Financing Constraints and the Adjustment Dynamics of Enterprises – A Roadmap

Overall Summary

The thesis investigates the behaviour of enterprises under financing constraints, especially regarding investment. The guiding insight is that financing constraints imply a slow reaction of firms to positive shocks. This is not only their very essence, but it can also be tested empirically. The analysis of differential adjustment behaviour offers a new and promising empirical access to the significance of finance for real behaviour.

The empirical analysis relies heavily on panel methods. In order to deal with the core problem, new estimators based on the Generalised Method of Moments are developed. Differential adjustment is measured using data bases for companies in two different countries and two rather unrelated statistical methodologies. Yet the results are surprisingly coherent, indicating a high degree of robustness.

The thesis takes up the criticism regarding the standard procedure of empirical work regarding financing constraints. I suggest, first, to use direct information on financing restrictions from survey data, in order to avoid the problems involved in the use of a priori criteria noted in the literature. Second, I develop a feasible and informative alternative to the much criticised comparison of cash flow sensitivities. A theoretical model develops how the adjustment dynamics of firms depend on their financial status. The core hypothesis is that the adjustment of financially constrained firms to positive, expansionary shocks is slow compared to unconstrained firms. This difference in adjustment dynamics can be used for the identification of such constraints, as their "empirical fingerprint".

Two large survey data sets are used for the empirical work. On the one hand, a large qualitative business cycle survey for the UK economy is explored. A non-parametric analysis and a duration analysis show that financing constraints and capacity constraints are tightly interrelated. Financially constrained firms take significantly longer to close capacity gaps.

Then, the micro data of the large Ifo *Investitionstest* for German companies is used to observe the capital stock adjustment directly. Aside from detailed information on investment, the survey also contains data on financing constraints and innovation behaviour. The survey information allows me to identify adjustment needs and to compare the

behaviour of constrained and unconstrained firms. As some core information in the Ifo *Investitionstest* is metrically scaled, it is possible to estimate error correction models and explicit structural adjustment equations. The standard techniques in dynamic panel estimation require constant coefficients of adjustment functions. A first step, therefore, is to separate survey companies in constrained and unconstrained subgroups on the basis of their statements on financing constraints and to compare adjustment behaviour.

The resulting evidence, however, ignores the within variation of financing constraints data, the fact that firms switch in and out of constrained states. In order to make use of this important source of identification, we need to estimate regime dependent adjustment in a setup where the target of adjustment is not fully observable. The target can be modelled using a classic error component structure. A major methodological contribution of this thesis is the discussion of transformations and moment restrictions that allow the estimation of regime dependent adjustment equations using the Generalised Method of Moments. The panel estimators are derived and tested using Monte Carlo Simulations. In the final part of the thesis, a quasi-differencing technique is employed on the Ifo investment data to estimate a partial adjustment model for capital stock dynamics. Constrained firms are significantly slower than unconstrained firms. The effect seems essentially to be limited to small firms. In general, however, these small firms are clearly faster to adapt than larger firms. This is exactly the same pattern that resulted from the duration analysis of capacity adjustment by UK firms, using an entirely different methodology. The chapter ends in describing how information on financing constraints of other adjustment regimes can be used in timely policy analysis.

The thesis is divided into four chapters, all of which are published or forthcoming as separate Discussion Papers of the Research Centre of the Deutsche Bundesbank in Frankfurt. Chapter 2 is published in *Economica*, 2006. The fact that chapters are written in such a way as to function independently produces some redundancies and cross references that would not have been necessary in a monolithic treatise. Chapter 4, for example, uses the data set and the basic identification strategy described in Chapter 2 and puts to use one of the estimators developed in Chapter 3. However, this strategy has facilitated discussion on conferences and meetings enormously, it will ease the publication process and in the end readers may find it helpful to have all necessary information within the confines of the same chapter. The rest of this roadmap gives a non-technical overview of the chapters.

Chapter 1: Financial constraints for investors and the speed of adaptation: Are innovators special?

