Investment activity in Germany under the influence of technological change and competition among production locations

By virtue of its dual function as a demand factor and as a supply factor, investment plays a key role in the business cycle and the growth process. From a cyclical standpoint, corporate investment has now become an important second pillar in the current economic upswing. Over the longer term, investment is a crucial parameter in the process by which enterprises adjust to structural change, which has been increasingly marked since the 1990s by technological and global factors.

This article retraces the cyclical movements and longer-term trends in capital formation in Germany. If the effects of reunification are taken into account, the relationship between investment behaviour and production activity in the corporate sector does not seem to have undergone any lasting change in the past few years. This is a sign that, although structural factors have changed the composition of gross fixed capital formation, on balance the diverging influences have had a neutral impact on the volume to date. However, there are still many challenges associated with Germany as an investment location with which the business sector, the social partners and economic policymakers are faced.

Looking back at the development of investment activity: cyclical and structural factors

Corporate investment as a cyclical link

The German economy has been undergoing a rapid cyclical upswing since 2006. Following a period of stubborn stagnation that gradually came to an end in mid-2003, the ensuing cyclical recovery was based initially almost exclusively on extremely dynamic export growth. Given declining corporate spending on new plant and equipment over a number of years, it was debated at the time whether investment was still capable of serving as a link between external activity and a broadly based cyclical recovery at all.[1] A year later, however, the upturn in business activity became entrenched when corporate investment[2] strengthened further. The basis for growth has broadened continuously since then. In the past year, private consumption and housing investment – albeit influenced by special effects – contributed moderately to economic growth, and the labour market took a turn for the better. In terms of the sequence, at least, the recovery pattern typical of the German economy seems to have remained intact so far in the current cycle. (See also the box on pages 20 and 21.)

Role of investment in structural change

Nevertheless, it is still worth asking what strategies German enterprises have employed to adapt to other, more sustained changes in the conditions for accumulating and allocating investible funds in Germany. In a competitive environment, investment is subject to a variety of motives and determinants inherent in the domestic economy. However, in a microeconomic context, it always reflects a gap between the existing or available capital stock and the desired (read: optimum) stock of fixed assets. The velocity and intensity at which companies adapt their investment policies depend not only on their options and the costs of capital adjustment but also on the size of the aforementioned disparity.

Technological and international influences

The dominant lasting influences include both the penetration of the economy with new information and communication technologies (ICT) and the real and financial effects of the accelerated pace of globalisation. Both have done more than merely push forward sectoral structural change in the German economy. They have also provided a key boost towards changing the way factors of production are deployed in Germany and thereby adapting the capital stock and financing structure. These factors can influence investment *a priori* through various channels and in various ways. Compared to overall economic development, the increasing percentage of ICT goods in the stock of commercial fixed assets has coincided with a tendency for gross fixed capital formation to rise more sharply. At the same time, in the wake of increasing globalisation (especially through the integration of transition countries and emerging markets into the world economy), the domestic capital stock is being called upon to deliver higher yields than just a few years ago. The adjustment to this trend, viewed in isolation, is likely to have had more of a dampening ef-

1 See also Deutsche Bundesbank, Corporate investment behaviour in the current cycle – hints of a structural break?, box in the Monthly Report, November 2004, pp 36-37.
2 In the following, corporate investment is understood as private investment in machinery, equipment and other plant as well as commercial investment in construction.

fect on domestic corporate fixed asset formation. Finally, German reunification, through which capital-intensive production methods in the former East Germany were prioritised not least for economic policy reasons, left an impact in commercial investment behaviour that lingered for a longer period of time.

