Financing constraints and capital accumulation: microeconometric evidence

Financing constraints can potentially hamper corporate investment activity. The importance of this relationship is tested using two very different data sets: a qualitative UK study of firms and the ifo Investment Survey.

The results show that financially constrained firms are slower to adjust their capital stock upwards than are financially unconstrained firms. This adjustment delay is particularly evident in the case of small firms. However, small firms are, by nature, more flexible than large firms. On the basis of the microeconometric estimates, it is possible to construct an indicator of the sensitivity of investment demand as a function of the severity of the financial constraints.

The results presented in this article, as well as the fact that there has been a continuous substantial improvement in balance sheet structures for many years, appear to indicate that German firms' investment activity during the current business cycle up until the end of the observation period (late autumn 2007) was not exposed to any meaningful external finance constraints.

The importance of financing constraints

Types of financing constraints

There are various ways in which firms can be financially constrained. External financing costs may be high enough to prevent the im-

plementation of projects that might have paid off had sufficient internal finance been available. Financing constraints may also take the form of quantitative restrictions (credit rationing) if borrowing in excess of a certain limit is not permitted. Lastly, lending may also be attached to the fulfilment of further conditions, such as the maturity of liabilities or how the funds are being used.

Cause of financing constraints

The default risk of the borrower is not *per se* the cause of the external finance premium. The agreed interest rate contains a default premium even in perfect markets. The real world, however, is characterised by imperfect markets with transaction costs and information asymmetry. The lender also needs to be compensated for the expected added costs of financing the project externally rather than internally. These are caused by the costs of obtaining and processing information as well as of monitoring, assessing and collecting the debt.

Financing constraints as necessary elements of a market economy

Constraints on external debt or equity finance are, by their very nature, a market-driven response by responsible agents to the imperfections of the financial markets. The dotcom bubble in the Neuer Markt at the start of the new millennium was a particularly striking example of what can happen when these mechanisms fail – equity was all too often provided without sound knowledge of the projects being financed, without adequate safety nets to protect against bad entrepreneurial decisions and without taking into account the incentives being given to decision-makers. Capital misallocation on a grand scale was the result.

Importance for economic growth

The ability of real-world financial systems to deal with information problems has obvious implications for allocative efficiency and growth. On the heels of the seminal paper by Rajan and Zingales,[1] the state of financial development of a given country was identified as one of the major sectoral and macroeconomic determinants of growth, especially in terms of the growth outlook for economies in transition and how they are integrated into the system of the international division of labour.

Role in the monetary transmission mechanism

Financing constraints are also a factor in the monetary transmission process. Monetary policy measures can impact on potential borrowers' ability to borrow and also alter the banking industry's ability to lend.[2] In a very general sense, the financing constraints faced by firms are a key reason why there is any relationship at all between the financial health of a firm, its total value and its activity in the real sector.[3]

1 See R G Rajan and L Zingales (1998), Financial Dependence and Growth, American Economic Review, 88, pp 559-586.
2 This refers to the balance sheet channel and the bank lending channel of the monetary transmission process. For more on this topic, see Deutsche Bundesbank, Bank balance sheets, bank competition and monetary policy transmission, Monthly Report, September 2001, pp 51-70, and Deutsche Bundesbank, Monetary policy and investment behaviour – an empirical study, Monthly Report, July 2002, pp 41-54, as well as the in-depth description of the monetary transmission process in I Angeloni, A Kashyap and B Mojon (eds) (2003), Monetary Policy Transmission in the Euro Area, Cambridge University Press, Cambridge et al.
3 The Modigliani-Miller theorems, with their assertion of neutrality, are regarded as the foundation and starting point of modern corporate finance. See F Modigliani and M H Miller (1958), The Cost of Capital, Corporate Finance and the Theory of Investment, American Economic Review, Vol 48, pp 261-297, and F Modigliani and M H Miller (1961), Dividend Policy, Growth and the Valuation of Shares, Journal of Business, Vol 34, pp 411-433. Neutrality fails in the case of information asymmetry and tax-related distortions.

