project Coordinator: Bořek Vašíček

© Czech National Bank, January 2014  
Martin Pospíšil, Jiří Schwarz

# Bankruptcy, Investment, and Financial Constraints: Evidence from a Post-Transition Economy

Martin Pospíšil and Jiří Schwarz \*

## Abstract

In this paper we use balance-sheet data and information on bankruptcy to study the relationship between investment, financial constraints, and bankruptcy in a post-transition country. Our data constitute a dynamic panel and cover the period 2006–2011, which also allows us to study the impact of the 2008 crisis on Czech companies. Using investment–cash flow sensitivity to analyze financial constraints we find there is robust evidence that cash flow and the level of debt have a positive and significant impact on the investment rate. By taking a closer look at individual subsamples we reveal that the existence of financial constraints, proxied by investment–cash flow sensitivity, is evident mainly after 2008 and in small and medium-sized enterprises. At the same time, we do not uncover any evidence that firms going bankrupt during our observed period faced more severe financial constraints. Moreover, companies going bankrupt had significantly higher levels of external debt and bank loans, which indicates that they may have been, in fact, less constrained than others.

## Abstrakt

Pomocí rozvahových dat a informací o bankrotech v tomto článku zkoumáme vztah mezi investicemi, finančními omezeními a bankrotů v posttranzitivní ekonomice. Naše data tvoří dynamický panel a pokrývají roky 2006–2011. To nám umožňuje zkoumat i vliv krize, která vypukla v roce 2008, na české podniky. Finanční omezení zkoumáme pomocí analýzy citlivosti investic na cash flow. Nacházíme robustní důkazy, že cash flow a velikost dluhu mají kladný a významný vliv na míru investic. Bližším pohledem na dílčí vzorky firem odhalujeme, že existence finančních omezení, vyjádřená citlivostí investic na cash flow, je zřejmá zejména po roce 2008 a také v kategorii malých a středních podniků. Současně však nic nenasvědčuje tomu, že by podniky, které v námi sledovaném období zbankrotovaly, čelily silnějším finančním omezením. Bankrotující podniky navíc měly významně vyšší úroveň externího dluhu a bankovních úvěrů, což naznačuje, že ve skutečnosti mohly být méně omezeny než ostatní.

**JEL Codes:** D22, D92, E22, G32.

**Keywords:** Bankruptcy, cash flow, credit rationing, financial constraints, investment, post-transition economy.

---

\* Martin Pospíšil, CERGE-EI (CERGE-EI is a joint workplace of the Center for Economic Research and Graduate Education, Charles University, and the Economics Institute of the Academy of Sciences of the Czech Republic; martin.pospisil@cerge-ei.cz; corresponding author)

Jiří Schwarz, Czech National Bank, and Institute of Economic Studies, Charles University, Prague (jiri.schwarz@cnb.cz)

This research was supported by Czech National Bank Research Project No. C6/2012. The views expressed in this paper are those of the authors and not necessarily those of the Czech National Bank or other institutions with which the authors are affiliated. We are grateful to Jan Hanousek, Randall Filer, Oleksandr Talavera, and Miroslav Plašil for a thorough review of the paper. We would like to thank Jan Kmenta, Evangelia Vourvachaki, Evžen Kočenda, Jakub Kastl, Jacek Cukrowski, Štěpán Jurajda, Andreas Ortmann, Jakub Kastl, Beyongju Jeong, Jan Švejnar, Lubomír Lízal, Iryna Momotenko, and Avner Shaked, and seminar participants at the 2013 IES Economic Meeting, the Bratislava Economic Meeting 2012, IES FSV UK, CERGE-EI, and the Czech National Bank for useful comments and suggestions. Martin Pospíšil would like to thank Organizational Dynamics at the University of Pennsylvania for their hospitality during his research stay. Martin Pospíšil acknowledges the support of GAUK grant 616812. All remaining errors are ours.

## **Nontechnical Summary**

The concepts of financial constraints and credit rationing have been analyzed extensively since the 1980s (Stiglitz and Weiss, 1981). A correct understanding and estimation of financial imperfections is crucial for monetary policy, as it influences the functioning of policy transmission channels. The logic behind credit rationing is that the credit market does not necessarily clear, because beyond a certain interest rate, any higher rate can be considered too risky from the bank's perspective. However, it remains difficult to identify credit rationing from aggregate data. A decline in lending can be driven either by unwillingness of lenders to lend, or by low demand for new loans (Bernanke, 1993). Therefore, there has recently been a shift toward micro-level data, which enable better identification of credit constraints. As there is no direct indicator of financial constraints, one way of estimating the extent of credit rationing is to use survey data to get firm-level information on credit denial.

The other method builds on the fact that investment should be determined not by a firm's internal funds but rather by the expected return on investment. But in reality, financial constraints exist and are not evenly distributed across firms – some firms simply face higher costs of raising capital. The majority of authors, therefore, statistically test for the presence and scope of investment–cash flow sensitivity as an indication of firms being credit constrained (e.g. Fazzari et al., 2000). A positive statistical correlation between the investment rate and cash flow indicates that firms are more likely to invest in new assets if they generate enough funds of their own. Such finding means that firms have to rely on its internal funds to finance investment – i.e., they are financially constrained. Analyses also reveal that there is a link between credit access and the likelihood of bankruptcy (e.g. Mach and Wolken, 2012).

Studies analyzing financial constraints, investment, and bankruptcy usually focus on publicly traded companies and make heavy use of various market value measures. This makes the commonly utilized methods difficult to apply on post-transition economies with small stock markets. As a consequence, empirical literature on financial constraints in countries such as the Czech Republic is scarce, even though firms in these countries need to use bank credit extensively as their principal form of external financing. It has been observed that the 2008 crisis strongly affected firms in the Czech Republic. Banks were reported to be reluctant to lend money, and lending to non-financial companies declined significantly. On the other hand, statistical surveys did not indicate a severe increase in financial constraints in that period. To shed light on this issue, we estimate the size and development of credit constraints during the years preceding and following the 2008 crisis using investment–cash flow sensitivity, bankruptcy information, and other balance-sheet items and firm-related characteristics.

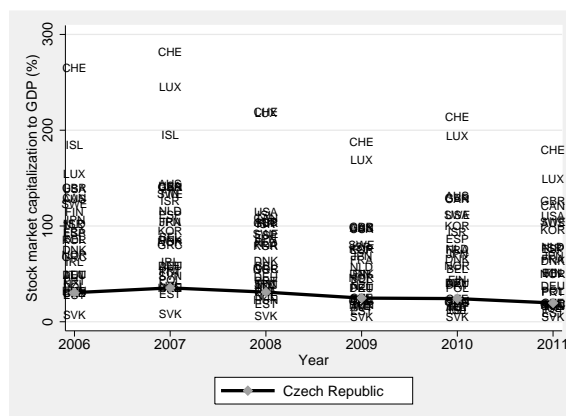
Our results show that companies which went bankrupt in the period 2006–2011 had lower cash flow, a higher level of overall debt, and a higher level of bank loans compared to healthy companies. Their investment rate started to decrease only shortly before they declared bankruptcy. In the last year before bankruptcy, the level of bank loans started to decrease as well. The level of debt had a positive impact on the investment rate. Turnover, on the other hand, was negatively correlated with the investment rate. We also find that firms were, in fact, more likely to invest in new assets if they generated enough funds of their own. In other words, Czech firms seem to be, on average, financially constrained. This result appears to be driven mainly by post-2008 observations. Also, our data reveal that it was mainly small and medium-sized enterprises that were financially constrained. However, currently available data and our model specification do not allow precise identification of financially constrained companies for potential policy intervention. Companies which went bankrupt did not face different financial constraints than healthy companies.

## 1. Statement of the Problem

In a country with a small stock market such as the Czech Republic, firms have limited access to capital and need to use bank credit extensively as their principal form of external financing. 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 global credit markets, constrains the whole economy and may lead to an increased incidence of bankruptcy.

Generally, investment is the most volatile part of GDP and is strongly linked to external credit provision, as investors usually do not have enough internal funds for their investment projects. Financial constraints influence investment to a varying degree over the business cycle. As a consequence, financially constrained firms may be forced to forgo good investment opportunities and the whole economy can suffer. Knowing more about the link between finance, investment, and bankruptcy can help policy-makers understand how to mitigate the consequences of such a credit crunch.<sup>1</sup> Recognizing this, in this paper we focus on the link between investment, bankruptcy, and financial constraints. Linking the latest balance-sheet data with original information on bankruptcy, we offer a new perspective on this important relationship in the economy.

**Figure 1: Stock Market Capitalization in High-Income OECD Countries**



**Note:** The Czech Republic is among the OECD countries with the lowest stock market capitalization. Moreover, stock market capitalization decreased after 2008. This supports the notion that bank lending is of crucial importance for investment and growth in the Czech Republic.

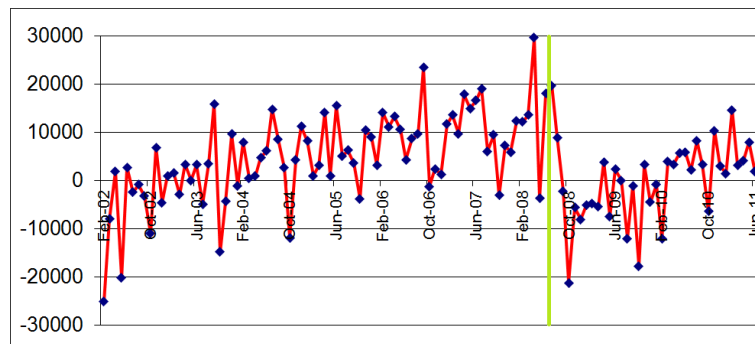
**Source:** The World Bank (<http://go.worldbank.org/X23UD9QUX0>), authors' calculations.

Analysis of financial constraints using data from the Czech Republic constitutes an interesting and important contribution to the existing literature for several reasons. First, the Czech Republic is a small and open economy. As such, it is vulnerable to external economic shocks such as the global credit crunch after September 2008. Second, it is a good example of a country with a small stock market.<sup>2</sup> Because of the low stock market capitalization, bank lending is crucial for investment and growth in the country. Third, the Czech banking crisis of 1997 and the subsequent privatization of Czech banks to Western global banking groups<sup>3</sup> helped the Czech banking sector learn how to better assess risk and was one of the reasons why the Czech banking sector weathered the 2008 crisis relatively well. Therefore, it is assumed that banks know how to assess the risk of investment

<sup>1</sup> As Bernanke et al. (1999) note, Fisher (1933) argued that the severity of the Great Depression was due to a heavy debt burden and financial constraints.

<sup>2</sup> In Figure 1 we plot stock market capitalization against GDP in OECD countries. The figure also shows that the already low Czech stock market capitalization decreased further after 2008.

<sup>3</sup> Large state-owned banks were privatized to foreign investors (e.g. KBC, Erste, and Société Générale.)

**Figure 2: Evolution of Credit to Non-Financial Companies in the Czech Republic**

**Note:** Monthly flows in CZK million. Before the 2008 crisis credit grew significantly. September 2008 marks a significant decline in lending to non-financial companies.

**Source:** Czech National Bank, authors' calculations.

projects in the country. Fourth, Czech companies had to face a decline in lending after the fall of Lehman Brothers in 2008 (see Figure 2).<sup>4</sup> Finally, the Czech Republic is a typical post-transition country.<sup>5</sup> As such, an analysis of this country can help us understand other countries that are catching up in terms of development.

The decline in credit coincided with a number of company bankruptcies in the Czech Republic (see Figure 5). One of the reasons for companies going bankrupt might have been the often mentioned difficult access to finance during the time of economic distress. However, detailed analysis of this link has so far been limited due to the unavailability of firm-level data in the post-2008 period. Today, now the data are finally available, we are able to link balance-sheet data with an original dataset of company bankruptcies to study firms' investment behavior in relation to financial constraints and bankruptcy in the Czech Republic.