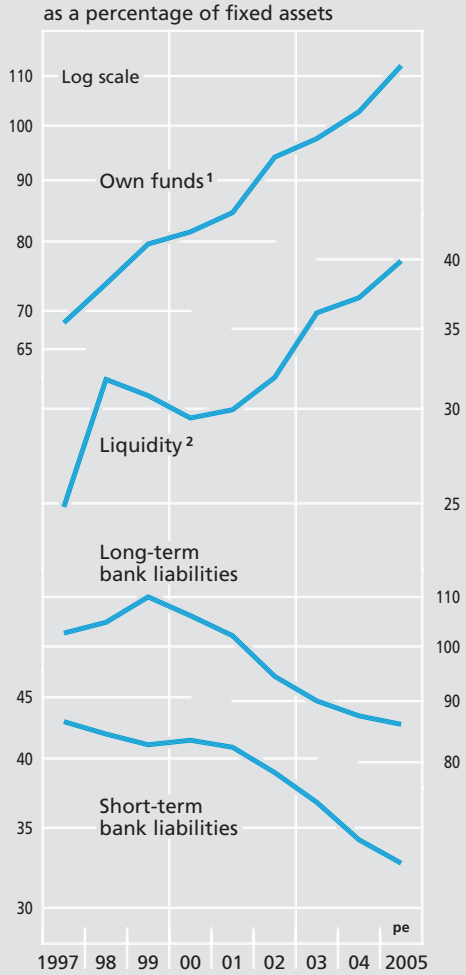
Improvement in own funds

In addition, there are also signs that, in the past few years, shocks to the real economy have been modulated by the financial environment in a different manner from past decades. For instance, enterprises have striven to improve their credit rating and thereby free themselves from dependency on external finance. Between 1997 and 2005, (adjusted) equity went up from 68.8% of fixed assets in corporate balance sheets to 112.9%. Own funds rose particularly sharply among small and medium-sized enterprises.[3] However, enterprises' liquidity holdings rose during the same period from 25.0% to 40.1% of fixed assets. A decline in borrowing, including bank liabilities, was in line with an increase in own funds. Both short-term and long-term bank liabilities fell sharply during the period under review, namely by a combined total of approximately 27% of fixed assets.

This correction in financing relationships is attributable partly to adjustment processes in the banking sector, which was facing increasing competition and pressure on margins and which was needed to create the capital reserves for risk required by Pillar I of the new Basel Capital Framework. However, it was also helped along by enterprises' own efforts to restore stability to a financing structure that had suffered from previous misalignments. During the adjustment period, this "investment" in their own balance sheet structures could also have occasionally competed with investment in machinery, equipment and structures. The attendant consequences for accumulation, however, should only be of a primarily transitory nature.

Enterprises' own funds, liquidity and bank liabilities*

as a percentage of fixed assets



* According to the corporate balance sheet statistics of the Deutsche Bundesbank. — **1** Less adjustments to the capital account. — **2** Cash and short-term securities.

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3 See Deutsche Bundesbank, The economic situation of small and medium-sized enterprises in Germany since 1997, Monthly Report, December 2006, p 52.

Determinants and indicators of commercial investment: empirical short-run and long-run results

According to theory, investment activity in the corporate sector is, over the long run, closely related to the development of value added. Indeed, the econometric study of these time series reveals the existence of a stable long-run equilibrium relationship which can be described adequately by the (log) price-adjusted investment-to-GDP ratio. For the observation period chosen here, however, a level shift coinciding with reunification needs to be taken into account. Moreover, the empirical analysis shows that the (lagged) investment-to-GDP ratio does not directly contribute to explaining the contemporaneous rate of change in corporate sector value added (weak exogeneity of the activity variable). Under these conditions, the investment-to-GDP ratio may be regarded as the cyclical component of commercial gross fixed capital formation, whereas, from the standpoint of time series analysis, gross value added comprises the common trend of both series.[1] For entrepreneurial fixed capital formation, therefore, the overall economic growth outlook is the decisive factor over the long term. One key condition, however, is that the earning power of the capital employed can, in the long run, keep up with the yield on alternative forms of use and the systematic risk component of investment.

The pronounced fluctuation of the investment-to-GDP ratio is influenced not only by the cyclical earnings component but also by the cost of capital services, the form of financing and, not least, fiscal factors. At the macro level, many of these determinants can be approximated by suitable indicators. The extent of future earnings is surely correlated with assessments of current and expected business which are obtained in the business surveys run by the Ifo Institute and the German Chamber of Commerce and Industry (Deutsche Industrie- und Handelskammer, or DIHK).[2] The costs of external funding can be approximated with the help of *ex ante* real interest rates.[3] The macroeconomic profit ratio – defined as the operating surplus as a percentage of nominal GDP – could serve as an indicator of the additional own funds available in the corporate sector (if dividend distribution and profit-taking remain constant).[4] Whereas the information on the degree of fixed capital utilisation and the stock of orders surveyed by the Ifo Institute can indirectly point to the need for investment in capacity extensions, the enterprises taking part in the DIHK survey are asked directly for information on their investment plans.

The variables described above may be considered as indicators of cyclical investment dynamics not only because of their theoretical importance but also because they are recorded at multiple times during the year, are available without a long time-lag, and – at least from a theoretical standpoint – are not trending over time. Granger causality analyses may be used to review whether the indicators have any predictive content for the cyclical component of commercial investment.[5]

The majority of the selected indicators feature favourable forecasting characteristics. Survey data based on the general economic situation seem to perform better than survey results on specifics such as production expectations and selling price expectations. The Ifo Institute's utilisation indicators, much like the DIHK survey of investment plans, are useful criteria for assessing the movement of commercial fixed asset formation in a short-run perspective. To a slightly lesser extent, this also applies to the profit ratio but not to *ex*

1 A trend-cycle decomposition with this forecasting characteristic follows directly from the econometric structure which is valid for the system of real gross fixed capital formation and real gross value added in the corporate sector. See J Gonzalo and C W J Granger (1995), Estimation of Common Long-Memory Components in Cointegrated Systems, in Journal of Business and Economic Statistics 13, 1, pp 27-35. — **2** The DIHK's business cycle surveys are run three times a year. The results are used to interpolate quarterly data. — **3** The ex ante real interest rates used here are calculated on the basis of the average yield on bearer bonds issued by German corporates with a commensurate residual maturity and the survey-based inflation expectations for Germany published in the "Consensus Forecasts" journal. See also Deutsche Bundesbank, Real interest rates: movements and determinants, Monthly Report, July 2001, p 35. — **4** By way of an analogy to the approach taken for the investment-to-GDP ratio, the profit ratio is also adjusted for a level shift that coincided with reunification. — **5** The hypothesis of empirical Granger non-causality is tested using bivariate vector autoregressions (VAR), each