Problems of measurement and operationalisation

The traditional approach …

For a long time, the approach developed by Fazzari, Hubbard and Petersen was used to identify and measure financing constraints in quantitatively oriented economic research.[4] The underlying idea may be illustrated as follows: the financing constraints faced by school-leavers can be tested by determining whether or not the decision to attend university and the financial wealth of the parents are correlated. If all the success factors of a four-year degree are controlled for, there should be no such correlation in the absence of financing constraints. Accordingly, the cash flow sensitivity of corporate investment can be used to identify financing constraints for firms. Without any external finance premium or credit rationing, current cash flow should have no explanatory power, provided all aspects of investment projects which actually determine the value can be adequately accounted for.

… and criticism thereof

In the past few years, however, this approach has come under heavy criticism.[5] The criteria for dividing firms into financially constrained and financially unconstrained groups proved to be spurious and not robust to generalisation. The sensitivity itself is virtually impossible to interpret under real-world conditions. A monotone relationship between this sensitivity and the degree of financing constraints exists neither theoretically nor empirically. If, therefore, a comparison is made between more constrained and less constrained firms instead of conceptually selecting the absence of any financing constraint as a reference point, it is not clear which group can be expected to be more sensitive. An additional fundamental problem is that cash flow is calculated empirically as the sum of the firm's profit and depreciations. Profit, however, is the target variable for the entire range of entrepreneurial activities. Current profits and investment, the latter being the key instrument of corporate policy, are correlated for a multitude of reasons that have nothing to do with financing constraints. This remains true even if due account is taken of the fact that investment at a given point in time largely has no impact on output during the same period. Expectation formation, the time needed to develop and implement major projects and the persistence of productivity shocks all play a key role, as well as learning effects and the length of market penetration periods.

Direct observation using surveys of firms

Surveys of firms as a source of data

The problems involved in breaking firms down into constrained and unconstrained firms, and the difficulties in interpreting the cash flow sensitivity, can be avoided by ob-

4 See, for example, S M Fazzari, R G Hubbard and B C Petersen (1988), Financing Constraints and Corporate Investment, Brookings Papers on Economic Policy, Vol 19, pp 141-195.

5 An animated discussion on this topic was conducted in the Quarterly Journal of Economics. See S N Kaplan and L Zingales (1997), Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints? Quarterly Journal of Economics, Vol 112, pp 169-215; the reply by S M Fazzari, R G Hubbard and B C Petersen (2000), Investment-Cash Flow Sensitivities are Useful: A Comment on Kaplan and Zingales, Quarterly Journal of Economics, Vol 115, pp 695-705; rounded out by S N Kaplan and L Zingales (2000), Investment-Cash Flow Sensitivities Are Not Valid Measures of Financing Constraints, Quarterly Journal of Economics, Vol 115, pp 707-712.

serving financing constraints directly. Data from surveys of firms, in which firms report anonymously on their plans and their assessment of the situation, the current trends in their sales and other business figures, are a useful tool for this purpose. Some surveys also contain information on financing conditions and constraints.

Adjustment speed as an indicator

The survey data can be validated and evaluated by measuring the speed at which firms respond to new investment projects that hold out the promise of profit.[6] Financially unconstrained firms are able to react immediately, or at least very rapidly, to new opportunities. By contrast, financially constrained firms do not instantaneously succeed in reaching the long-run optimum, but instead take time to adjust. In some cases, only part of the necessary fixed capital can be purchased using debt, whereas further investment has to be conducted with retained earnings from sales while, at the same time, the balance sheet is being repaired. The difference in the speed of adjustment is the statistical "fingerprint" of financing constraints and helps to identify their impact econometrically. It is a measure that can represent the core of the economic importance of such constraints.

Survey data for the UK…

This approach was first tested using qualitative survey data from the United Kingdom.[7] The test was based on the Industrial Trends Survey (ITS) conducted by the Confederation of British Industry (CBI), which plays a key role in business cycle analysis in the United Kingdom. The cleaned panel contains 49,244 observations on 5,196 firms over 11 years of data from January 1989 to October 1999. The CBI claims that ITS represents around 33% of total current employment in the UK manufacturing sector. The panel covers all size categories; however, small firms, on which little information is otherwise available in the UK, are particularly well represented. More than 63% of observations in the sample relate to firms having fewer than 200 employees. On average, around 20.8% of those surveyed indicate that their firms were constrained by the lack of either internal or external finance and that these constraints had a real impact on investment behaviour. The study focuses on capacity adjustments. Firms report whether their capacity is insufficient relative to demand. Following the ideas outlined above, one would expect firms reporting financial constraints to experience capacity shortfalls more frequently than others and for these gaps to require more time to close.