This chapter uses a large panel of survey data on West German firms in the manufacturing sector to analyse the effects of financing constraints for investors in general and for innovative firms in particular. Empirical work on financial constraints has traditionally been based on an approach pioneered by Fazzari, Hubbard and Peterson. If the investment of supposedly financially constrained firms shows a higher sensitivity to internal finance than the investment of their supposedly unconstrained counterparts, this is seen as evidence for the existence of binding financial constraints. In more recent times, this procedure has been heavily attacked on theoretical grounds. Survey data with information on financing conditions can be a valuable tool that avoids this criticism. However, the informational content of survey data needs to be validated. Using the autumn and the spring wave of the Ifo Institute's Investment Tests (IT) during the years 1988-1998, a panel with information on investment, innovation activity and financing conditions is created.

To identify the effects of financial constraints in the investment data, I use the fundamental influence of financial constraints on the *distribution of investment over time*. Following a shock, the adjustment of a constrained firm is slower and less spiky. After developing this argument theoretically, I test the empirical content of the survey data by means of an error correction model of investment activity. The analysis proceeds in three steps. A reduced form model based on the "factors influencing investment" from the survey indicates that there is indeed a strong relationship between investment, on the one hand, and these factors, among them financial conditions, on the other. Step two starts from a simple error-correction model and then uses the information on financing conditions as firm-specific and time-varying proxies for the costs of finance. Using GMM estimators, I show that the financing conditions variables keep their predictive content when we exclude contemporaneous correlation using predetermined instruments. This demonstrates that the informational content of the financing conditions information goes beyond a mere "justification effect", and it corrects for reverse causality via the marginal costs of finance schedule. Step three, finally, is a structural test on whether the financing conditions information corresponds to the model of how financial constraints condition the pattern of investment.

The results indicate that constrained firms, in fact, do react more slowly, but innovative firms do not seem to be especially affected. This supports an argument made recently by Bond, Harhoff and van Reenen: In equilibrium, innovative activity will come from a

group of firms that is self-selected on the basis of their being able to overcome the special difficulties of financing innovation.

Chapter 2: Financial constraints and capacity adjustment in the United Kingdom. Evidence from a large panel of survey data

Recent research has shown that the causes and effects of financial constraints for firms in the private sector are of key importance for a variety of policy issues relevant to central banks. First, the quantitative and qualitative features of monetary transmission depend on whether or not a credit channel exists. Second, the real consequences of shocks to the financial system are conditioned by the way in which firms cope with their financial constraints. Due to credit chains between firms, financial constraints also may form part of a propagation mechanism creating systemic risk. Third, financial constraints might be especially relevant for future-oriented activities that are difficult to collateralise but quite important for economic growth, such as research and development, or the introduction of innovative products and processes.

I am able to explore the data base for the CBI Industrial Trends Survey (ITS), which is an important survey for business cycle analysis in the United Kingdom. For the 11 years between January 1989 and October 1999, the cleaned, unbalanced panel contains 49,244 quarterly observations on 5,196 firms. According to the CBI, the ITS represents around 33% of the total current employment within UK manufacturing. The data set covers all size ranges but small firms, in particular, are represented well, on which very little information is available from micro data sets based on quoted companies. More than 63% of the ITS observations refer to firms with less than 200 employees. On average, around 20.8% of respondents state that they are constrained by the lack of either internal or external financial resources, and that these constraints have an influence on their investment behaviour.

The focus is on capacity adjustment, as the ITS data on capacity gaps, planned expansion and rates of capacity utilisation are especially rich. Firms report whether their capacity is insufficient with respect to demand. Those firms which indicate financial constraints should be capacity constrained more often and take longer to close a capacity gap – either because they are less able to finance their investments or else because they have bigger gaps to fill.

First, I look at the statistical association between two types of constraints: capacity restrictions and financial constraints. It is tested whether those two types of constraints tend to occur jointly. Then the time dimension is investigated by undertaking a duration

analysis with respect to spells of capacity restrictions. To the best of my knowledge, the duration of capacity constraints has never been investigated before on a micro-econometric level.