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ante real interest rates. As regards interest rates, however, it must be noted that the test results are based on the relatively short period from the fourth quarter of 1989, which is marked by a downward trend in interest rates.[6]

The results for the *ex ante* real interest rates could support the view that favourable external financing conditions alone are not sufficient to ensure lively investment activity. Approaches to estimating the interest elasticity of the demand for capital based on macro data, however, are not without problems. For one thing, the (real) interest rate varies as a component of the user cost of capital over time because, as economic activity increases, market interest rates increase as well, and this, in itself, implies a positive correlation between the demand for investment and the interest rate. In addition, risks to price stability are usually linked positively to real economic activity or tensions in the goods and factor markets, thus giving rise to corresponding risk premiums. Micro studies, by contrast, are better able to take account of both aspects, since macroeconomic effects can be filtered out and the user cost of capital contains numerous enterprise-specific elements that are not subject to macroeconomic endogeneity. If estimates are made using micro data from the Bundesbank's corporate balance sheet statistics, investment demand turns out to be significantly dependent on the user cost of capital.[7]

The extraordinarily optimistic assessments of the business situation and business expectations at the current end may lead to the conclusion that the rather dynamic corporate investment activity will probably continue in the near future. This assessment is also backed up by the investment plans surveyed by the DIHK and

Granger causality relating to the investment-to-GDP ratio [8]

Indicator	Start of sample	Test statistic
A Earnings outlook		
Business situation(Ifo)	1st quarter of 1970	(2) 8.5*
Business situation (DIHK)	3rd quarter of 1991	(2) 14.8**
Business expectations (Ifo)	1st quarter of 1970	(2) 5.7(*)
Business expectations (DIHK)	3rd quarter of 1991	(2) 10.5**
Export expectations (Ifo)	1st quarter of 1970	(6) 13.7*
Export expectations (DIHK)	4th quarter of 1992	(1) 9.2**
Production expectations (Ifo)	1st quarter of 1970	(1) 1.4
Sales price expectations (Ifo)	1st quarter of 1970	(6) 7.3
B Financing conditions		
Ex ante real interest rate (5 years)	4th quarter of 1989	(1) 0.0
Ex ante real interest rate (10 years)	4th quarter of 1989	(1) 0.3
Profit ratio (national accounts)	1st quarter of 1970	(1) 4.0*
C Fixed capital utilisation		
Capacity utilisation (Ifo)	1st quarter of 1978	(1) 13.0**
Stock of orders (Ifo)	1st quarter of 1970	(2) 9.0*
D Investment survey		
Investment plans (DIHK)	4th quarter of 1992	(2) 7.5*

the currently high level of capacity utilisation in the manufacturing industry. Enterprises are likely to react to a continuation of the lively ordering activity by expanding their production capacities, especially as corporate earnings have been high for some time now and financing conditions remain favourable. Finally, it must also be stated that investment in movables will still benefit from the temporary increase in depreciation allowances in 2007 and that the resultant surpluses – as is intended by the planned corporate tax reform – will be taxed at lower rates from 2008.

of which contains one indicator alongside the log investment-to-GDP ratio, which is adjusted for statistical breaks. — **6** The results do not change qualitatively if the time series are trend-adjusted. — **7** See Deutsche Bundesbank, Monetary policy and investment behaviour – an empirical study, Monthly Report, July 2002, pp 41-55; and U v Kalckreuth, Investment and monetary transmission in Germany: a microeconomic investigation, in I Angeloni, A Kashyap and B Mojon (eds), Monetary Policy Transmission in the Euro Area, Cambridge University Press, 2003. — **8** The listed results of the tests for empirical Granger non-causality are asymptotically χ^2-distributed; see inter alia H Lütkepohl (2005), New Introduction to Multiple Time Series Analysis, chapter 3.6.1. The number of degrees of freedom (given in parentheses) is, in this particular case, equal to the lag order of the underlying vector autoregression (VAR) which is defined according to the Schwarz information criterion. **, * and (*) mean rejection of the null hypothesis at the 1%, 5% and 10% significance level respectively.

Accelerator mechanism largely intact

Whether – and to what extent – the structural influences exerted by technology and the global environment have caused investment activity to change overall is ultimately an empirical question. It turns out that, since 1991, real gross fixed capital formation and real gross value added in the corporate sector have grown largely in parallel, after eliminating cyclical fluctuations. This represents the continuation of a pattern that could already be seen in the former West Germany during the 1970s and 1980s. This evidence of a stable long-run investment-to-GDP ratio at constant prices shows that, on balance, the influences described above have so far largely cancelled one another out. All the same, each of these "shocks" raises the need for adjustment in the domestic capital formation process.