… and results of the estimates

A proportional hazard model is estimated in order to measure the speed of adjustment. Financially constrained firms take longer to complete a spell of restricted capacity. According to the results of the study, the measured difference in duration is marked but not significant. At any given time, financially constrained firms will leave the state of capacity restrictions at a rate that is around 20% lower than that of firms not reporting financial constraints.

6 The relationships presented below are formally derived in U von Kalckreuth, Financial Constraints for Investors and the Speed of Adjustment: Are Innovators Special?, Discussion Paper, Series 1: Studies of the Economic Research Centre, No 20/2004.
7 See U von Kalckreuth (2006), Financial Constraints and Capacity Adjustment: Evidence from a Large Panel of Survey Data, Economica, Vol 73, pp 691-724.

A breakdown of the sample shows that the relationship is less significant for large firms than for small firms. This could indicate that financial constraints are less important for the activity of large firms. However, it is interesting to observe that small firms overcome their capacity shortfalls more quickly than large firms – on average and conditional on their financial status. This may mean that, with their flat hierarchies and low coordination costs, small firms are more nimble and flexible in dealing with demand shocks than large firms.

Studying the adjustment behaviour of UK firms relies on qualitative information; this means that the survey can only state whether or not a firm suffered capacity restrictions. Nothing is said about the extent of restrictions. This provides leeway for interpreting the results cited above. Another reason why financially constrained firms take a longer time to adjust is that firms with a large investment demand encounter financing constraints more frequently than firms with a smaller demand for finance. The two possible directions of causation can be distinguished only if quantitative information about the need for adjustment is either available or can be constructed.

ifo Investment Survey as a source of data for Germany

The ifo Institute's Investment Survey provides high-quality quantitative information on investment volume, employment and sales, covering multiple consecutive years. The information is sufficient to reconstruct measures of firms' real capital stock and to estimate a partial adjustment model for the capital stock in which the speed of adjustment is measured as the strength of the reaction to a gap between the target capital stock and installed capital. The size of the adjustment requirement can thus be explicitly included.[8] Also, the dataset contains information on how various factors affect investment behaviour, including financing conditions.

The micro data from the Ifo Investment Survey in Western German Manufacturing for 1988 to 1998 were available for sampling. During this 11-year period, the autumn survey, which contains information on financial constraints, contained 25,643 observations on a total of 4,443 firms with an average of 2,331 observations per year.

The advantage of this dataset, like the UK data, lies not only in its size and representativeness but also in containing a large number of relatively small firms. Nearly half of the observations refer to firms with fewer than 200 employees, and 20% of the firms have fewer than 50 employees. Around one-quarter of the surveyed firms indicated that their investment was constrained by the availability or cost of finance. To some extent, these responses could also be due to variations in the general level of lending rates. Such aggregated effects can be taken account of, and thus filtered out of the estimation equation by including time dummies indicating the year. Thus, it is only deviations of firm-level data from the sectoral average which are relevant for identification (see also the explanatory notes on page 64).

8 For more on the study cited below, see U von Kalckreuth, Financing Constraints, Firm Level Adjustment of Capital and Aggregate Implications, Deutsche Bundesbank, Research Centre, Discussion Paper, Series 1, Economic Studies, No 11/2008.

Adjustment with regime-dependent speed and partly unobserved targets

The starting point is a static neoclassical equation for factor demand. With a CES production function, the first-order conditions for the static maximum profit result in the following linear relationship for the capital stock:

$$log\, K^* = log\, Y^* - \sigma\, log\, UC^* + log\, h^*. \quad (1)$$

Here, K is capital, Y real output, UC the user cost of capital, σ stands for the elasticity of substitution, and h for a variable that is dependent on firm-specific technology parameters. The asterisk denotes a long-term equilibrium value. To describe the adjustment dynamics, it is necessary to model the unobservable target variable econometrically. Following the error component approach for panel data, one may assume that the unobservable variable can be approximated by observable variables, augmented by error terms that either assume the same value for all individuals at a given point in time or are constant for a given individual. The desired capital stock of enterprise i at time t is modelled as follows:

$$log\, K^*_{i,t} = log\, S_{i,t} + \lambda_t + \mu_i. \quad (2)$$

In this case, the logarithm of real sales, $log\, S_{i,t}$, is a proxy for the evolution of real output over time. In addition, it is also possible to use indicators for the expected sales development. The time effect λ_t captures the effects of changes in the user cost of capital and other macroeconomic effects which apply to all enterprises alike, including total factor productivities which are variable in time. The fixed effect μ_i represents unobservable firm-specific technological determinants of capital intensity. It is now assumed that the speed with which the real capital stock is adjusted varies with the financing conditions:

$$\Delta\, log\, K_{i,t} = -\phi(\boldsymbol{r}_{i,t-1})(log\, K_{i,t-1} - K^*_{i,t}) + \epsilon_{i,t} \quad (3)$$

with

$$\phi(r_{i,t-1}) = 1 - \alpha_{i,t-1} = 1 - \boldsymbol{\alpha}'\boldsymbol{r}_{i,t-1}, \quad (4)$$

where $\phi(\boldsymbol{r}_{i,t-1})$ is the speed of adjustment dependent on the financing situation and $\alpha_{i,t-1}$ is a measure of the persistence. Variable $\alpha_{i,t-1}$ cannot be observed; however, there are ordinal data on the financing conditions. Vector $\boldsymbol{r}_{i,t-1}$ indicates the financing situation depending on the given answer. In each case, one element assumes the value of 1, all the others are zero. Coefficient vector $\boldsymbol{\alpha}$ is to be estimated.

In this specification, the habitual procedure for dynamic panel estimations cannot be used. Writing equation (3) in first differences would not cause the fixed effects μ_i to disappear, because they interact with the time-variable expression $\phi(\boldsymbol{r}_{i,t-1})$. If equation (3) is multiplied by $\phi(\boldsymbol{r}_{i,t-2})/\phi(\boldsymbol{r}_{i,t-1})$ and if the lagged original equation is subtracted, substituting equation (4) results in

$$\frac{1-\alpha_{i,t-2}}{1-\alpha_{i,t-1}}\Delta\, log\, K_{i,t} - \alpha_{i,t-2}\,\Delta\, log\, K_{i,t-1} - (1-\alpha_{i,t-2})(\Delta\, log\, S_{i,t} + \lambda_t) = \xi_{i,t}, \quad (5)$$

where

$$\xi_{i,t} = \frac{1-\alpha_{i,t-2}}{1-\alpha_{i,t-1}}\varepsilon_{i,t} - \varepsilon_{i,t-1}. \quad (6)$$

The transformed equation looks more complicated than the original, but has the advantage that the unobservable error term μ_i is eliminated and GMM estimations become possible for the $\boldsymbol{\alpha}$ coefficients. However, the non-linearity of equation (5) has to be taken into account in an appropriate manner.[1]

1 Such transformations are called "quasi-differences". The term was coined by D Holtz-Eakin, W Newey and H S Rosen (1988), Estimating Vector Autoregressions with Panel Data, Econometrica, Vol 56, pp 1371–1395. The transformation developed by Holtz-Eakin et al deals with a different case, however. For the technique described here, see U von Kalckreuth, Panel estimation of state dependent adjustment when the target is unobserved, Deutsche Bundesbank Research Centre, Discussion Paper, Series 1, Economic Studies, No 09/2008. This paper also analyses other estimation methods and compares them in a simulation study.

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Regimes of capital stock adjustment…