Due to the nature of available data, our identification of financially constrained companies is only indirect. But if combined, for example, with survey data or data on firms' credit, it would be possible to identify a more direct link between credit and investment. Such research would then have potential policy implications. Good identification of financially constrained companies and sectors can help, for instance, in times of economic crisis to support the argument for well-targeted policy intervention (loan provision, guarantees) on the credit market.<sup>6</sup>

The remainder of the paper is organized as follows. The next section reviews the related literature. In section 3 we look at financial constraints through the lens of a number of surveys. Then we explain our research methodology. In section 5 we describe our data and data management. Section 6 presents and discusses the results, and section 7 concludes.

<sup>4</sup> The 2008 crisis hit firms in the Czech Republic hard. For example, in 2009 they were complaining that they were being hit by a credit crunch, with banks reluctant to lend money (<http://goo.gl/r2u1ZA>). 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 from parent banks from abroad, and lower demand for credit in general due to low aggregate demand.

<sup>5</sup> At the end of 2007, the Czech Republic opted out of funding from the European Bank for Reconstruction and Development (EBRD).

<sup>6</sup> As Oliner and Rudebusch (1996) note, the research on the credit channel stresses that central bank actions affect output, in part, by causing shifts in the supply of loans.



## 2. Literature Review

The concept of financial constraints and credit rationing<sup>7</sup> were first well analyzed theoretically by Stiglitz and Weiss (1981).<sup>8</sup> The outcome of their research is that under financial imperfections, the Modigliani-Miller theorem<sup>9</sup> does not hold, firms can be constrained, and overall economic growth may slow. Over time, credit rationing theory has become highly important, especially in macroeconomic models with financial frictions.<sup>10</sup> The logic of credit rationing is that there is no linear relationship between the 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 among the first to claim that the credit view approach aims to identify the propagation mechanism of the conventional interest rate effect. As Chatelain et al. (2003) note, however, standard macro-models usually do not include balance-sheet information on firms' behavior and are, therefore, not good enough to test for broad-credit-channel effects and imperfections.

Good evidence on how financial constraints affect 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; Kashyap et al., 1994) confirm the robustness of the variation in the severity of financial constraints over time. However, it remains difficult to identify credit rationing from the aggregate data. For example, a decline in lending may be driven either by unwillingness of lenders 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 credit supply from credit demand shifts. A decrease (no matter how strong) in aggregate lending per se does not say anything about a credit crunch, as this decline may have been caused by a strong decrease in the demand for credit (for example due to expected limited business opportunities).

In recognition of that, there has been a recent shift in economics from aggregate data toward 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. At the same time, financial constraints are empirically unobservable and there is no balance-sheet item that will indicate financial constraints. Therefore, to test for financial constraints, several authors use the presence of investment-cash flow sensitivity as an indication of firms being credit constrained (e.g. Fazzari et al., 1988; Hobdari et al., 2009).

Other authors use survey data to get firm-level information on credit denial (e.g. Gaiotti, 2011; Holton et al., 2012). But as Campello et al. (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 became more significant

---

<sup>7</sup> In this paper the terms credit constraints and financial constraints are used interchangeably.

<sup>8</sup> 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.

<sup>9</sup> 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.

<sup>10</sup> 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 include Keynes, Minsky, and Stiglitz.

during the 2008 crisis. Mach and Wolken (2012), in their study based on survey data on credit experiences, report that there is a link between credit access and the likelihood of bankruptcy, even though the authors themselves admit that their data on bankruptcy are not fully reliable. Similar results are obtained by Keasey and Watson (1991) and Musso and Schiavo (2008).

Literature on the investment behavior and credit constraints of firms in countries with larger stock markets is rich (e.g. Chava and Roberts, 2008; Whited, 2001; Hovakimian and Titman, 2006). For example, 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. He concludes that a credit crunch strongly affects investment and the whole economy. Recently, Clarke et al. (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. Carpenter and Guariglia (2008), using UK data, show that finance constrains a firm's investment decisions after controlling for investment opportunities and distinguishing between internal and external constraints.

On the other hand, there is scarce empirical literature on financial constraints in post-transition countries. Geršl and Jakubík (2011) focus on the question of how Czech firms obtain financing from domestic banks. Their results show that the vast majority of non-financial corporations obtain finances from just one lender. Plašil et al. (2013) apply an error-correction model on macroeconomic data to disentangle demand and supply effects on the amount of loans and describe the evolution of their mutual relationship.

To conclude, studies analyzing financial constraints, investment, and bankruptcy focus usually on publicly traded companies and make heavy use of various market value measures. This approach is unfortunately an unusable one for countries such as the Czech Republic, where the very small share of publicly traded companies makes this kind of information unavailable. As a consequence, we have to rely solely on microeconomic balance-sheet data. There are only a few papers on these topics that use Czech panel data (e.g. Fidrmuc et al., 2010; Pruteanu, 2004; Lízal and Svejnar, 2002). A couple of papers, such as Lízal and Svejnar (2000) and Konings et al. (2003), use investment–cash flow sensitivities to identify financial constraints. But to our knowledge, there is no study using Czech data to link bankruptcy information with financial constraints or to investigate the impact of the 2008 crisis on financial constraints.

### **3. A First Qualitative Look at Financial Constraints**

To assess financial constraints, surveys are often used as a useful quick and cost-efficient tool.<sup>11</sup> Before we start with the microeconomic analysis, we therefore focus on three surveys to illustrate how much of an obstacle finance is to firms in the Czech Republic.<sup>12</sup>

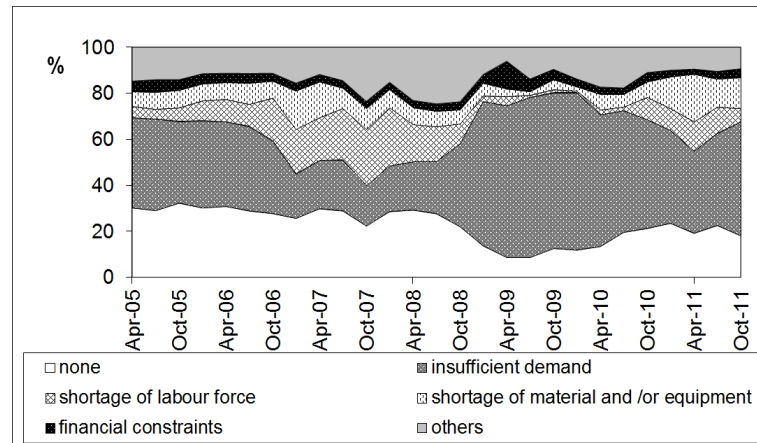
#### **3.1 Czech Statistical Office Survey**

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

---

<sup>11</sup> See for example, the European Central Bank (<http://goo.gl/xuHj3P>), or the European Commission (<http://goo.gl/jZxRdQ> or <http://goo.gl/1XDmGM>).

<sup>12</sup> In a similar fashion, Kaplan and Zingales (1997) examine firms' annual reports and read the management's liquidity needs, which should describe the need for funds. From that, the Kaplan-Zingales critique emanates.

**Figure 3: Barriers to Growth in Industry**

**Note:** The evolution of barriers to growth in industry in the Czech Republic. The relative importance of financial constraints has not increased since 2008. There was an only temporary increase in the financial constraints indicator 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 3 and we see that finance (the darkest area in the figure) does not appear to constrain companies in their growth.<sup>13</sup> Surprisingly, the 2008 crisis does not seem to have made a significant change either, as there was only a relatively small and temporary increase after summer 2008. However, we see a significant increase in the “insufficient demand” barrier (the dark grey area in the Figure 3).

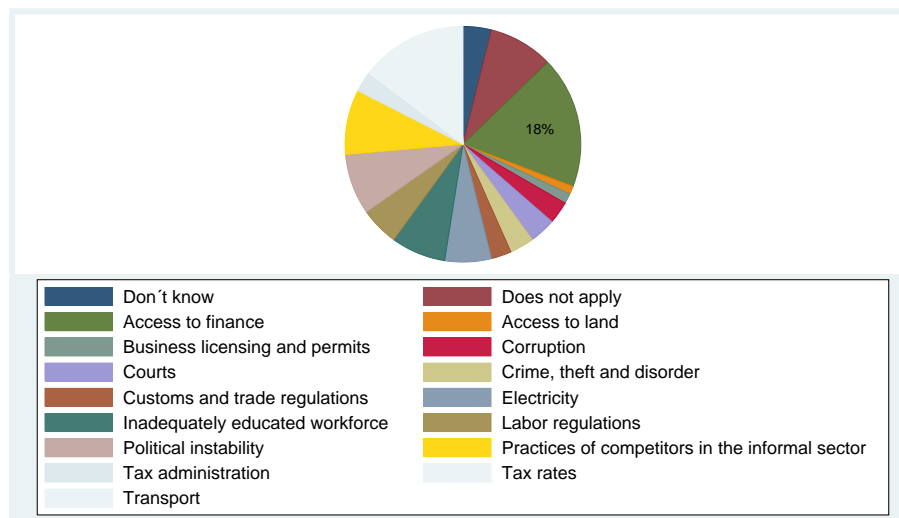
This qualitative assessment would support the view that the sharp reduction in lending (see Figure 2) was demand rather than supply driven. Or, in other words, even though there was a dramatic decline in credit, these survey data suggest that the decline was more likely due to insufficient demand on 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 cannot speak of a credit crunch. To be more specific, if we observe a large decline in credit, while firms did not increasingly perceive finance as an obstacle to their growth, then the credit decline was most likely demand driven.

On the other hand, we have to interpret these survey data 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.

### 3.2 Czech National Bank Survey

The second survey comes from the Czech National Bank and was carried out in June 2009 among 399 Czech companies with the goal to shed more light on the issue of the size of the constraints. Czech companies were asked to what extent did the 2008 crisis present itself in each of the following areas: falling demand for products or services; difficulties in financing activities through the usual channels; difficulties due to late payments from customers; difficulties in obtaining intermediate

<sup>13</sup> For the time series for firms in services, see the Appendix.

**Figure 4: Biggest Obstacles in Running a Business. BEEPS Data for the Czech Republic.**

**Note:** For 18% of Czech companies, finance was the biggest constraint on their business growth in the fiscal year 2007. 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.

goods from the usual suppliers. The share of companies that answered the question about the extent of difficulties in financing with “exceptionally strong” and “strong” 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. But the results indicate that financial constraints did play some role during the crisis.

There are two other sources of survey-based information regarding financial constraints published by the Czech National Bank. Unfortunately, both surveys started long after the onset of the 2008 crisis. First, there is the quarterly survey in the non-financial corporations’ sector published since March 2011. The results show that finances restrict firms’ growth far less than insufficient demand, prices of inputs, or competition. The average impact of insufficient finances lies around 2.5 (where 1 = not at all, and 5 = the most).

The second potentially useful information source is the Czech bank lending survey, which has been published only since July 2012 and shows the relative development of the credit supply and credit demand sides. The problem is that the answers always refer to changes since the last quarter. That is, they only reveal information about easing and tightening of the conditions, not about the absolute levels.

### 3.3 Business Environment and Enterprise Performance Survey (BEEPS)

The third survey we analyze is the Business Environment and Enterprise Performance Survey (BEEPS) published regularly by the World Bank and the European Bank for Reconstruction and Development (EBRD).<sup>14</sup> In this survey, among other topics, managers of businesses report on the biggest constraints they face 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

<sup>14</sup> 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.

been used in a similar context, for example by Brown et al. (2009), to analyze 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.<sup>15</sup> The survey results show that for 18% of Czech companies, finance was the biggest constraint on their economic growth in 2009 (see Figure 4).<sup>16</sup>

To conclude the survey results, finance seems to be an obstacle for a significant proportion of firms in the Czech Republic. At the same time, the Czech Statistical Office survey shows that financial constraints did not increase much after 2008 despite a large decrease in lending. It will be interesting to observe how financial constraints have developed in the next wave of BEEPS data. To sum up, the available survey data do not provide enough evidence in favor of, or against, the existence of financial constraints.

## **4. Research Methodology**

Research on financial development usually cannot rely on experiments to verify its hypothesis. The 2008 financial crisis, however, can be perceived as an experiment with regard to financial constraints in the Czech Republic. The crisis is assumed to be exogenous with respect to Czech firms,<sup>17</sup> there is a clearly identifiable change in the economy, and we have pre- and post-crisis data. As noted, financial constraints are unobservable. Therefore, to identify the relationship between investment, bankruptcy, and financial constraints we first present relevant survey results and then carry out an econometric analysis of firm-level data.