Penetration of the economy by information and communication technology (ICT)

Growing importance of ICT

The technical progress associated with ICT is penetrating the working environment in industrial countries with increasing strength. In Germany, the percentage share of ICT goods in total investment in machinery and equipment[4] went up in real terms from just over 15% in 1991 to over 40% in 2005.[5] Although this rise was temporarily halted when the New Economy bubble burst, it appears to have resumed since 2004. This development should not come as a surprise: companies seeking to maintain their competitiveness always have to keep up with the latest developments in the ICT field. One aspect of this requirement is that companies are introducing completely new procedures and products.[6] Another is that ICT modernisation is comparatively costly because the installed capital goods are prone to extremely rapid economic obsolescence despite their technical functionality.

Reduced economic service life and increased need for depreciation

The growing share of ICT goods and the shorter product lifecycles in this segment have led to a reduction in the average service life of capital, increasing the need for replacement investment. Thus, economic agents deciding upon new investments are faced with a rising depreciation rate which, through this channel, raises the cost of capital and makes it optimal to keep a smaller capital stock than under unchanged conditions regarding depreciation.

Data from the national accounts can be used to calculate the average depreciation rates for the corporate sector. Whereas the average depreciation rate on structures has stood unchanged at just over 3% per annum since reunification, for machinery and equipment the figure rose from 14½% in 1991 to over 18% in 2005. For this period, this means that the depreciation rate on the representative cap-

4 Machinery and equipment in this context also include "other assets" (particularly software).
5 In line with the Federal Statistical Office definitions, ICT investment comprises the following categories of investment in fixed assets, by group of goods: investment in office machinery and computers; investment in radio, television and communication equipment and apparatus; intangible fixed asset investment. See also Deutsche Bundesbank, The significance of information and communication technology, Monthly Report, April 2004, p 48.
6 This often involves changes in human capital, by, for instance, hiring specialised workers to operate the new technology and giving existing staff further training to acquire additional qualifications.

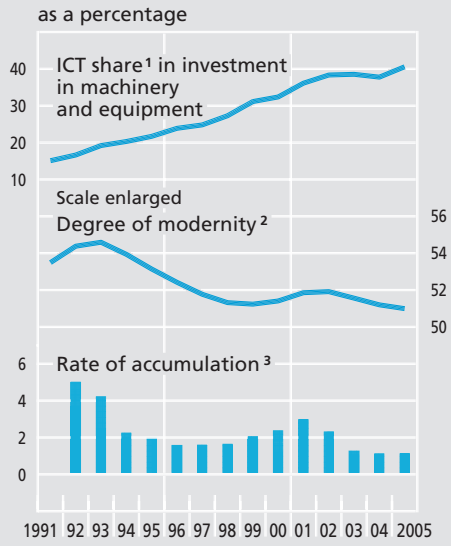
ital good has gone up by just under 1½ percentage points to around 8% per annum.[7] However, the higher productivity of the new machinery and equipment means that a typical capital unit now provides a higher degree of service, suggesting that a smaller quantity of new capital goods will suffice to replace older plant.

Relative price of capital goods falling

The increasing penetration of ICT goods affects the user cost of capital and thus investment behaviour through further channels. The stock of ICT goods already installed in a given configuration loses market value practically every year of its service life because continuous quality improvements generally tend to reduce prices in this segment. Owing to the rapid penetration of the market by ICT, the average price of machinery and equipment has therefore been falling continuously since 1993. Even the slight overall price increases in structures were not enough to offset this trend: in 2005 the price of the investment good which is representative for German enterprises stood at 5% below its 1991 level. In fact, compared with the price when the construction boom peaked in 1995, the decline was even twice as large. It is not just the absolute price of the capital good but its price relative to the selling price of commercial products which is relevant for businesses' investment decisions. However, relative capital goods prices, too, have been on a pronounced and nearly uninterrupted downward trend since reunification, averaging around 1½% a year.

If the market price for fixed assets falls relative to the (net) selling price of the manufactured goods, corporate investment decisions are affected in two ways. One is that entrepreneurs will be likely to prefer capital-intensive production technology, because fixed assets are cheaper to procure, thereby making their use more profitable than that of other factor inputs. However, if the trend towards falling prices is expected to continue, entrepreneurs must also reckon with the possibility that the new capital good will lose value in real terms. If, for instance, the investor expects the post-1991 relative price development of the representative capital good to continue at a similar pace in the future, too, he will assume a loss in real value of 1½%

Selected indicators of movable fixed assets



1 Percentage invested in information and communication technology, price-adjusted. — **2** Ratio of net stock of fixed assets to gross stock of fixed assets at 2000 prices. — **3** Rate of change in gross stock of fixed assets at 2000 prices.