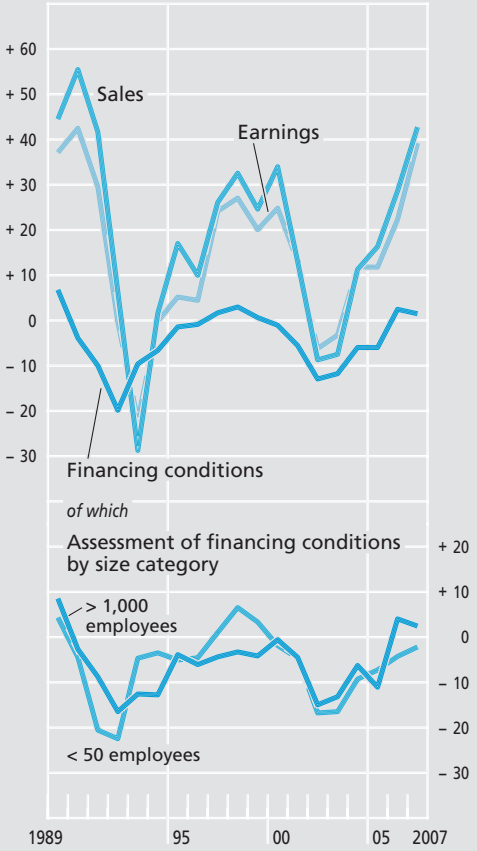
The preferred estimate featured a distinction between three different adjustment regimes. The first regime is for stationary or expanding firms that are not financially constrained. The second regime covers stationary or expanding firms which report financing constraints, and the third is for potentially downsizing firms. For such firms, financial constraints do not, in fact, necessarily lead to a slower adjustment speed because the adjustment does not require the purchase of new capital goods. Expansion is modelled on the basis of sales expectations. Owing to potential endogeneity, lagged expectations of the impact of financial constraints and sales patterns are used to define the adjustment regime.

… and the concomitant adjustment speeds

A comparison is made between the adjustment speeds of stationary or expanding firms that are either financially constrained or financially unconstrained. The adjustment speed is defined as the fraction of the gap between the (logarithmic) values of the current and the target capital stock that is removed within a year. The estimates show that financial constraints do, in fact, reduce the adjustment speed. As in the study of UK firms, the effect is concentrated on smaller firms where, once again, the adjustment speed is generally higher than in the case of large firms. For small, financially unconstrained firms, the adjustment speed per year is measured at a rate of 0.243. If the firms are constrained, the rate decreases markedly to 0.166. For unconstrained large firms, the adjustment speed is 0.186, with the speed falling only marginally to 0.165 for constrained firms.[9] The fact that estimates with two wholly different datasets and entirely different methods reach qualitatively very similar outcomes may be regarded as a sign of the robustness of the selected approach.

Determinants of industrial firms' investment

Retrospective assessment, weighted balances[1]



Source: Ifo Investment Survey in Western German Manufacturing. — **1** The standard answers are "very stimulating", "stimulating", "no influence", "limiting" and "very limiting". The values in the chart are weighted balances of the percentage points of positive and negative assessments, with the weight of the response categories "stimulating" and "limiting" being halved.

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9 The estimates reproduced here are those in which sales developments have also been included in the model of the target capital stock.

Sensitivity of industrial firms' investment

Average adjustment speed, weighted average[1]

Source of the original data: Ifo Investment Survey in Western German Manufacturing. — **1** Based on estimates of adjustment speed as a function of the size category and the response to the question about how financing conditions are assessed. For more on coefficient estimation, see von Kalckreuth (11/2008), op cit, Table 6 (3) and (5).

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German firms' financing situation

Survey findings on firms' investment behaviour

In the investment survey which yielded the micro data on which the above-described study is based, west German firms are surveyed once a year, in autumn, on the determinants of their investment behaviour, among other factors. The firms are asked to assess the impact of the following factors on a five-part scale: sales conditions/expectations, availability/costs of finance, earnings expectations, technological development, basic economic policy conditions and other factors. This assessment is made for both the current and the following year. The information is disaggregated by size category for the first time here.

The significance of availability of finance

In its upper half, the chart on this page initially shows the significance of the availability of finance for investment behaviour in a comparison with the key factors of sales expectations and earnings expectations across all size categories. The weighted balances of percentage points of positive and negative assessments are given, with the weight of "stimulating" and "limiting" answer categories each being halved. In terms of the strength of the fluctuation, availability of finance is less important for explaining investment behaviour than the other two factors. The microeconometric analysis also bears out this assessment.[10] However, sales expectations and earnings expectations are highly correlated, whereas the information provided by the "availability of finance" factor is partly independent.

