

Innovator rate has fallen again

The innovator rate – the percentage share of innovative enterprises in the overall SME sector – slipped four percentage points to 23% in the period under review. The number of innovative SMEs has dropped by 150,000 to around 850,000 enterprises. The proportion of innovators has thus fallen to the level of 2013/2015, so the positive trend of the previous period has not continued. The percentage of innovative SMEs has dropped by just under half from the peak in 2004/2006. Small businesses, above all, have discontinued their innovation activities. The innovator rate dropped the least in R&D-intensive manufacturing.

The recent decline was driven by the trend in product innovations. The share of product innovators has dropped to the lowest level ever measured by the KfW SME Panel (15%). By contrast, the share of process innovators has increased for the second time in a row (17%). This is likely due to the fact that SMEs are allocating more resources to digitalisation and in turn deferring product innovations.

As part of this trend, innovation expenditure also dropped in the medium term to just under EUR 31 billion in the period under review. While some enterprises thus abandoned innovation activity, the remaining ones continued their innovation efforts undiminished. SMEs spent EUR 15 billion on research and development (R&D). This expenditure was concentrated in large SMEs and manufacturers even more than innovation expenditure.

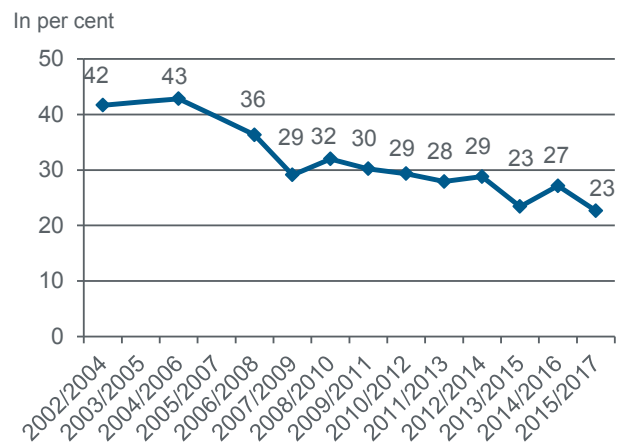
Enterprises that perform R&D are the pioneers among the innovators. With a share of 87% in the period under review, they innovate far more often than firms that conduct no R&D. At 22%, the share of enterprises with new-to-market products was also around seven times higher among those with R&D activities than those without.

The polarisation in the SME sector thus continues. On the one hand, more and more SMEs are discontinuing innovation work of their own. This applies mainly to those that used to introduce imitative product innovations. On the other hand, the remaining innovators are keeping up their innovation activities.

Innovation policy therefore needs to create enabling conditions for businesses in general to stop the decline in the innovator rate. Highly innovative enterprises, however, also need support so that they can fulfil their pioneer role. This is also important given the current economic trend, which has the potential to additionally hamper innovation activity.

Innovation and technological advances are the key drivers of productivity growth and sustainable economic expansion.¹ In developed economies they are therefore regarded as guarantors of rising prosperity which accelerate the structural transformation towards viable economic sectors.² From a business perspective, innovations are an important mechanism for developing a competitive position in the market. Numerous studies confirm that innovations increase enterprises' headcount, turnover, returns and productivity.³ This also benefits the employees working in those enterprises in the form of higher wages.⁴

Figure 1: Development of innovators among SMEs



Note: Figures extrapolated to the number of enterprises.

Source: KfW SME Panel, own calculations

Innovations do not just mean novelties based on research and development (R&D), such as sensors for autonomous driving or programming of gesture-based control of industrial robots. What is often overlooked is that small and medium-sized enterprises, in particular, often develop innovations out of the normal production process or in cooperation with customers and suppliers ('learning-by-doing, using and interacting').⁵ The introduction of a home food delivery service or a hotel chain that targets new, specific customer groups can

also be innovations. A product (including a service) or manufacturing process is regarded as an innovation when it is new or significantly improved in material aspects for the relevant enterprise or the market.⁶