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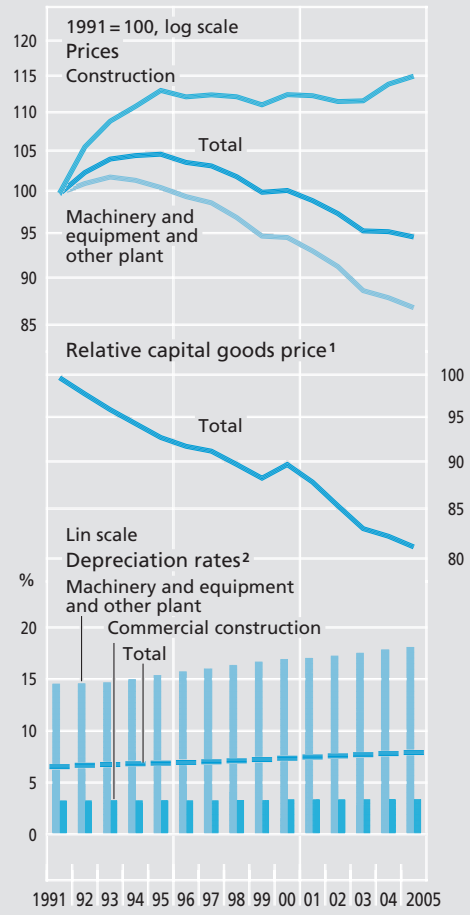
7 See also G Ziebarth, Abschreibungen im Spiegel der Volkswirtschaftlichen Gesamtrechnungen: Ökonomische Relevanz und analytischer Gehalt, Wirtschaft und Statistik 12/2002, pp 1119-1127.

Prices and depreciation rates of capital goods



1 Ratio of the deflator of gross fixed capital formation to the deflator of gross value added. — **2** Calculated as a geometrically degressive rate (as a percentage of the net capital stock), based on the national accounts.

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per year of use (upon a hypothetical resale). When a profit-maximising enterprise is deciding on investments, this negative valuation effect will increase the user cost of capital in the same manner as a lasting increase in real financing costs or in the allowance for wear and tear. This effect only raises the profitability threshold, reducing *ceteris paribus* the optimal capital stock in a one-off manner. As the former effect, however, accumulates over time, the sustained slide in the relative price of capital goods is expected to – at least over the longer term – increase investment.

Overall effect of ICT on gross fixed capital formation positive

Theoretically, the rapid proliferation of ICT goods has had disparate impacts on investment activity. The stimulating influence is likely to outweigh the dampening effects, which means that, on the whole, gross fixed capital formation in the corporate sector should have grown must faster, on average, than value added.

International competition among production locations

Intensified competition for capital as the mobile factor of production

The second major trend that was of primary importance for corporate investment behaviour over the past decade was the globalisation in large areas of economic activity.[8] The increasing international competition for capital as the mobile factor of production is a telling feature of this development. This competition has intensified significantly since the early 1990s and evolved into an element of competition among production locations owing to the opening of the markets of emerging economies and transition countries, the advance of European integration and the relative decline in transport and communication costs. To prevail in this competitive environment, German companies are increasingly facing the challenge of meeting the requirements regarding returns on fixed assets imposed by the global market. The improve-

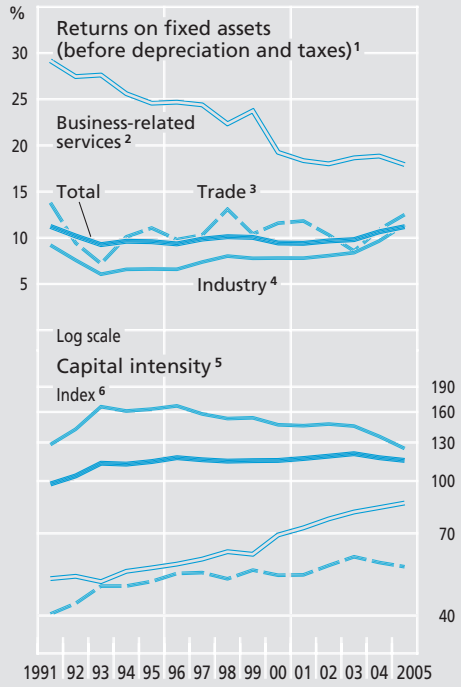
8 For the impact of globalisation on the German economy see also Deutsche Bundesbank, Germany in the globalisation process, Monthly Report, December 2006.

ment in the price competitiveness of German products over the past few years ultimately shows that companies and their employees have generally embarked on the right path towards maintaining or even expanding their market position in the age of globalisation.