Differences by size category

A look at the availability of finance by size category shows a rather pronounced comovement. Despite the overall low level of interest rates, firms found it particularly difficult to obtain finance for their projects in the period after 2002. The situation has been improving again since 2005. It is interesting to note, however, that the volatility is stronger among the smallest firms than among firms with over 1,000 employees. This points to size-specific differences in the importance of financing constraints. When interpreting them, it should again be noted that the credit risk associated with loans to firms fluctuates over the business cycle. The possibility that

10 See U von Kalckreuth (2004), op cit.

these fluctuations are stronger for smaller firms cannot be ruled out.[11]

Availability of finance in the manufacturing sector

According to the assessment by firms in the west German manufacturing sector, the availability of finance was above average at the end of the data horizon in autumn 2007. The aggregate balance of positive and negative answers is only slightly below the previous year's peak. Even this slight decline is limited to large firms with 200 and more employees. If, instead of the assessment of the current year, one looks at the outlook for the forthcoming period, the assessment becomes somewhat gloomier at the current end, which also includes smaller firms. However, the assessment of the availability of finance remained at an above-average level.

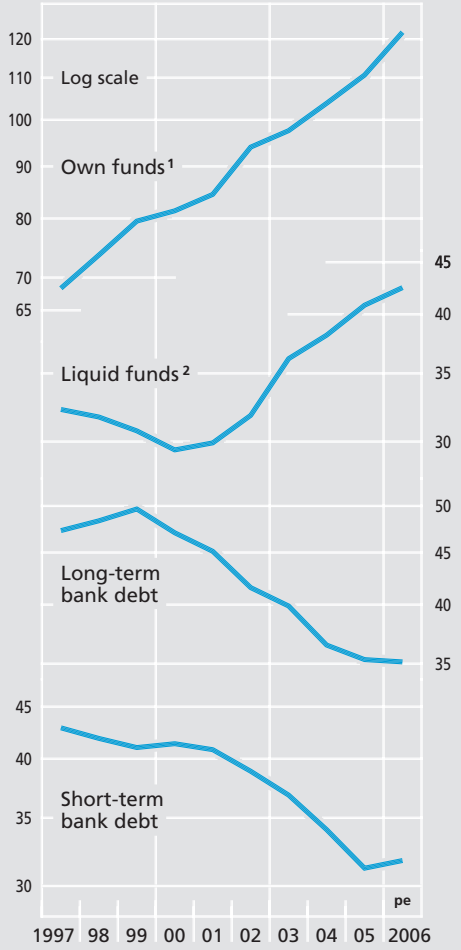
Aggregate adjustment speed

The microeconomic estimates enable the survey data to be converted for analytical purposes into a sensitivity of the aggregate to positive investment opportunities. Financially constrained firms are slower to act on their investment opportunities. For these firms, the number of such new opportunities that can actually be realised is smaller. The aggregated adjustment speeds indicate the extent to which the availability of finance enables firms to respond quickly to growth opportunities.

The time series of estimated aggregate adjustment speeds clearly shows the recession that followed the end of the "reunification boom" of the early 1990s and the slump that followed the bursting of the New Economy bubble at the beginning of the new millennium. During the mid- to late 1990s, however, firms were especially well able to respond quickly to new opportunities. The chart on this page shows that, up until the end of 2007, the finances available to firms still provided good growth opportunities despite weakening slightly, with the aggregate adjustment speed fluctuating between 0.195 and 0.202 during the observation period.

Firms' own funds, liquidity and bank liabilities*

As a percentage of fixed assets



* According to the Deutsche Bundesbank's corporate balance sheet statistics. — **1** Less adjustments to equity. — **2** Cash and short-term securities.

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11 Such differences have also been observed in other countries. For the UK, see U von Kalckreuth (2004), op cit.

Among small firms, the average adjustment speed varied between 0.256 and 0.267. The effect of changes in the availability of finance was therefore more pronounced than for large firms, whose estimated adjustment speed, as a function of the availability of finance, fluctuated only between 0.176 and 0.180.

Firms' finances in sound condition

German firms' finances are currently in sound condition, which reflects increased restructuring efforts and higher profitability. The chart on page 67 shows that firms' equity has been rising markedly and that their liquidity cushion has also seen strong growth. At the same time, the importance of short and long-term bank loans for corporate finance has been on a pronounced slide. On the whole, Germany's non-financial corporate sector has sound financing structures, which reduces dependency on external capital and yet, at the same time, makes it easier for banks to grant loans. It is precisely in those cases where the financial markets encounter rough patches that the soundness of capital structures in the non-financial corporate sector benefits the economy as a whole.