### **4.1 Investment–Cash Flow Sensitivity**

The core belief in the financial growth literature is that investment should be determined by future investment opportunities rather than by the firm's internal funds (net worth). There is a lively discussion, however, about how much cash flow matters. 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 indicator of being credit constrained. Poncet et al. (2010) argue that the larger the sensitivity of investment to cash flow, the more constrained the firm is because it has to rely more on its internal funds to finance investment.

Moreno Badia and Sloomackers (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

---

<sup>15</sup> BEEPS has the advantage of allowing for the control of heterogeneity at the firm level. The notable exception as regards the linking of BEEPS and balance-sheet (Amadeus) data is Kochanova (2012).

<sup>16</sup> It is important to note that BEEPS 2009 was effectively surveyed in 2008 and asked about the fiscal year 2007. Therefore, the crisis was not yet a part of the survey. The first set of post-2008 data is expected to be published in 2014. In the Appendix we show that financial constraints remained relatively stable between 2002 and 2009 in the Czech Republic, while they increased dramatically in Russia, for example.

<sup>17</sup> This means not that the Czech National Bank is powerless, but rather that the source of the crisis was outside the economy. This is in sharp contrast to the Czech currency crisis in 1997, which was to a large extent driven from within the Czech economy.

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 et al. (2000) counter-argue that these sensitivities matter.<sup>18</sup> At the same time, Agca and Mozumdar (2008) and Chen and Chen (2011) empirically showed a significant decline in investment–cash flow sensitivity over time. This investment–cash flow bias is a central point in the corporate finance literature. We can therefore follow the work of Kaplan and Zingales (1997), who note that:

*While it is easy to show that constrained firms should be sensitive to internal cash flow while unconstrained firms should not, it is not necessarily true that the magnitude of the sensitivity increases in the degree of financing constraints.*

Based on the above-mentioned arguments and literature review, we hypothesize the following:

*H1a:* Investment rates of Czech firms will display positive and significant sensitivity to the availability of internal funds.

*H1b:* Investment rates of Czech **small and medium-sized enterprises** will display positive and significant sensitivity to the availability of internal funds.

*H1c:* Investment rates of Czech **large firms** will **not** display positive and significant sensitivity to the availability of internal funds.

*H2a:* Investment rates of Czech firms will **not** display positive and significant sensitivity to the availability of internal funds **before** 2008.

*H2b:* Investment rates of Czech firms will display positive and significant sensitivity to the availability of internal funds **after** 2008.

## 4.2 Our Framework: The Q Model

To empirically test for financial constraints, one can use the Q model derived from the Euler equation<sup>19</sup> and an investment–cash flow relation. Under the assumptions of perfect competition, capital as the only input, and constant returns to scale, and conditional on average Q,<sup>20</sup> no other variable

---

<sup>18</sup> 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), the 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 necessarily increase in 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 may be more complicated, with overly risk-averse firms preferring to invest their own cash flow.

<sup>19</sup> The derivation of the Euler equation is given in the Appendix.

<sup>20</sup> The 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 the market value of an additional unit of capital to its replacement cost. In most empirical work, average Q serves as the proxy for marginal Q.

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):

$$\frac{I_{it}}{K_{it}} = \beta_0 + \beta_1 Q_{it} + \beta_2 \frac{CF_{it}}{K_{it}} + e_{it} \quad (4.1)$$

where  $\frac{I_{it}}{K_{it}}$  denotes the investment rate,  $\beta_0$  is the non-stochastic additive parameter,  $\beta_1$  is the multiplier in the adjustment-cost function, and  $CF_{it}$  is the cash flow in the same year. Tobin's  $Q_{it}$  is a proxy for the availability of investment opportunities and is often calculated using information on firms' market values, and  $e_{it}$  is the stochastic additive component (assumed to be an *i.i.d.* process).

However, as noted above, we focus on a post-transition country where large information asymmetry is still assumed. Also, Tobin's  $q$  would be available only for a very limited sample of publicly listed companies. Therefore, our baseline equation follows, for example, Hobdari et al. (2009) and Cinquegrana et al. (2012) and makes use of the available balance-sheet data to instrument for Tobin's  $q$ :

$$\frac{I_{it}}{K_{it}} = \beta_0 + \beta_1 \frac{I_{it-1}}{K_{it-1}} + \beta_2 \left( \frac{I_{it-1}}{K_{it-1}} \right)^2 + \beta_3 \frac{Y_{it-1}}{K_{it}} + \beta_4 \frac{CF_{it-1}}{K_{it}} + \beta_5 \frac{D_{it-1}}{K_{it}} + \mu_{kt} + e_{it} \quad (4.2)$$

where  $I_{it}$  is investment,  $K_{it}$  is beginning-of-period fixed assets,<sup>21</sup>  $Y$  is turnover,  $CF$  is cash flow,  $D$  is total debt, and  $\mu_{kt}$  is a sector-time specific effect.<sup>22</sup> Coefficient  $\beta_4$  is of interest to us because for financially-constrained firms, internal cash flow is expected to 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 flow is, the more constrained the firm is, because it has to rely on its internal funds to finance investment projects. To reduce potential omitted variable bias and to get more information on the relation between investment, bankruptcy, and cash flow, we also include information on future firm bankruptcy as an explanatory variable. While there may be a problem with reverse causality (e.g. lower investment leading to bankruptcy), including information on future firm bankruptcy can have the power to capture unobserved variables that can be related to bankruptcy and determine investment rates. At the same time, we believe that the reverse causality problem can arise for a dummy capturing whether a firm goes bankrupt sometime during our time period, but not for a dummy capturing whether the firm goes bankrupt in the next period. Due to the length of the bankruptcy process, it is unlikely that this year's investment rate would affect next year's bankruptcy.

<sup>21</sup> Therefore, a lagged observation.

<sup>22</sup> In the Albertina database, cash flow is calculated as current year profit (loss) + depreciation of tangible and intangible fixed assets. There are generally two approaches to calculating cash flow: direct and indirect. For direct calculation of cash flow, balance-sheet information is clearly insufficient. Indirect calculation starts with the information available on the balance sheet, but usually adjusts for revenues and costs which should be included in net income but are not, or, on the other hand, should not be included but are. However, such adjustments cannot be made based on data available to an outside observer who has access only to the financial statements of firms. As a consequence, for the purposes of financial constraints analysis, cash flow is usually calculated in the same way as in Albertina.

## 5. Data and Data Management

### 5.1 Data

Our analysis uses Czech firm-level microdata. We take the firms' **balance-sheet data** from the Albertina database.<sup>23</sup> This is a Czech database containing financial and ownership structure information on major public and private companies in all sectors of the economy in the Czech Republic.

The database is updated monthly and each version features only currently registered (existing) entities, i.e., if any entity has gone successfully through a process of bankruptcy or liquidation ending in an 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 for the bankruptcy process to take several years, ignoring enterprises which have gone through a swift bankruptcy and have 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, 2011, and 2012. Together with the data available in June 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 our analysis, the most relevant variables are the book value of the firm's total, tangible and fixed assets, employment, total debt, bank loans, turnover, and cash flow.

We also assembled original **data on bankruptcy** in the Czech Republic. This data is available only from 2006. This and the limited or zero availability of post-2011 financial data justifies the choice of our time span (2006–2011). It is not a simple task to create a reliable measure of bankruptcy. The legal status provided in the Albertina database for every entity indicates whether the entity is healthy, is going (or has gone) through the bankruptcy process, or is in 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 the record in the Insolvency Register, which is attached to each entity in the database. In cases where there were multiple dates of insolvency declaration in the Register, we used the most recent one. Such a situation can arise if, for example, a declaration of insolvency was cancelled by a court due to deficiencies in the insolvency proposal and was then followed by a revised proposal. The date extracted from the Register is given priority over the one provided in the database in the event of data conflict.

In a significant number of cases this process revealed serious inconsistencies in the database. Sometimes, for example, bankruptcy was not declared by a court in the end, but still appeared in the legal status of the firm in the database. Going through the details in the Insolvency Register allowed us to cleanse the data and remove all incorrect observations. We should note that studies relying solely on information on bankruptcy taken from the Albertina database will probably be misleading.<sup>24</sup> We therefore correct for potential bias related to bankruptcy information.

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

---

<sup>23</sup> Operated by Bisnode Ceska republika, a.s., [www.albertina.cz](http://www.albertina.cz). We would like to thank the Czech National Bank for access to this dataset.

<sup>24</sup> A similar problem would arise if Amadeus, a European-wide, firm-level dataset, was used. Amadeus is compiled by Bureau Van Dijk (BvD) by harmonizing companies' annual reports obtained from various European vendors. Again, the information on bankruptcy is not accurate for the above-mentioned reasons.



status are included in the dataset only before the declaration of insolvency. Linking the bankruptcy information with balance-sheet data we get our final sample.

We distinguish between three types of companies:

- “healthy”, i.e., companies that do not go bankrupt during the period studied
- “at some point going bankrupt”, i.e., companies that go bankrupt during the period studied (i.e., in  $n+t$ , where  $n \in \{2006; 2011\}$  is the fiscal year and  $t \in \{1; 5\}$ )
- “next year going bankrupt”, i.e., companies that go formally bankrupt during the following period<sup>25</sup> (i.e., in  $n+1$ , where  $n \in \{2006; 2011\}$  is the fiscal year)

As the dependent variable, we have a measure of the investment rate (capital expenditures) scaled by beginning-of-year capital (this follows, for example, Julio and Yook, 2012; Cetorelli and Strahan, 2006). Following the literature, we define the investment rate as the percentage change in net fixed assets (see, for example, Cai and Harrison, 2011; Moreno Badia and Sloomakers, 2009).

## 5.2 Data Management

Our data management follows previous work in this field. We drop all observations which do not cover a 12-month-long fiscal year and all observations with missing employment data. Due to the source of the data (the data mostly come from forms filled out by hand by employees of individual companies), we also exclude all zero observations on employment because anecdotal evidence confirms that sometimes zero in fact means “no data.” There is no way we can discriminate between these two possibilities so we drop zero observations. When possible, we fill in missing values by extrapolating previous values of employment. We also drop firms in the public administration, defense, and compulsory social security sectors (62 observations).

Another potential problem with our dataset is outliers. While performing a random check of the data, we found a significant number of cases where typos and wrong order of numbers render the observations unusable. The large heterogeneity of firms also complicates the analysis. We identify outliers in our multivariate data using the blocked adaptive computationally efficient outlier nominators (BACON) algorithm proposed by Billor et al. (2000) and described in Weber (2010). Using this effective way of detecting outliers in multivariate data, we identify outliers with respect to the following variables: total assets, fixed assets, and employment (on the 1% level). Out of 729,508 observations, we drop 18,455.

We also winsorize large firms in the top one percentile of employment, total assets, and fixed assets. We exclude firms with less than CZK 1,000 in total assets (2,369 observations) or with negative total, tangible, or intangible assets (2,508 observations), and drop all observations for which the balance-sheet equation does not hold (i.e., assets do not equal liabilities and shareholders’ funds; 10,562 observations). In some cases, financial data for one year were provided from several sources for one entity. In order to remove these duplications, the source with more filled-out information was chosen. We deflate all financial variables by the relevant producer price indices taken from the EBRD.<sup>26</sup>

<sup>25</sup> As noted, due to the length of the bankruptcy process, it makes more sense to assign the bankruptcy to the year just preceding the year when the firm formally goes bankrupt.