Return on fixed assets in the industrial sector …

The industrial sector,[9] which is, on the whole, subject to especially powerful international competitive pressure, has seen its returns on fixed assets increase noticeably since the mid-1990s. In 2005 the operating surplus per capital unit at replacement cost was just over 11½% (before taxes and depreciation), returning to double digits for the first time since reunification. Leaving aside phenomena specific to individual companies, this development is the upshot of cost cutting, productivity increases and changes in the use of factor inputs. Moreover, wage moderation and the reduction in non-core payments readjusted the remuneration structure of labour, which had not been productive enough for the international competitive environment. Longer operating hours for machinery, achieved through extended working hours and flexitime agreements, as well as employee training measures served to increase capital productivity. However, non-replacement and the targeted downsizing of machinery and equipment through, for instance, shifting production activities requiring a low-skilled workforce to foreign countries with a more favourable (wage) cost structure, also increased productivity.[10] Both capital adjustment measures led to a lower volume of gross domestic investment. With a fixed production technology, companies influence capital productivity by changing the use of factor inputs or the

Returns on fixed assets and capital intensity in selected sectors



1 Gross value added less compensation of employees and imputed labour income of the self-employed as a percentage of gross fixed assets at replacement cost. — **2** Financing, renting and business activities excluding real estate; in the cases of capital intensity, also excluding renting of machinery and equipment without operator (figures for 2005 partly estimated). — **3** Including repair of motor vehicles, motorcycles and personal and household goods. — **4** Production sector excluding construction. — **5** Gross stock of fixed assets per hour worked, measured in efficiency units. — **6** Total corporate sector in 1991 = 100.

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9 The industrial sector is defined here as the production sector excluding construction.

10 A distinction must be made between whether enterprises commission foreign third-party companies to produce intermediate input or whether, in a process known as vertical foreign direct investment, they shift parts of the production chain to foreign subsidiaries. A detailed discussion of the latter effect appears in Deutsche Bundesbank, German foreign direct investment relationships: recent trends and macroeconomic effects, Monthly Report, September 2006, pp 43-58.

Value added and capital stocks of selected business sectors

Percentages

Period	Industry [1]	Trade [2]	Business-related services [3]	
			Total	Operating leases [4]
	Gross value added [5]			
1991-1995	37.7	15.9	21.9	2.0
1996-2000	35.7	15.7	23.3	2.5
2001-2005	35.9	15.7	23.3	2.7
	Gross stock of fixed assets [6]			
1991-1995	47.0	7.2	14.7	6.1
1996-2000	43.1	7.8	16.9	7.7
2001-2005	39.5	8.2	20.2	9.5

1 Production sector excluding construction. — **2** Including repair of motor vehicles, motorcycles and personal and household goods. — **3** Financing, renting and business activities excluding real estate (figures for 2005 partly estimated). — **4** Renting of machinery and equipment without operator. — **5** Value added percentage shares in the year 2000 (at current prices) projected using factors measuring the change in the price-adjusted value added percentage shares. — **6** At 2000 prices.

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capital intensity.[11] Over the past decade, capital intensity in the industrial sector has, in fact, seen a visible decline (see adjacent chart). Given exogenous factor price movements and a predetermined production technology, reducing domestic capital intensity is the optimum reaction by the corporate sector to the increase in the required return on fixed assets. To that extent, more subdued domestic investment in the industrial sector may therefore also be regarded as a reaction to the challenge of globalisation.

... in the trade sector ...

Even in the initial post-reunification period, retailers' and wholesalers' return on capital stood at just over 10% on average. In contrast to industry, the profitability of the trade sector kept pace with that of the business sector. In terms of production theory, it therefore comes as no surprise that the capital intensity of the trade sector has since developed virtually in parallel to that of the corporate sector as a whole. The existing difference in levels is probably also a reflection of the relatively large labour input, especially among retailers.

... and in business-related services

Finally, a look at the business-related services sector is of particular interest with regard to the developments in returns on fixed assets and in capital intensity. For reasons related to production theory, the latter quantity is calculated without considering the segment of fixed assets rented to third parties without an operator. Early in the 1990s, the return on capital in this economic sector was just under 30%, significantly exceeding that in the industrial and trade sectors. However, the gap in returns between the sectors has narrowed considerably in the past 15 years; as of late, however, the capital stock belonging to this sector was still creating a return that was about one-half greater than the average of the entire corporate sector. In the past, these relatively large returns may have attracted increasing investment in the sector for business-related services. The rise in capital intensity during the period under review may be regarded as empirical evidence of this development. The fact that capital intensity has actually accelerated since 1999 makes it seem likely that this process, which may be regarded as structural change, has probably not come to an end. A growth equilibrium that is stable across sectors will not have been

11 Capital intensity is defined as the capital stock per efficiency unit of labour; in terms of production theory, the efficiency parameter represents technical progress.

reached until the (if need be, risk-adjusted) returns on capital of all economic sectors, after deducting taxes and depreciations, have converged completely.

Key position of industrial sector

The above table lists the percentage shares of the aforementioned sectors in corporate value added and fixed assets in five-year periods since 1991. The three sectors taken together produced three-quarters of economic output using just over two-thirds of the capital stock tied up in the corporate sector. While these overall ratios remained relatively stable during the period under review, a look at the individual sector information shows that, during the past 15 years, the percentage of fixed assets tied up in the industrial sector has gone down by nearly one-sixth to just under 40%. By contrast, providers of business-related services increased their share in the commercial capital stock from around 15% in the early 1990s to just over 20% on average during the first half of the current decade. However, it must be noted that, in the national accounts, movables rented to users in other sectors, such as industrial enterprises, are posted to business-related services. The increasing significance of operating leases is probably the main reason behind the notional shift in asset shares from the secondary sector to the tertiary sector. The weight of the industrial sector in capital use probably declined less sharply.