For both size classes, I find a clear contemporaneous association between the two types of constraints. This association stays intact when we condition on whether capacity constraints were present in the previous period. With respect to duration, financially constrained firms do take longer to end a period of insufficient capacity. The measured difference in duration is clear, but not dramatic. In any given moment of time, a firm will leave the state of capacity restrictions with a rate that is about 20% lower if it is financially constrained compared to a firm that does not report financial constraints. This is entirely consistent with results from association analysis if we restrict attention to capacity restricted firms: a firm will leave this state with a probability of about 50% if it is not financially constrained, but with a probability of only about 40% if it reports shortages of internal finance or the inability to raise external finance.

This allows the conclusion that there is informational content in the survey data on financial constraints. Thus, a necessary condition for using them in regular policy analysis is fulfilled.

Splitting the sample shows that the relationship between financing constraints and the duration of capacity restrictions is less strong for larger firms. This indicates that financing constraints may be less relevant for their activity. On the other hand, it is quite interesting to see that small firms appear to be able to overcome their capacity shortfalls faster than larger firms - both in general and conditional on their financial status. This may mean that small firms, due to flat hierarchies and low co-ordination costs, are more flexible in coping with the demand shocks typical for their size.

Chapter 3: Panel estimation of state dependent adjustment when the target is unobserved

Estimating economic adjustment on the micro level is inherently difficult, as the target of adjustment is usually observed only imperfectly. This paper investigates economic adjustment dynamics that are state dependent, as they may arise if adjustment is subject to time varying constraints such as financing conditions. The problem of unobserved targets is dealt with using panel information and an error component approach.

The standard dynamic panel estimators as devised by Anderson and Hsiao (1982), Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998)

cannot be used directly, as in this class of estimators the dynamics are assumed to be linear and constant over time. This paper shows how GMM methodology can be adapted for the analysis of economic adjustment if the target is (partially) unobserved and the non-linearity takes the form of discrete regimes. This is not straightforward, as the unknown and time varying adjustment coefficient interacts with the equally unknown individual specific measurement error. But the reward is substantial: a well-known array of procedures and tests can be brought to bear on the investigation of economic adjustment. The estimation methods described here may help to analyse a large variety of economic problems more adequately. Examples are the dynamics of capital and labour demand, the price setting of firms, and the financial adjustment of firms and banks.

After an introduction, the chapter first characterises the stochastic process to be estimated. A continuous scalar and a discrete regime vector are evolving jointly, and the adjustment of the continuous-type variable depends on the regime. It is shown that the standard procedure for estimating linear dynamic panel models is not applicable. Next, two estimators on the basis of quasi-differencing are proposed, one of them with the virtue of great simplicity, the other being more efficient. Both of them are non-linear, which may lead to a small sample bias if in one of the regimes the adjustment speed is almost zero. The next section works out two linear GMM estimators that are immune to this problem. One of them uses state dependent filtering, the other is a level estimator applied to a modified model equation. The latter can also cope with contemporaneously correlated regimes. The last section tests and compares the proposed routines in a Monte Carlo study.

Chapter 4: Financing constraints, micro adjustment of capital demand and aggregate implications

This chapter is the “capstone" of the thesis, drawing together the insights of all previous parts and putting them into context. It uses the dataset and basic identification strategy developed in Chapter 1 and employs the estimation techniques developed in Chapter 3 to estimate a parametric model of regime dependent adjustment, with regimes being defined according to the financing constraints status. In a way, this repeats what was done in Chapter 2 in a non-parametric way using the UK survey data, on the basis of a completely different set of econometric techniques.

Adjustment functions for the real capital stock are estimated. These estimates show that regime specific dynamic behaviour can successfully be disentangled. We see that – as

hypothesized – financing constraints slow down the adjustment speed of firms. Furthermore, this effect is concentrated on or perhaps even limited to smaller firms. With large firms, no clear speed differential can be detected. The speed of adjustment of small firms is clearly higher than of large firms. The analogies to the results of Chapter 2 are striking, even quantitatively.

In a last step, some of the aggregate implications are elucidated. The aggregate sensitivity changes with the composition of the aggregate. With estimated adjustment functions in hand, it is easy to trace the time-varying aggregate sensitivity. This offers an important new way in which analysts and forecasters can use survey data.