<sup>26</sup> We cannot use the possibly most relevant deflators based on the EU KLEMS database in order to obtain country-sector-specific output and intermediate input deflators, as EU KLEMS data are available only until 2007. We

**Table 1: Summary Statistics of Relevant Variables for the Whole Sample, Healthy Firms, and Firms Going Bankrupt (2006–2011)**

Variable	Sample	Mean		Std. Dev.	N
Investment rate per unit of fixed assets	all	0.9009		3.4411	347,457
	healthy	0.9009		3.4394	344,337
	going bankrupt	0.8925		3.6262	3,120
	next year bankrupt	0.1718	***	2.0072	464
Cash flow per unit of fixed assets	all	1.1871		6.6897	482,247
	healthy	1.2065		6.6739	477,844
	going bankrupt	-0.9082	***	7.9494	4,403
	next year bankrupt	-3.3566	***	8.9077	599
Debt per unit of fixed assets	all	15.6975		53.8349	482,247
	healthy	15.4930		53.3923	477,844
	going bankrupt	37.8979	***	86.9137	4,403
	next year bankrupt	46.7683	***	97.1966	599
Bank loans per unit of fixed assets	all	5.8652		169.2749	193,785
	healthy	5.6147		163.4643	190,940
	going bankrupt	22.6760	***	397.7208	2,845
	next year bankrupt	10.8390		42.4261	382
Turnover per unit of fixed assets	all	0.0522		0.1690	464,780
	healthy	0.0519		0.1684	460,463
	going bankrupt	0.0850	***	0.2211	4,317
	next year bankrupt	0.0724	***	0.1944	577

**Note:** Hypothesis of equality of means with healthy companies tested using a t-test.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

### 5.3 Summary Statistics

Altogether, we have 655,582 observations in our sample, which spans from 2006 to 2011. We have 650,090 observations on healthy companies, 5,492 observations on companies that will go bankrupt at some point in the future and 810 companies that will go bankrupt the following year.<sup>27</sup> Figure 5 depicts the evolution of bankruptcy incidence in our dataset. The coincidence between macroeconomic development, credit restriction (see Figure 2), and bankruptcy is clearly visible.

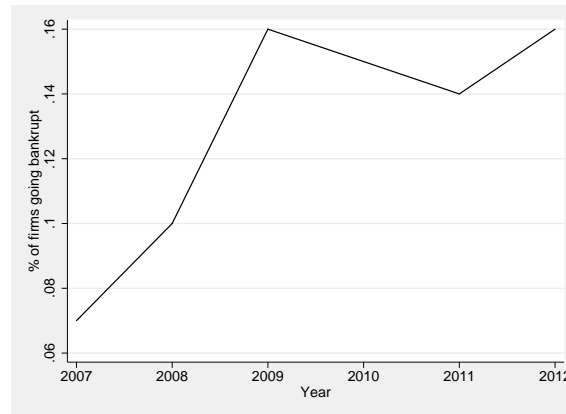
Figure 6 shows that after 2009 the investment rate started to decline. This is also roughly in line with the drop in lending to non-financial companies depicted in Figure 2. Table 1 summarizes the balance-sheet items of interest in the final dataset always for the whole sample, for healthy companies, for companies which go bankrupt, and for companies which go bankrupt the following year. We also test the hypothesis of equality of means with healthy companies. Asterisks mean that the hypothesis of equality is rejected (see the table notes).

Interestingly, we do not find significantly differing investment behavior of healthy firms and firms which will go bankrupt during our observed period. Only in the last year before declaring

believe that using EBRD deflators will be sufficient. However, these deflators vary only on the country level, which is a drawback.

<sup>27</sup> The numbers differ because “at some point going bankrupt” are the yearly observations for the 810 companies which go bankrupt.

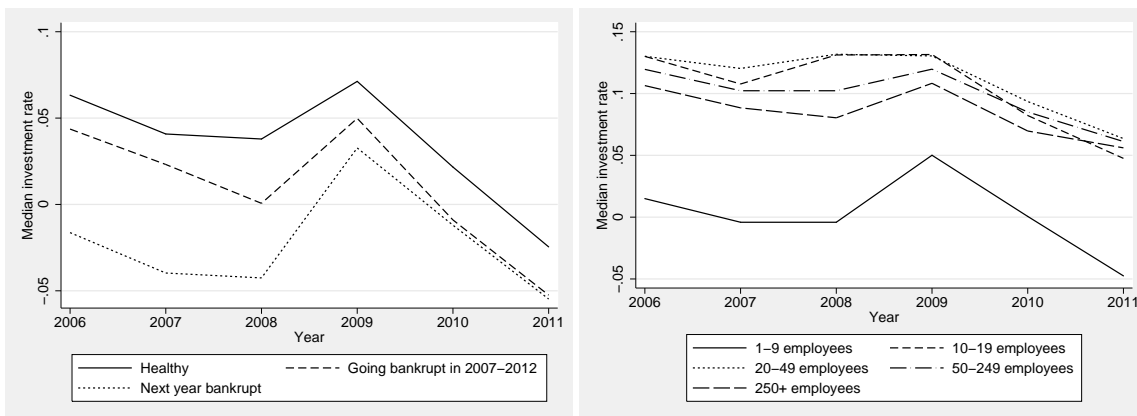
**Figure 5: Evolution of Bankruptcy in the Czech Republic**



**Note:** The figure depicts the share of bankrupt companies in total companies in the sample for the particular year.

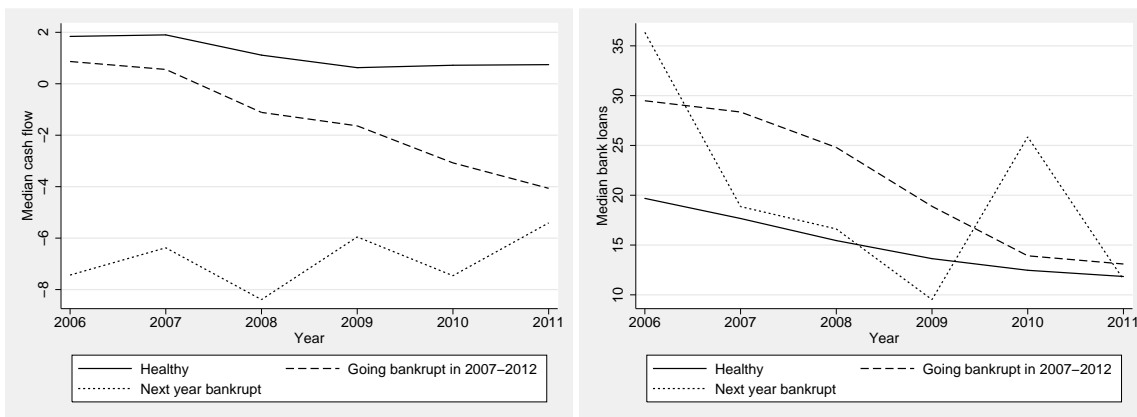
**Source:** Albertina, authors' calculations.

**Figure 6: Evolution of Investment Rate for Healthy and Bankrupt Companies and for Firms of Different Sizes**



**Source:** Albertina, authors' calculations.

**Figure 7: Evolution of Cash Flow and Bank Loans for Healthy and Bankrupt Companies**



**Source:** Albertina, authors' calculations.

**Table 2: Investment Rate Regression: All Companies**

Dependent variable: Investment rate	(1)	(2)	(3)
Investment rate <sub>(t-1)</sub>	-7.3e-05 (6.3e-05)	-6.9e-05 (6.4e-05)	-4.1e-05 (7.5e-05)
Squared investment rate <sub>(t-1)</sub>	-5.7e-04*** (1.2e-04)	-5.5e-04*** (1.2e-04)	-5.6e-04*** (1.3e-04)
Turnover <sub>(t-1)</sub>	-.027* (.016)	-.029* (.017)	-.024* (.013)
Cash flow <sub>(t-1)</sub>	2.3e-03*** (7.1e-04)	2.4e-03*** (7.5e-04)	3.2e-03*** (9.0e-04)
External debt <sub>(t-1)</sub>	4.8e-04*** (1.6e-04)	5.1e-04*** (1.7e-04)	4.3e-04*** (1.6e-04)
(Cash flow) <sub>(t-1)</sub> *(At some point bankrupt)		-.132 (.165)	
(Cash flow) <sub>(t-1)</sub> *(Next year bankrupt)			-6.46 (5.37)
Constant	.496*** (.025)	.496*** (.025)	.464*** (.059)
Observations	236250	236250	236250

**Note:** Heteroskedasticity and autocorrelation consistent standard errors in parentheses. All specifications include year and industry fixed effects. All variables are normalized by the respective firm's capital stock (fixed assets).

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

bankruptcy do firms invest less. The cash flow of companies going bankrupt is negative (see Figure 7).<sup>28</sup> On average, we can say that firms with negative cash flow are on the path to bankruptcy. However, companies going bankrupt on average have higher bank loans than healthy ones. This indicates that companies which are going to declare bankruptcy during our sample period do not have problems with obtaining bank credit. Again, this changes only a year before declaring bankruptcy, when the difference in bank loans between healthy and next-period-going-bankrupt companies turns statistically insignificant. Companies going bankrupt are more indebted than healthy ones.

## 6. Regression Results and Discussion

We have a classical situation with a panel of small T (limited time periods) and large N (many companies). Our independent variable (investment rates) is not strictly exogenous, meaning it is correlated with past and possibly current realizations of the error. We also have fixed effects, heteroskedasticity, and autocorrelation within companies. In this case, the most relevant estimators

<sup>28</sup> Negative cash flow means that cash inflow from sales is lower than cash outflow of cash payments. The common reasons for negative cash flow are usually thought to be low sales, high operating expenses, wrong investments, or unattractive financing conditions.

Table 3: Investment Rate Regression: Separate Results for 2006–2008 and 2008–2011

Dependent variable: Investment rate	06–08	06–08	06–08	08–11	08–11	08–11
Investment rate <sub>(t-1)</sub>	-1.2e-04* (6.6e-05)	-1.2e-04* (6.2e-05)	-7.9e-05* (4.3e-05)	-5.0e-05 (6.8e-05)	-2.9e-05 (9.0e-05)	-1.9e-05 (9.7e-05)
Squared investment rate <sub>(t-1)</sub>	8.9e-05 (2.7e-04)	1.3e-04 (2.9e-04)	-1.7e-04 (4.9e-04)	-6.9e-04*** (1.3e-04)	-5.0e-04* (2.6e-04)	-6.6e-04*** (1.4e-04)
Turnover <sub>(t-1)</sub>	-4.5e-03 (.022)	-4.4e-03 (.021)	-.019 (.027)	-.036** (.018)	-.029** (.014)	-.025* (.014)
Cash flow <sub>(t-1)</sub>	2.9e-03 (2.1e-03)	2.9e-03 (2.1e-03)	4.7e-03 (3.0e-03)	2.4e-03*** (8.3e-04)	3.5e-03*** (1.1e-03)	3.6e-03*** (1.2e-03)
External debt <sub>(t-1)</sub>	4.7e-04** (2.3e-04)	5.2e-04* (2.8e-04)	4.0e-04 (2.6e-04)	6.0e-04*** (1.7e-04)	5.6e-04*** (1.6e-04)	5.4e-04*** (1.6e-04)
(Cash flow) <sub>(t-1)</sub> *(At some point bankrupt)		-.13 (.254)			-3.73 (3.29)	
(Cash flow) <sub>(t-1)</sub> *(Next year bankrupt)			-40.9 (48.8)			-6.68 (5.99)
Constant	.387*** (.039)	.385*** (.039)	.347*** (.059)	.168*** (.024)	.105 (.07)	.083 (.103)
Observations	82216	82216	82216	198760	198760	198760

Note: Heteroskedasticity and autocorrelation consistent standard errors in parentheses. All specifications include year and industry fixed effects. All variables are normalized by the respective firm's capital stock (fixed assets).