Industrial enterprises hold a volume of capital stock that is, at the very least, nearly double the size of that held by business-related services providers. With regard to investment activity, the dampening influences from the production sector will thus probably have more than compensated for the capital intensification in the tertiary sector. Therefore, the increased mobility of capital, fostered by the need for higher returns on the fixed assets in the production sector, would have caused the growth path of gross fixed capital formation in the entire corporate sector to flatten, when viewed in isolation.

Results of econometric analysis

Theoretical issues

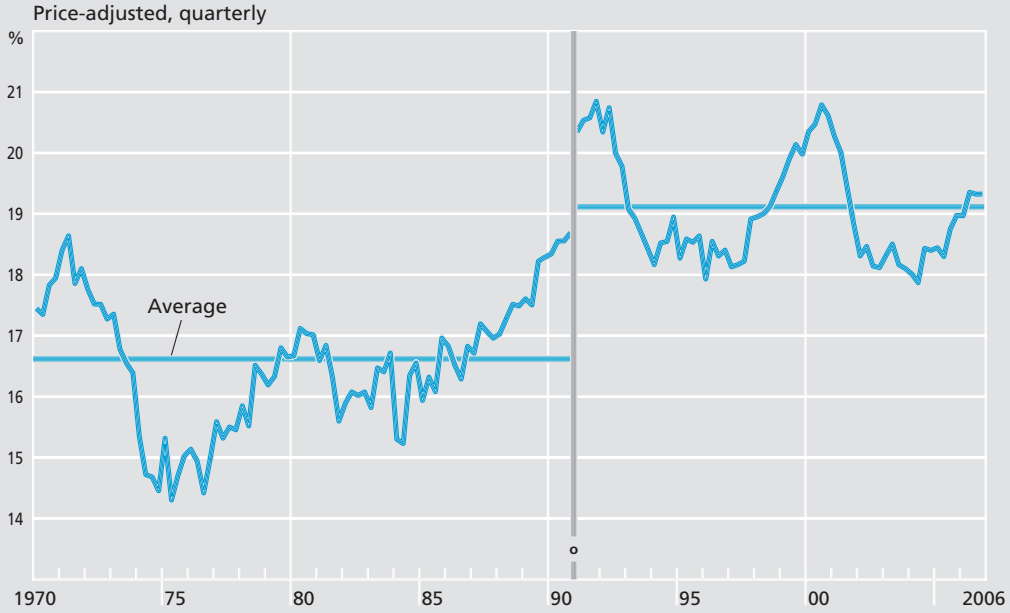
The question as to whether, and if so, how the aforementioned structural factors have, in the aggregate, influenced domestic investment can also be empirically tested in a more systematic fashion using econometric methods. Since the impact of penetration with ICT goods and intensified international competition for fixed assets can influence investment in different ways, the aggregate effects are difficult to isolate and identify at the macro level. Were the globalisation effect to prevail, the investment-to-GDP ratio should be expected to decline. However, were the ICT shock predominant, a rising trend investment-to-GDP ratio should be visible.

Cointegration analysis

In principle, growth theory implies a constant long-run relationship between commercial investment and production. In an econometric analysis, this theory can be considered valid if the time series of real gross fixed capital formation and real gross value added in the corporate sector follow a common trend such that their ratio, the (price-adjusted) investment-to-GDP ratio, is itself not trending

Investment-to-GDP ratio* of the corporate sector

Price-adjusted, quarterly



* Investment-to-GDP ratio of 1991 (at current prices) projected using factors measuring the change in the price-adjusted investment-to-GDP ratio (change in the factors measuring the change in gross fixed capital formation relative to that of gross value added of the corporate sector, each at previous year's prices). — o Western Germany until 1990 Q4; the whole of Germany from 1991 Q1.

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over time.[12] This was the case, for instance, in the former West Germany between 1970 and 1990, once the west German economy had completed the accumulation of capital that was characteristic of the reconstruction period.[13] It is questionable, however, whether this empirical outcome was still valid in the following period in the light of the factors described above.

Reunification effects

The need to use data for reunified Germany from 1991 makes it more difficult to test the hypothesis of a stable investment-to-GDP ratio during the entire observation period. However, it is not only the statistical break caused by the change in the territorial basis that make the empirical analysis more difficult. Account must also be taken of the fact that German economic and monetary union suddenly threw the east German production sector into a competitive situation where efficiency was of the essence and where, owing to the delayed structural change and the previous dominance of central planning, it was often unable to survive. In order to help the economic recovery process along and to cushion the social impacts of the economic transformation, in the early 1990s the