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

**Table 4: Investment Rate Regression: Companies of Different Sizes (Number of Employees in Columns)**

Dependent variable: Investment rate	1–9	10–19	20–49	50–249	250–
Investment rate <sub>(t-1)</sub>	-4.2e-04* (2.4e-04)	1.4e-04 (3.2e-04)	-6.8e-05 (5.9e-05)	5.3e-05 (5.8e-05)	-8.4e-04 (1.4e-03)
Squared investment rate <sub>(t-1)</sub>	-9.0e-04*** (1.7e-04)	-8.9e-04*** (3.2e-04)	-4.4e-04 (4.7e-04)	-1.8e-03*** (4.7e-04)	1.6e-03 (2.3e-03)
Turnover <sub>(t-1)</sub>	-.067 (.046)	.346*** (.104)	.935*** (.318)	-8.9e-03 (.188)	.147 (.56)
Cash flow <sub>(t-1)</sub>	4.6e-03*** (1.4e-03)	4.3e-03*** (1.1e-03)	-1.8e-03 (3.0e-03)	5.9e-03 (4.8e-03)	-3.7e-04 (1.3e-03)
External debt <sub>(t-1)</sub>	8.0e-04*** (3.0e-04)	8.3e-04*** (1.7e-04)	-3.5e-05 (5.4e-04)	7.0e-04*** (1.5e-04)	5.9e-04 (2.9e-03)
Constant	.875*** (.073)	.642*** (.063)	.329*** (.034)	.214*** (.026)	.195** (.077)
Observations	97105	34648	32585	26858	6130

**Note:** Heteroskedasticity and autocorrelation consistent standard errors in parentheses. All specifications include year and industry fixed effects. All variables are normalized by the respective firm's capital stock (fixed assets).

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

**Table 5: Investment Rate Regression: Healthy Companies and Companies Going at Some Point Bankrupt**

Dependent variable: Investment rate	Healthy	Going bankrupt
Investment rate <sub>(t-1)</sub>	-7.0e-05 (6.3e-05)	1.2e-03 (1.2e-03)
Squared investment rate <sub>(t-1)</sub>	-5.8e-04*** (1.2e-04)	-1.5e-03 (1.0e-03)
Turnover <sub>(t-1)</sub>	-.029* (.018)	.446 (.598)
Cash flow <sub>(t-1)</sub>	2.3e-03*** (7.2e-04)	3.8e-03 (9.0e-03)
External debt <sub>(t-1)</sub>	5.2e-04*** (1.8e-04)	-1.2e-03 (1.7e-03)
Constant	.499*** (.025)	-.614*** (.122)
Observations	234619	1631

**Note:** Heteroskedasticity and autocorrelation consistent standard errors in parentheses. All specifications include year and industry fixed effects. All variables are normalized by the respective firm's capital stock (fixed assets).

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

appear to be the Arellano–Bond (Arellano and Bond, 1991) and Arellano–Bover/Blundell–Bond (Arellano and Bover, 1995; Blundell and Bond, 1998) dynamic panel estimators.<sup>29</sup>

First, we apply the GMM estimator on the whole sample with the interaction of a dummy capturing whether the firm goes bankrupt with the cash flow (see Table 2). The results indicate that there is a positive statistical correlation between the investment rate and cash flow for Czech firms in the period 2006–2011. Firms are, therefore, more likely to invest in new assets if they generate enough funds of their own. As we argue above, such a finding means that financial constraints exist and are binding. The coefficient shows the impact of a unit cash flow increase on the investment rate, both normalized by the capital stock of the company (proxied by its fixed assets). As we explain in the literature review, there is no clear consensus regarding the relationship between the coefficient size and the severity of the financial constraints faced by a firm. The results also show a non-linear negative impact of the past investment rate on the current investment rate. This supports the notion that investments tend to be made in clusters. Turnover should approximate firm specific investment opportunities but the negative coefficients indicate that it tends to capture other influences. Because we are interested in the link between bankruptcy and financial constraints, we add interaction terms between cash flow and going bankrupt during the whole observed period, or during the following year. This term captures the additional impact of cash flow on investment if the company is a bankrupting one. The results reveal that companies going bankrupt do not face significantly different financial constraints captured by the investment–cash flow sensitivity.

<sup>29</sup> We use the Stata command *xtabond2* to apply these estimators.

However, we are particularly interested in the impact of the 2008 crisis. Therefore, we apply this model on separate periods 2006–2008 and 2008–2011 (Table 3). The results show that even though the investment–cash flow sensitivity did not increase after 2008, it was not statistically significant in the pre-crisis period. This indicates that financial constraints started to play a more important role after 2008.

To better understand the potential impact of firm heterogeneity, we also split the sample according to firm size (Table 4) and health status (healthy firms vs. firms going bankrupt during the period 2007–2012; Table 5). The results reveal differences: whereas investment by small and medium-sized enterprises is sensitive to internal cash flow, investment by larger firms is not. Furthermore, whereas the investment rate of small and medium-sized enterprises is sensitive to external debt, this does not seem to be the case for larger companies (with the exception of firms with 50–249 employees).

Splitting the sample according to the health status of the firms further confirms what we found using the interaction terms between cash flow and the bankruptcy dummy: there does not seem to be a systematic relationship between going bankrupt and being financially constrained. In this case, however, the high standard errors may be partly caused by the relatively low number of observations and large differences between individual companies.

## **7. Conclusion**

In this paper, we used balance-sheet data to empirically study the relationship between investment, cash flow, and bankruptcy in a post-transition country. Specifically, we looked at the evolution of investment with respect to financial constraints. Our paper links balance-sheet microdata with original bankruptcy data, which allows us to study the evolution of firms' behavior and their reaction to the 2008 crisis from a new perspective.

Companies which went bankrupt in the period 2006–2011 had significantly lower cash flow and, maybe surprisingly, a higher level of bank loans than healthy companies. This indicates that companies which are going to declare bankruptcy do not have problems obtaining bank credit. We find that they did not face more severe financial constraints than healthy companies. We could even speculate that the lack of financial constraints in some companies led to excess accumulation of external debt and subsequent financial difficulties. At least, this hypothesis is not falsified by our analysis. The data clearly show that a lack of external financing was not the primary reason for bankruptcy.

Regarding the factors which influence the rate of investment, we conclude that there is robust evidence that cash flow and the level of debt have a positive and significant impact on the investment rate. At the same time, future bankruptcy as a proxy for unobserved variables does not seem to have any significant impact on the investment rate. Only in the last year before declaring bankruptcy did firms invest less.

Investment–cash flow sensitivities, which are used as an indicator of financial constraints, did not increase after 2008. But internal cash flow is significant in the investment equations after the crisis and not before. This leads us to conclude that financial constraints became more widespread and severe in the post-crisis period. We also find that whereas the investment decisions of larger firms were not sensitive to internal cash flow, the latter played a significant role in the case of small and medium-sized enterprises. This is in line with existing literature showing that financial constraints are usually negatively correlated with firm size. Our analysis also reveals that investment by small



and medium-sized enterprises was sensitive to external debt, which was mostly not the case for larger companies.

The analysis could be taken even further in the future. It is, for instance, probable that the division between credit-constrained and credit-unconstrained companies is in fact much more complicated than just according to their size. It may be possible to link some of the above-mentioned survey results on whether companies feel financially constrained with balance-sheet data and other firm characteristics, and use them to estimate threshold values for splitting the sample into constrained and unconstrained regimes. An estimation of investment–cash flow sensitivity on these subsamples could lead to even more precise answers regarding the severity of financial constraints in the Czech Republic.

## References

- AGCA, S. AND A. MOZUMDAR (2008): “The impact of capital market imperfections on investment-cash flow sensitivity.” *Journal of Banking & Finance*, 32(2):207–216.
- ARELLANO, M. AND S. BOND (1991): “Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations.” *Review of Economic Studies*, 58(2):277–97.
- ARELLANO, M. AND O. BOVER (1995): “Another look at the instrumental variable estimation of error-components models.” *Journal of Econometrics*, 68(1):29–51.
- BERNANKE, B. AND M. GERTLER (1995): “Inside the Black Box: The Credit Channel of Monetary Policy Transmission.” *Journal of Economic Perspectives*, 9(4):27–48.
- BERNANKE, B. S. (1993): “Credit in the Macroeconomy.” *Federal Reserve Bank of New York Quarterly Review*, 18(1):50–70.
- BERNANKE, B. S. AND A. S. BLINDER (1992): “The Federal Funds Rate and the Channels of Monetary Transmission.” *American Economic Review*, 82(4):901–21.
- BERNANKE, B. S., M. GERTLER, AND S. GILCHRIST (1999): *The financial accelerator in a quantitative business cycle framework*. In Taylor, J. B. and M. Woodford, editors, volume 1, part C of *Handbook of Macroeconomics*, chapter 21, pages 1341–1393. Elsevier.
- BILLOR, N., A. S. HADI, AND P. F. VELLEMAN (2000): “BACON: blocked adaptive computationally efficient outlier nominators.” *Computational Statistics & Data Analysis*, 34(3): 279–298.
- BLUNDELL, R. AND S. BOND (1998): “Initial conditions and moment restrictions in dynamic panel data models.” *Journal of Econometrics*, 87(1):115–143.
- BROWN, M., T. JAPPELLI, AND M. PAGANO (2009): “Information sharing and credit: Firm-level evidence from transition countries.” *Journal of Financial Intermediation*, 18(2):151–172.
- CAI, J. AND A. HARRISON (2011): “The Value-Added Tax Reform Puzzle.” NBER Working Papers 17532, National Bureau of Economic Research, Inc
- CAMPELLO, M., J. R. GRAHAM, AND C. R. HARVEY (2010): “The real effects of financial constraints: Evidence from a financial crisis.” *Journal of Financial Economics*, 97(3):470–487.
- CARPENTER, R. E. AND A. GUARIGLIA (2008): “Cash flow, investment, and investment opportunities: New tests using UK panel data.” *Journal of Banking & Finance*, 32(9):1894–1906.
- CETORELLI, N. AND P. E. STRAHAN (2006): “Finance as a Barrier to Entry: Bank Competition and Industry Structure in Local U.S. Markets.” *Journal of Finance*, 61(1):437–461.
- CHATELAIN, J.-B., M. EHRMANN, A. GENERALE, J. MARTÍNEZ-PAGÉS, P. VERMEULEN, AND A. WORMS (2003): “Monetary Policy Transmission in the Euro Area: New Evidence From Micro Data on Firms and Banks.” *Journal of the European Economic Association*, 1(2-3): 731–742.
- CHAVA, S. AND M. R. ROBERTS (2008): “How Does Financing Impact Investment? The Role of Debt Covenants.” *Journal of Finance*, 63(5):2085–2121.

- CHEN, H. AND S. CHEN (2011): "Investment-Cash Flow Sensitivity Cannot Be a Good Measure of Financial Constraints: Evidence from the Time Series." *Journal of Financial Economics*, 103(2):393–410.
- CINQUEGRANA, G., C. DONATI, AND D. SARNO (2012): "Financial constraints and relationship lending in the growth of italian SMEs." MPRA Paper 39825, University Library of Munich, Germany
- CLARKE, G. R., R. CULL, AND G. KISUNKO (2012): "External Finance and Firm Survival in the Aftermath of the Crisis: Evidence from Eastern Europe and Central Asia." Policy Research Working Paper 6050, The World Bank
- FAZZARI, S. M., R. G. HUBBARD, AND B. C. PETERSEN (1988): "Financing Constraints and Corporate Investment." *Brookings Papers on Economic Activity*, 19(1):141–206.
- FAZZARI, S. M., R. G. HUBBARD, AND B. C. PETERSEN (2000): "Financing Constraints and Corporate Investment: Response to Kaplan and Zingales." NBER Working Papers 5462, National Bureau of Economic Research, Inc
- FIDRMUC, J., R. HORVATH, AND E. HORVATHOVA (2010): "Corporate Interest Rates and the Financial Accelerator in the Czech Republic." *Emerging Markets Finance and Trade*, 46(4):41–54.
- FISHER, I. (1933): "The debt-deflation theory of great depressions." *Econometrica*, 1(4):337–357.
- GAJOTTI, E. (2011): "Credit availability and investment in Italy: lessons from the Great Recession." Temi di discussione (Economic working papers) 793, Bank of Italy
- GERŠL, A. AND P. JAKUBÍK (2011): "Relationship Lending in Emerging Markets: Evidence from the Czech Republic." *Comparative Economic Studies*, 53(4):575–596.
- GERTLER, M. L. AND R. G. HUBBARD (1989): "Financial Factors in Business Fluctuations." NBER Working Papers 2758, National Bureau of Economic Research, Inc
- GILCHRIST, S. AND C. HIMMELBERG (1999): *Investment: Fundamentals and Finance*. In Bernanke, B. S. and J. J. Rotemberg, editors, *NBER Macroeconomics Annual 1998, volume 13*, pages 223–274. MIT Press.
- HARRISON, A. E., I. LOVE, AND M. S. MCMILLAN (2004): "Global capital flows and financing constraints." *Journal of Development Economics*, 75(1):269–301.
- HOBDAI, B., D. C. JONES, AND N. MYGIND (2009): "Capital investment and determinants of financial constraints in Estonia." *Economic Systems*, 33(4):344–359.
- HOLTON, S., M. LAWLESS, AND F. MCCANN (2012): "Firm Credit in Europe: A Tale of Three Crises." Research Technical Paper 04/RT/12, Central Bank of Ireland
- HOVAKIMIAN, G. AND S. TITMAN (2006): "Corporate Investment with Financial Constraints: Sensitivity of Investment to Funds from Voluntary Asset Sales." *Journal of Money, Credit and Banking*, 38(2):357–374.
- JANDA, K. (2011): "Inefficient Credit Rationing and Public Support of Commercial Credit Provision." *Journal of Institutional and Theoretical Economics JITE*, 167(2):371–391.
- JULIO, B. AND Y. YOOK (2012): "Political Uncertainty and Corporate Investment Cycles." *Journal of Finance*, 67(1):45–83.

- KAPLAN, S. N. AND L. ZINGALES (1997): “Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints.” *The Quarterly Journal of Economics*, 112(1): 169–215.
- KAPLAN, S. N. AND L. ZINGALES (2000): “Investment-Cash Flow Sensitivities Are Not Valid Measures Of Financing Constraints.” *The Quarterly Journal of Economics*, 115(2):707–712.
- KASHYAP, A. K., O. A. LAMONT, AND J. C. STEIN (1994): “Credit Conditions and the Cyclical Behavior of Inventories.” *The Quarterly Journal of Economics*, 109(3):565–92.
- KEASEY, K. AND R. WATSON (1991): “The State of the Art of Small Firm Failure Prediction: Achievements and Prognosis.” *International Small Business Journal*, 9(4):11–29.
- KOCHANOVA, A. (2012): “The Impact of Bribery on Firm Performance: Evidence from Central and Eastern European Countries.” CERGE-EI Working Papers 473, Center for Economic Research and Graduate Education – Economics Institute, Prague
- KONINGS, J., M. RIZOV, AND H. VANDENBUSSCHE (2003): “Investment and financial constraints in transition economies: micro evidence from Poland, the Czech Republic, Bulgaria and Romania.” *Economics Letters*, 78(2):253–258.
- LOVE, I. (2003): “Financial Development and Financing Constraints: International Evidence from the Structural Investment Model.” *Review of Financial Studies*, 16(3):765–791.
- LÍZAL, L. AND J. SVEJNAR (2000): “Financial Conditions and Investment during the Transition: Evidence from Czech Firms.” CERGE-EI Working Papers 153, Center for Economic Research and Graduate Education – Economics Institute, Prague
- LÍZAL, L. AND J. SVEJNAR (2002): “Investment, Credit Rationing, And The Soft Budget Constraint: Evidence From Czech Panel Data.” *The Review of Economics and Statistics*, 84(2): 353–370.
- MACH, T. L. AND J. D. WOLKEN (2012): *Examining the Impact of Credit Access on Small Firm Survivability*. In Calcagnini, G. and I. Favaretto, editors, *Small Businesses in the Aftermath of the Crisis*, pages 189–210. Physica-Verlag HD.
- MORENO BADIA, M. AND V. SLOOTMAEKERS (2009): “The Missing Link Between Financial Constraints and Productivity.” IMF Working Papers 09/72, International Monetary Fund
- MUSSO, P. AND S. SCHIAVO (2008): “The impact of financial constraints on firm survival and growth.” *Journal of Evolutionary Economics*, 18(2):135–149.
- OLINER, S. D. AND G. D. RUDEBUSCH (1996): “Is there a broad credit channel for monetary policy?” *Federal Reserve Bank of San Francisco Economic Review*, 1996:3–13.
- PLAŠIL, M., Š. RADKOVSKÝ, AND P. ŘEŽÁBEK (2013): *Modelling bank loans to non-financial corporations*. In *CNB Financial Stability Report 2012/2013*. Czech National Bank.
- PONCET, S., W. STEINGRESS, AND H. VANDENBUSSCHE (2010): “Financial constraints in China: Firm-level evidence.” *China Economic Review*, 21(3):411–422.
- PRUTEANU, A. (2004): “Was There Evidence of Credit Rationing in the Czech Republic?” *Eastern European Economics*, 42(5):58–72.
- STIGLITZ, J. E. AND A. WEISS (1981): “Credit Rationing in Markets with Imperfect Information.” *American Economic Review*, 71(3):393–410.

- WEBER, S. (2010): “bacon: An effective way to detect outliers in multivariate data using Stata (and Mata).” *Stata Journal*, 10(3):331–338.
- WHITED, T. M. (2001): “Is It Inefficient Investment that Causes the Diversification Discount?” *Journal of Finance*, 56(5):1667–1691.

## Appendix 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 Sloomakers (2009), Gilchrist and Himmelberg (1999), and Harrison et al. (2004)<sup>30</sup> we can define the value of the firm as

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

subject to

$$D_t = \Pi(K_t, \xi_t) - C(K_t, I_t) - I_t \quad (\text{A.2})$$

$$K_{t+1} = (1 - \delta)K_t + I_t \quad (\text{A.3})$$

where  $\xi_t$  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, and  $\beta_t$  is the discount factor.

The Q model of the investment Euler equation is:

$$1 + \frac{\partial C(I_t, K_t)}{\partial I_t} = \beta_t \left\{ \Psi_t \frac{\partial \Pi_{t+1}}{\partial K_{t+1}} + (1 - \delta) \left( 1 + \frac{\partial C(I_{t+1}, K_{t+1})}{\partial I_{t+1}} \right) \right\} \quad (\text{A.4})$$

where  $\lambda_t$  is the Lagrange multiplier and  $\Psi_t = \frac{1+\lambda_{t+1}}{1+\lambda_t}$  is the marginal cost of capital and 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.

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

$$\Psi_t = a_0 + a_1 \frac{CashFlow}{K} \quad (\text{A.5})$$

<sup>30</sup> Our work also draws inspiration from the literature on credit rationing and capital market imperfections (e.g. Harrison et al., 2004). Recently, Janda (2011) modeled credit guarantees and interest rate subsidies in a framework of credit rationing.

The marginal product of capital can be proxied as:

$$MPK_t = \frac{\partial \pi_t}{\partial K_t} = \theta_i \left( \frac{Sales}{K} \right)_i \simeq b + \theta_i + \bar{\theta} \left( \frac{Sales}{K} \right)_i, \quad (A.6)$$

and

$$\theta_i = \frac{\alpha_k}{\mu} \quad (A.7)$$

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

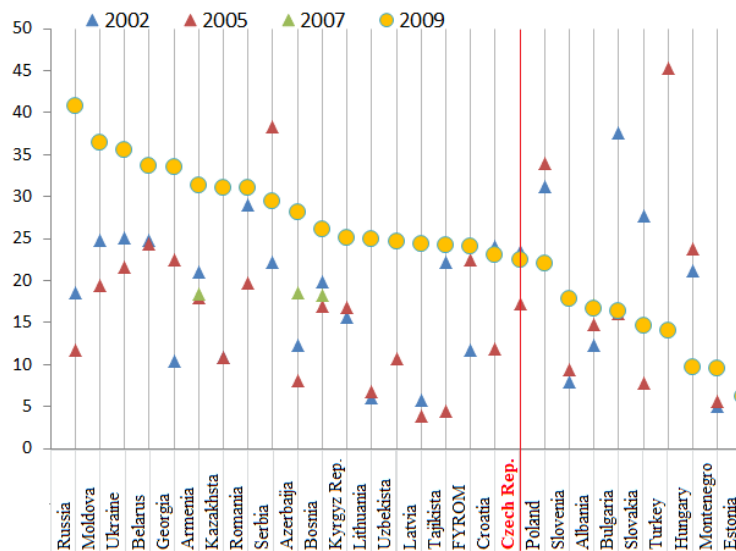
$$\frac{\partial C(I_t, K_t)}{\partial I_t} = \frac{1}{\alpha_1} \left[ \left( \frac{I}{K} \right)_t - \alpha_2 \left( \frac{I}{K} \right)_{t-1} - \alpha_i + \alpha_t \right] \quad (A.8)$$

where  $\alpha_1, \alpha_2$  are constants,  $\alpha_i$  is the firm-specific level of investment (fixed effect), and  $\alpha_t$  is a time effect.

To get the empirical equation we linearize the Euler equation and use first-Euler Taylor approximation around the means.

## Appendix B: Additional Figures

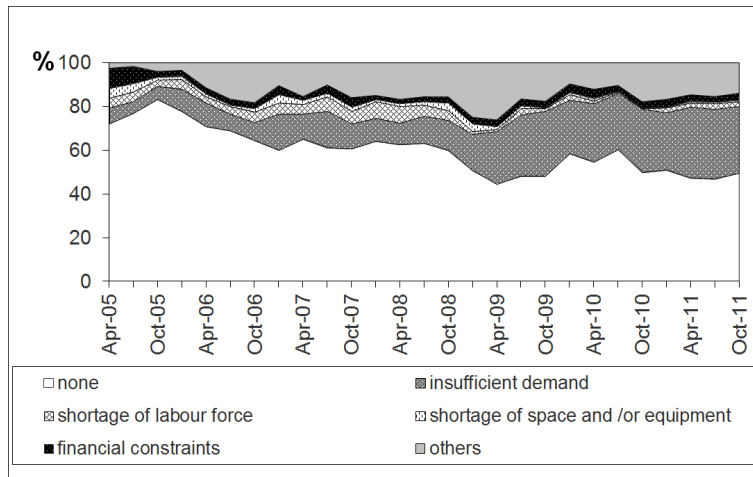
Figure B.1: Finance as a Major or Severe Obstacle



**Note:** The figure depicts the share of companies that assess finance as a 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, authors' calculations.

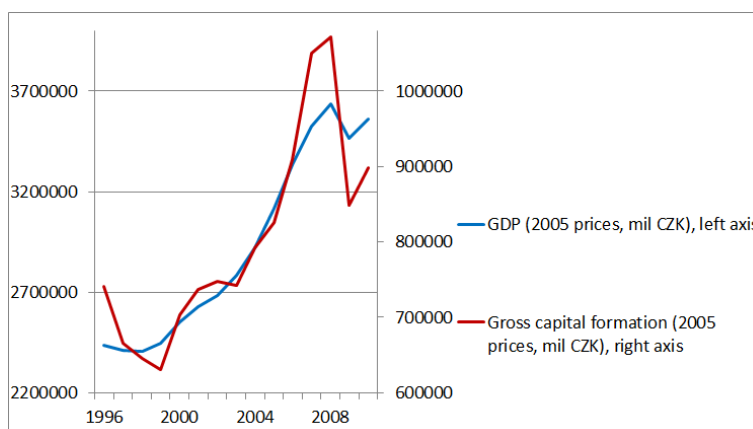
**Figure B.2: Barriers to Growth in Services**