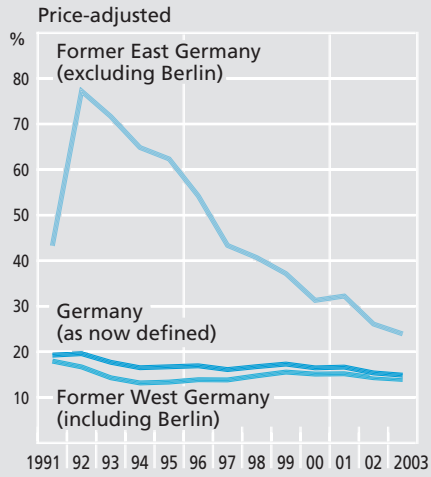
12 Technically speaking, this means that it is possible to establish a long-run relationship between the non-stationary log time series of gross fixed capital investment and corporate value added which, freely estimated, does not deviate statistically significantly from the cointegration vector. See R G King, C I Plosser, J H Stock and M W Watson (1991), Stochastic Trends and Economic Fluctuations, American Economic Review 81, 4, pp 819-840.

13 The development of the overall economy in the 1950s and 1960s can be described adequately as a process of convergence towards a stationary growth equilibrium. See B Lucke (2005), Is Germany's GDP Trend-Stationary? A Measurement-With-Theory Approach, Jahrbücher für Nationalökonomie und Statistik 225, 1, pp 60-76.

government granted generous tax breaks, financial assistance and inexpensive loans for investment in the new Federal states. These measures not only promoted economic development in eastern Germany but also served to distort the allocation of factors of production by favouring capital-intensive production methods in eastern Germany, for instance.[14] Thus, in connection with the integration of eastern Germany, the share of gross fixed capital formation in gross value added – shown in the above chart using the industrial sector as an example – initially jumped sharply in the first half of the 1990s. The gap between east and west, which then declined but was still visible even as late as 2003, was probably associated with a relatively large amount of replacement investment due to the relatively capital-intensive structure of the east German industrial sector.

If the study of the long-run relationship between investment and production is extended to cover the entire period between the first quarter of 1970 and the third quarter of 2006, econometric tests do, in fact, provide evidence of a structural break that coincided with reunification. The existence of an evident level shift not only in the time series but also in the long-run relationship between investment and production is most likely due to the higher investment-to-GDP ratio in the production structure in eastern Germany. Over and above that, though, there are hardly any signs that the parallel movement of gross fixed capital formation and gross value added in the corporate sector could not have continued since 1991. On balance, the effects of changes in the structural factors seem to have largely cancelled one another out.

East-West comparison of investment-to-GDP ratios* in the industrial sector



* Investment-to-GDP ratio of 1991 (at current prices) projected using factors measuring the change in the price-adjusted investment-to-GDP ratio (change in the factors measuring the change in gross fixed capital formation relative to that of gross value added of the corporate sector, each at previous year's prices).

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Conclusion

In the past 15 years, corporate investment has been largely exposed to disparate influences. Of these, neither technological change nor global competition between production sites seems to be predominant at present. As things now stand, however, it cannot be as-

14 See also Deutsche Bundesbank, Progress in the adjustment process in eastern Germany and the contribution of economic promotion measures, Monthly Report, July 1995, pp 37-54; also, the contributions by M C Burda (2006), Factor Reallocation in Eastern Germany after Reunification, American Economic Review 96, 2, pp 368-374, and D J Snower and C Merkl (2006), The Caring Hand that Cripples: The East German Labor Market after Reunification, American Economic Review 96, 2, pp 375-382.

sumed that the process of converging to an optimum capital stock has been completed yet in an increasingly internationally-oriented production environment, especially as ICT will further penetrate the working environment and return expectations engendered by globalisation are hardly likely to decline.

Since, by contrast, competition among production sites both within and outside the enlarged EU will probably intensify further, it will be possible to increase fixed asset formation in Germany only if the supply conditions are also adequate by international standards and are regarded as sustainable. Wage moderation and reliability are therefore still key conditions. Even if domestic investment is hardly able to react to changes in the user cost of capital or factor price ratios in the short term owing to, for instance, technical restrictions in capital adjustment or problems gauging the sustainability of recent developments, their knock-on effects will be all the more severe over time. Moreover, capital productivity will also increase if the efficiency of labour is upgraded. This is necessary not least in the light of the fact that modern ICT is making increasingly exacting demands on labour and that complex capital goods and human capital are often complementary factors of production.

The international competition for returns is affecting not only financial assets but also, in increasing measure, fixed assets. The impending corporate tax reform should account for this insight as well as for the fact that all types of investment – replacement, extensions or rationalisation – initially represent a positive decision in favour of production sites in Germany; with a large amount of technology embodied in capital, great importance should be given to tax modalities regarding depreciation allowances. This is also necessary given that, despite the rising share of ICT goods, capital accumulation in machinery and equipment has remained weak throughout the period under review, thereby causing the modernity of plant and machinery to suffer over the years.

Along with the intensive use of new technologies, it will also be important for Germany to maintain its traditional strengths even in the production of fixed assets, within the framework of European and global specialisation patterns. Only then will it be possible to exploit the productivity effects of new technologies to the full. It is also an empirically well-founded finding that, in this respect, the best results can be obtained in deregulated, highly competitive markets.