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

**Source:** Czech Statistical Office, authors' calculations.

**Figure B.3: 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 subsequent events.

**Source:** Czech Statistical Office, authors' calculations.



**CNB WORKING PAPER SERIES**

1/2014	Martin Pospíšil Jiří Schwarz	<i>Bankruptcy, investment, and financial constraints: Evidence from a post-transition economy</i>
15/2013	Jaromír Baxa Miroslav Plašil Bořek Vašíček	<i>Inflation and the steeplechase between economic activity variables</i>
14/2013	Narcisa Kadlčáková Luboš Komárek Zlatuše Komárková Michal Hlaváček	<i>Identification of asset price misalignments on financial markets with extreme value theory</i>
13/2013	Giovanni Calice RongHui Miao Filip Štěrba Bořek Vašíček	<i>Short-term determinants of the idiosyncratic sovereign risk premium: A regime-dependent analysis for European credit default swaps</i>
12/2013	Michal Skořepa Luboš Komárek	<i>Sources of asymmetric shocks: The exchange rate or other culprits?</i>
11/2013	Alexis Derviz	<i>Collateral composition, diversification risk, and systemically important merchant banks</i>
10/2013	Tomáš Konečný Oxana Babecká Kucharčuková	<i>Evaluating the links between the financial and real sectors in a small open economy: The case of the Czech Republic</i>
9/2013	Michal Franta	<i>The effect of non-linearity between credit conditions and economic activity on density forecasts</i>
8/2013	Jan Babecký Tomáš Havránek	<i>Structural reforms and economic growth: A meta-analysis</i>
7/2013	Michal Andrlé Jan Brůha Serhat Solmaz	<i>Inflation and output comovement in the Euro Area: Love at second sight?</i>
6/2013	Marek Rusnák	<i>Nowcasting Czech GDP in real time</i>
5/2013	Tomáš Havránek Roman Horváth Petra Valičková	<i>Financial development and economic growth: A meta-analysis</i>
4/2013	Peter Tóth	<i>Currency shocks to export sales of importers: A heterogeneous firms model and Czech micro estimates</i>
3/2013	Aleš Bulíř Jaromír Hurník Kateřina Šmídková	<i>Inflation reports and models: How well do central banks really write?</i>
2/2013	František Brázdík	<i>Expected regime change: Transition toward nominal exchange rate stability</i>
1/2013	Adam Geršl Jitka Lešánovská	<i>Explaining the Czech interbank market risk premium</i>
15/2012	Róbert Ambriško Jan Babecký Jakub Ryšánek Vilém Valenta	<i>Assessing the impact of fiscal measures on the Czech economy</i>
14/2012	Václav Hausenblas Ivana Kubicová Jitka Lešánovská	<i>Contagion risk in the Czech financial system: A network analysis and simulation approach</i>

13/2012	Michal Franta	<i>Macroeconomic effects of fiscal policy in the Czech Republic: Evidence based on various identification approaches in a VAR framework</i>
12/2012	Konstantin Belyaev Aelita Belyaeva Tomáš Konečný Jakub Seidler Martin Vojtek	<i>Macroeconomic factors as drivers of LGD prediction: Empirical evidence from the Czech Republic</i>
11/2012	Adam Geršl Petr Jakubík Tomáš Konečný Jakub Seidler	<i>Dynamic stress testing: The framework for testing banking sector resilience used by the Czech National Bank</i>
10/2012	Tomáš Havránek Marek Rusnák	<i>Transmission lags of monetary policy: A meta-analysis</i>
9/2012	Volha Audzei František Brázdk	<i>Monetary policy and exchange rate dynamics: The exchange rate as a shock absorber</i>
8/2012	Alexis Derviz Jakub Seidler	<i>Coordination incentives in cross-border macroprudential regulation</i>
7/2012	Peter Claeys Bořek Vašíček	<i>Measuring sovereign bond spillover in Europe and the impact of rating news</i>
6/2012	Michal Franta Jan Libich Petr Stehlík	<i>Tracking monetary-fiscal interactions across time and space</i>
5/2012	Roman Horváth Jakub Seidler Laurent Weill	<i>Bank capital and liquidity creation: Granger causality evidence</i>
4/2012	Jaromír Baxa Miroslav Plašil Bořek Vašíček	<i>Changes in inflation dynamics under inflation targeting? Evidence from Central European countries</i>
3/2012	Soňa Benecká Tomáš Holub Narcisa Liliana Kadlčáková Ivana Kubicová	<i>Does central bank financial strength matter for inflation? An empirical analysis</i>
2/2012	Adam Geršl Petr Jakubík Dorota Kowalczyk Steven Ongena José-Luis Peydró Alcalde	<i>Monetary conditions and banks' behaviour in the Czech Republic</i>
1/2012	Jan Babecký Kamil Dybczak	<i>Real wage flexibility in the European Union: New evidence from the labour cost data</i>
15/2011	Jan Babecký Kamil Galuščák Lubomír Lízal	<i>Firm-level labour demand: Adjustment in good times and during the crisis</i>
14/2011	Vlastimil Čadek Helena Rottová Branislav Saxa	<i>Hedging behaviour of Czech exporting firms</i>
13/2011	Michal Franta Roman Horváth Marek Rusnák	<i>Evaluating changes in the monetary transmission mechanism in the Czech Republic</i>

12/2011	Jakub Ryšánek Jaromír Tonner Osvald Vašíček	<i>Monetary policy implications of financial frictions in the Czech Republic</i>
11/2011	Zlataše Komárková Adam Geršl Luboš Komárek	<i>Models for stress testing Czech banks' liquidity risk</i>
10/2011	Michal Franta Jozef Baruník Roman Horváth Kateřina Šmídková	<i>Are Bayesian fan charts useful for central banks? Uncertainty, forecasting, and financial stability stress tests</i>
9/2011	Kamil Galuščák Lubomír Lízal	<i>The impact of capital measurement error correction on firm-level production function estimation</i>
8/2011	Jan Babecký Tomáš Havránek Jakub Matějů Marek Rusnák Kateřina Šmídková Bořek Vašíček	<i>Early warning indicators of economic crises: Evidence from a panel of 40 developed countries</i>
7/2011	Tomáš Havránek Zuzana Iršová	<i>Determinants of horizontal spillovers from FDI: Evidence from a large meta-analysis</i>
6/2011	Roman Horváth Jakub Matějů	<i>How are inflation targets set?</i>
5/2011	Bořek Vašíček	<i>Is monetary policy in the new EU member states asymmetric?</i>
4/2011	Alexis Derviz	<i>Financial frictions, bubbles, and macroprudential policies</i>
3/2011	Jaromír Baxa Roman Horváth Bořek Vašíček	<i>Time-varying monetary-policy rules and financial stress: Does financial instability matter for monetary policy?</i>
2/2011	Marek Rusnák Tomáš Havránek Roman Horváth	<i>How to solve the price puzzle? A meta-analysis</i>
1/2011	Jan Babecký Aleš Bulíř Kateřina Šmídková	<i>Sustainable real exchange rates in the new EU member states: What did the Great Recession change?</i>
15/2010	Ke Pang Pierre L. Siklos	<i>Financial frictions and credit spreads</i>
14/2010	Filip Novotný Marie Raková	<i>Assessment of consensus forecasts accuracy: The Czech National Bank perspective</i>
13/2010	Jan Filáček Branislav Saxa	<i>Central bank forecasts as a coordination device</i>
12/2010	Kateřina Arnoštová David Havrlant Luboš Růžička Peter Tóth	<i>Short-term forecasting of Czech quarterly GDP using monthly indicators</i>
11/2010	Roman Horváth Kateřina Šmídková Jan Zápál	<i>Central banks' voting records and future policy</i>
10/2010	Alena Bičáková Zuzana Prelcová Renata Pašaličová	<i>Who borrows and who may not repay?</i>

9/2010	Luboš Komárek Jan Babecký Zlataše Komárková	<i>Financial integration at times of financial instability</i>
8/2010	Kamil Dybczak Peter Tóth David Voňka	<i>Effects of price shocks to consumer demand. Estimating the QUAIDS demand system on Czech Household Budget Survey data</i>
7/2010	Jan Babecký Philip Du Caju Theodora Kosma Martina Lawless Julián Messina Tairi Rõõm	<i>The margins of labour cost adjustment: Survey evidence from European firms</i>
6/2010	Tomáš Havránek Roman Horváth Jakub Matějů	<i>Do financial variables help predict macroeconomic environment? The case of the Czech Republic</i>
5/2010	Roman Horváth Luboš Komárek Filip Rozsypal	<i>Does money help predict inflation? An empirical assessment for Central Europe</i>
4/2010	Oxana Babecká Kucharčuková Jan Babecký Martin Raiser	<i>A gravity approach to modelling international trade in South-Eastern Europe and the Commonwealth of Independent States: The role of geography, policy and institutions</i>
3/2010	Tomáš Havránek Zuzana Iršová	<i>Which foreigners are worth wooing? A Meta-analysis of vertical spillovers from FDI</i>
2/2010	Jaromír Baxa Roman Horváth Bořek Vašíček	<i>How does monetary policy change? Evidence on inflation targeting countries</i>
1/2010	Adam Geršl Petr Jakubík	<i>Relationship lending in the Czech Republic</i>
15/2009	David N. DeJong Roman Liesenfeld Guilherme V. Moura Jean-Francois Richard Hariharan Dharmarajan	<i>Efficient likelihood evaluation of state-space representations</i>
14/2009	Charles W. Calomiris	<i>Banking crises and the rules of the game</i>
13/2009	Jakub Seidler Petr Jakubík	<i>The Merton approach to estimating loss given default: Application to the Czech Republic</i>
12/2009	Michal Hlaváček Luboš Komárek	<i>Housing price bubbles and their determinants in the Czech Republic and its regions</i>
11/2009	Kamil Dybczak Kamil Galuščák	<i>Changes in the Czech wage structure: Does immigration matter?</i>
10/2009	Jiří Böhm Petr Král Branislav Saxa	<i>Perception is always right: The CNB's monetary policy in the media</i>
9/2009	Alexis Derviz Marie Raková	<i>Funding costs and loan pricing by multinational bank affiliates</i>
8/2009	Roman Horváth Anca Maria Podpiera David Kocourek	<i>Heterogeneity in bank pricing policies: The Czech evidence</i> <i>The impact of early retirement incentives on labour market</i>

7/2009	Filip Pertold	<i>participation: Evidence from a parametric change in the Czech Republic</i>
	Nauro F. Campos	<i>Reform redux: Measurement, determinants and reversals</i>
6/2009	Roman Horváth	
5/2009	Kamil Galuščák Mary Keeney Daphne Nicolitsas Frank Smets Pawel Strzelecki Matija Vodopivec	<i>The determination of wages of newly hired employees: Survey evidence on internal versus external factors</i>
4/2009	Jan Babecký Philip Du Caju Theodora Kosma Martina Lawless Julián Messina Tairi Rõõm	<i>Downward nominal and real wage rigidity: Survey evidence from European firms</i>
3/2009	Jiri Podpiera Laurent Weill	<i>Measuring excessive risk-taking in banking</i>
2/2009	Michal Andrej Tibor Hlédik Ondra Kameník Jan Vlček	<i>Implementing the new structural model of the Czech National Bank</i>
1/2009	Kamil Dybczak Jan Babecký	<i>The impact of population ageing on the Czech economy</i>
14/2008	Gabriel Fagan Vitor Gaspar	<i>Macroeconomic adjustment to monetary union</i>
13/2008	Giuseppe Bertola Anna Lo Prete	<i>Openness, financial markets, and policies: Cross-country and dynamic patterns</i>
12/2008	Jan Babecký Kamil Dybczak Kamil Galuščák	<i>Survey on wage and price formation of Czech firms</i>
11/2008	Dana Hájková	<i>The measurement of capital services in the Czech Republic</i>
10/2008	Michal Franta	<i>Time aggregation bias in discrete time models of aggregate duration data</i>
9/2008	Petr Jakubík Christian Schmieder	<i>Stress testing credit risk: Is the Czech Republic different from Germany?</i>
8/2008	Sofia Bauducco Aleš Bulíř Martin Čihák	<i>Monetary policy rules with financial instability</i>
7/2008	Jan Brůha Jiří Podpiera	<i>The origins of global imbalances</i>
6/2008	Jiří Podpiera Marie Raková	<i>The price effects of an emerging retail market</i>
5/2008	Kamil Dybczak David Voňka Nico van der Windt	<i>The effect of oil price shocks on the Czech economy</i>
4/2008	Magdalena M. Borys Roman Horváth	<i>The effects of monetary policy in the Czech Republic: An empirical study</i>
3/2008	Martin Cincibuch	<i>Central bank losses and economic convergence</i>

	Tomáš Holub Jaromír Hurník	
2/2008	Jiří Podpiera	<i>Policy rate decisions and unbiased parameter estimation in conventionally estimated monetary policy rules</i>
1/2008	Balázs Égert Doubravko Mihaljek	<i>Determinants of house prices in Central and Eastern Europe</i>
17/2007	Pedro Portugal	<i>U.S. unemployment duration: Has long become longer or short become shorter?</i>
16/2007	Yuliya Rychalovská	<i>Welfare-based optimal monetary policy in a two-sector small open economy</i>
15/2007	Juraj Antal František Brázdk	<i>The effects of anticipated future change in the monetary policy regime</i>
14/2007	Aleš Bulíř Kateřina Šmídková Viktor Kotlán David Navrátil	<i>Inflation targeting and communication: Should the public read inflation reports or tea leaves?</i>
13/2007	Martin Cinnibuch Martina Horníková	<i>Measuring the financial markets' perception of EMU enlargement: The role of ambiguity aversion</i>
12/2007	Oxana Babetskaia- Kukharchuk	<i>Transmission of exchange rate shocks into domestic inflation: The case of the Czech Republic</i>
11/2007	Jan Filáček	<i>Why and how to assess inflation target fulfilment</i>
10/2007	Michal Franta Branislav Saxa Kateřina Šmídková	<i>Inflation persistence in new EU member states: Is it different than in the Euro area members?</i>
9/2007	Kamil Galuščák Jan Pavel	<i>Unemployment and inactivity traps in the Czech Republic: Incentive effects of policies</i>
8/2007	Adam Geršl Ieva Rubene Tina Zumer	<i>Foreign direct investment and productivity spillovers: Updated evidence from Central and Eastern Europe</i>
7/2007	Ian Babetskii Luboš Komárek Zlataše Komárková	<i>Financial integration of stock markets among new EU member states and the euro area</i>
6/2007	Anca Pruteanu-Podpiera Laurent Weill Franziska Schobert	<i>Market power and efficiency in the Czech banking sector</i>
5/2007	Jiří Podpiera Laurent Weill	<i>Bad luck or bad management? Emerging banking market experience</i>
4/2007	Roman Horváth	<i>The time-varying policy neutral rate in real time: A predictor for future inflation?</i>
3/2007	Jan Brůha Jiří Podpiera Stanislav Polák	<i>The convergence of a transition economy: The case of the Czech Republic</i>
2/2007	Ian Babetskii Nauro F. Campos	<i>Does reform work? An econometric examination of the reform-growth puzzle</i>
1/2007	Ian Babetskii Fabrizio Coricelli Roman Horváth	<i>Measuring and explaining inflation persistence: Disaggregate evidence on the Czech Republic</i>
13/2006	Frederic S. Mishkin	<i>Does inflation targeting make a difference?</i>

---

	Klaus Schmidt-Hebbel	
12/2006	Richard Disney Sarah Bridges John Gathergood	<i>Housing wealth and household indebtedness: Is there a household 'financial accelerator'?</i>
11/2006	Michel Juillard Ondřej Kameník Michael Kumhof Douglas Laxton	<i>Measures of potential output from an estimated DSGE model of the United States</i>
10/2006	Jiří Podpiera Marie Raková	<i>Degree of competition and export-production relative prices when the exchange rate changes: Evidence from a panel of Czech exporting companies</i>
9/2006	Alexis Derviz Jiří Podpiera	<i>Cross-border lending contagion in multinational banks</i>
8/2006	Aleš Bulíř Jaromír Hurník	<i>The Maastricht inflation criterion: "Saints" and "Sinners"</i>
7/2006	Alena Bičáková Jiří Slačálek Michal Slavík	<i>Fiscal implications of personal tax adjustments in the Czech Republic</i>
6/2006	Martin Fukač Adrian Pagan	<i>Issues in adopting DSGE models for use in the policy process</i>
5/2006	Martin Fukač	<i>New Keynesian model dynamics under heterogeneous expectations and adaptive learning</i>
4/2006	Kamil Dybczak Vladislav Flek Dana Hájková Jaromír Hurník	<i>Supply-side performance and structure in the Czech Republic (1995–2005)</i>
3/2006	Aleš Krejdl	<i>Fiscal sustainability – definition, indicators and assessment of Czech public finance sustainability</i>
2/2006	Kamil Dybczak	<i>Generational accounts in the Czech Republic</i>
1/2006	Ian Babetskii	<i>Aggregate wage flexibility in selected new EU member states</i>

---

14/2005	Stephen G. Cecchetti	<i>The brave new world of central banking: The policy challenges posed by asset price booms and busts</i>
13/2005	Robert F. Engle Jose Gonzalo Rangel	<i>The spline GARCH model for unconditional volatility and its global macroeconomic causes</i>
12/2005	Jaromír Beneš Tibor Hlédik Michael Kumhof David Vávra	<i>An economy in transition and DSGE: What the Czech national bank's new projection model needs</i>
11/2005	Marek Hlaváček Michael Koňák Josef Čada	<i>The application of structured feedforward neural networks to the modelling of daily series of currency in circulation</i>
10/2005	Ondřej Kameník	<i>Solving SDGE models: A new algorithm for the Sylvester equation</i>
9/2005	Roman Šustek	<i>Plant-level nonconvexities and the monetary transmission mechanism</i>
8/2005	Roman Horváth	<i>Exchange rate variability, pressures and optimum currency area criteria: Implications for the central and eastern European countries</i>

7/2005	Balázs Égert Luboš Komárek	<i>Foreign exchange interventions and interest rate policy in the Czech Republic: Hand in glove?</i>
6/2005	Anca Podpiera Jiří Podpiera	<i>Deteriorating cost efficiency in commercial banks signals an increasing risk of failure</i>
5/2005	Luboš Komárek Martin Melecký	<i>The behavioural equilibrium exchange rate of the Czech koruna</i>
4/2005	Kateřina Arnoštová Jaromír Hurník	<i>The monetary transmission mechanism in the Czech Republic (evidence from VAR analysis)</i>
3/2005	Vladimír Benáček Jiří Podpiera Ladislav Prokop	<i>Determining factors of Czech foreign trade: A cross-section time series perspective</i>
2/2005	Kamil Galuščák Daniel Münich	<i>Structural and cyclical unemployment: What can we derive from the matching function?</i>
1/2005	Ivan Babouček Martin Jančar	<i>Effects of macroeconomic shocks to the quality of the aggregate loan portfolio</i>
<hr/>		
10/2004	Aleš Bulíř Kateřina Šmídková	<i>Exchange rates in the new EU accession countries: What have we learned from the forerunners</i>
9/2004	Martin Cincibuch Jiří Podpiera	<i>Beyond Balassa-Samuelson: Real appreciation in tradables in transition countries</i>
8/2004	Jaromír Beneš David Vávra	<i>Eigenvalue decomposition of time series with application to the Czech business cycle</i>
7/2004	Vladislav Flek, ed.	<i>Anatomy of the Czech labour market: From over-employment to under-employment in ten years?</i>
6/2004	Narcisa Kadlčáková Joerg Keplinger	<i>Credit risk and bank lending in the Czech Republic</i>
5/2004	Petr Král	<i>Identification and measurement of relationships concerning inflow of FDI: The case of the Czech Republic</i>
4/2004	Jiří Podpiera	<i>Consumers, consumer prices and the Czech business cycle identification</i>
3/2004	Anca Pruteanu	<i>The role of banks in the Czech monetary policy transmission mechanism</i>
2/2004	Ian Babetskii	<i>EU enlargement and endogeneity of some OCA criteria: Evidence from the CEECs</i>
1/2004	Alexis Derviz Jiří Podpiera	<i>Predicting bank CAMELS and S&amp;P ratings: The case of the Czech Republic</i>

---

#### **CNB RESEARCH AND POLICY NOTES**

2/2013	Jan Brůha Tibor Hlédik Tomáš Holub Jiří Polanský Jaromír Tonner	<i>Incorporating judgments and dealing with data uncertainty in forecasting at the Czech National Bank</i>
1/2013	Oxana Babecká Kucharčuková Michal Franta Dana Hájková	<i>What we know about monetary policy transmission in the Czech Republic: Collection of empirical results</i>

---



Petr Král  
Ivana Kubicová  
Anca Podpiera  
Branislav Saxa

---

3/2012	Jan Frait Zlataše Komárková	<i>Macroprudential policy and its instruments in a small EU economy</i>
2/2012	Zlataše Komárková Marcela Gronychová	<i>Models for stress testing in the insurance sector</i>
1/2012	Róbert Ambriško Vítězslav Augusta Dana Hájková Petr Král Pavla Netušilová Milan Říkovský Pavel Soukup	<i>Fiscal discretion in the Czech Republic in 2001-2011: Has it been stabilizing?</i>
3/2011	František Brázdík Michal Hlaváček Aleš Maršál	<i>Survey of research on financial sector modelling within DSGE models: What central banks can learn from it</i>
2/2011	Adam Geršl Jakub Seidler	<i>Credit growth and capital buffers: Empirical evidence from Central and Eastern European countries</i>
1/2011	Jiří Böhm Jan Filáček Ivana Kubicová Romana Zamazalová	<i>Price-level targeting – A real alternative to inflation targeting?</i>
1/2008	Nicos Christodoulakis	<i>Ten years of EMU: Convergence, divergence and new policy priorities</i>
2/2007	Carl E. Walsh	<i>Inflation targeting and the role of real objectives</i>
1/2007	Vojtěch Benda Luboš Růžička	<i>Short-term forecasting methods based on the LEI approach: The case of the Czech Republic</i>
2/2006	Garry J. Schinasi	<i>Private finance and public policy</i>
1/2006	Ondřej Schneider	<i>The EU budget dispute – A blessing in disguise?</i>
5/2005	Jan Stráský	<i>Optimal forward-looking policy rules in the quarterly projection model of the Czech National Bank</i>
4/2005	Vít Bárta	<i>Fulfilment of the Maastricht inflation criterion by the Czech Republic: Potential costs and policy options</i>
3/2005	Helena Šůvová Eva Kozelková David Zeman Jaroslava Bauerová	<i>Eligibility of external credit assessment institutions</i>
2/2005	Martin Čihák Jaroslav Heřmánek	<i>Stress testing the Czech banking system: Where are we? Where are we going?</i>
1/2005	David Navrátil Viktor Kotlán	<i>The CNB's policy decisions – Are they priced in by the markets?</i>
4/2004	Aleš Bulíř	<i>External and fiscal sustainability of the Czech economy: A quick look through the IMF's night-vision goggles</i>
3/2004	Martin Čihák	<i>Designing stress tests for the Czech banking system</i>
2/2004	Martin Čihák	<i>Stress testing: A review of key concepts</i>

**CNB ECONOMIC RESEARCH BULLETIN**

---

November 2013	<i>Macroeconomic effects of fiscal policy</i>
April 2013	<i>Transmission of monetary policy</i>
November 2012	<i>Financial stability and monetary policy</i>
April 2012	<i>Macroeconomic forecasting: Methods, accuracy and coordination</i>
November 2011	<i>Macro-financial linkages: Theory and applications</i>
April 2011	<i>Monetary policy analysis in a central bank</i>
November 2010	<i>Wage adjustment in Europe</i>
May 2010	<i>Ten years of economic research in the CNB</i>
November 2009	<i>Financial and global stability issues</i>
May 2009	<i>Evaluation of the fulfilment of the CNB's inflation targets 1998–2007</i>
December 2008	<i>Inflation targeting and DSGE models</i>
April 2008	<i>Ten years of inflation targeting</i>
December 2007	<i>Fiscal policy and its sustainability</i>
August 2007	<i>Financial stability in a transforming economy</i>
November 2006	<i>ERM II and euro adoption</i>
August 2006	<i>Research priorities and central banks</i>
November 2005	<i>Financial stability</i>
May 2005	<i>Potential output</i>
October 2004	<i>Fiscal issues</i>
May 2004	<i>Inflation targeting</i>
December 2003	<i>Equilibrium exchange rate</i>

---



Czech National Bank  
Economic Research Department  
Na Příkopě 28, 115 03 Praha 1  
Czech Republic  
phone: +420 2 244 12 321  
fax: +420 2 244 14 278  
<http://www.cnb.cz>  
e-mail: [research@cnb.cz](mailto:research@cnb.cz)  
ISSN 1803-7070