Innovator rate continues to decline

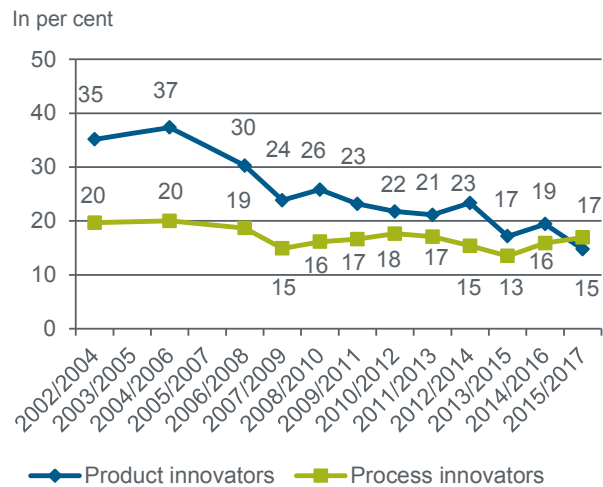
After increasing in the previous period, the share of SME innovators dropped by around four percentage points to 23% in the period under review (2015/2017) (Figure 1).⁷ The innovator rate measures the share of enterprises that have introduced at least one innovation in the past three years. It was thus on a similar level as in the period 2013/2015. Currently there are approximately 850,000 innovative small and medium-sized enterprises. That share has fallen by 150,000 enterprises on the previous period.

One possible reason for the decline in the innovator rate on the previous period could be that SMEs have currently devoted more resources to the issue of 'digitalisation' and are scaling back traditional innovation activity – particularly the output of new products – despite what is still a good business situation. Thus, unlike the innovator rate, the share of SMEs with completed digitalisation projects increased from 26 to 30% on the previous period.⁸

Compared with the peak of 2004/2006, the share of SME innovators dropped by almost half. The innovator rate dropped particularly sharply in the second half of the 2000s. After the economic and financial crisis, the innovator rate initially surged again. After that, however, the decline continued, albeit at reduced speed. In the past years the innovator rate was characterised by relatively high volatility.

The current decline is exclusively driven by the trend in product innovators. Their share dropped by four percentage points on the previous period. At 15% it is currently on the lowest level since it was first included in the KfW SME Panel (Figure 2). By contrast, the process innovator rate increased for the second time in a row to now 17%. The process innovator rate is thus higher than the rate of product innovators for the first time. In other words, 560,000 SMEs brought new or improved products to market and 640,000 modernised their manufacturing processes during the period under review.

Figure 2: Development of SME product and process innovators



Note: Figures extrapolated to the number of enterprises.

Source: KfW SME Panel, own calculations

The rise in the process innovator rate supports the belief that the development of innovators is linked to the development of digital transformers. Thus, 63% of digital transformers responded that they generated process innovations. A closer look at the type of digitalisation projects also corroborates such a link. As the KfW SME Digitalisation Report shows, the majority of digital transformers renew their IT systems or introduce new applications (53%). Digitalisation projects of this type constitute process innovations. At the same time, digitalisation in the SME sector so far only rarely means new, digitalised products and services. A mere 21% of digital transformers have digitalised their products or services.

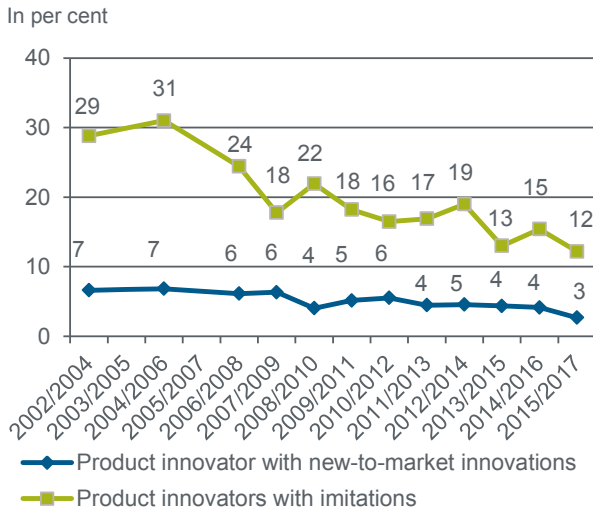
Product imitations: long-term decline continues

Product innovations can also be distinguished into new-to-market innovations and product imitations. New-to-market innovations are those for which competitors have so far failed to offer comparable products. Imitative innovations, on the other hand, are defined as the adoption of 'inventions' from competitors – possibly with certain modifications.

The adoption of inventions and ideas from competitors constitutes the bulk of innovations. The diffusion of innovations in a national economy is important from a macroeconomic point of view because it ensures a more efficient use of resources (and thus productivity), as well as competitiveness across the overall economy. The benefit of imitative innovations for consumers is

that as the number of suppliers (and users) rises, the price of the products or services usually tends to drop.⁹

Figure 3: Product innovators: new-to-market innovations and imitations



Note: Figures extrapolated to the number of enterprises.

Source: KfW SME Panel, own calculations

The share of SMEs with product imitations dropped by three percentage points to 12% in the period under review. The long-term trend thus continues (Figure 3). Since its peak in 2004/2006, that share has fallen by nearly two thirds. The share of SMEs with product imitations has thus experienced the sharpest drop.

Product imitations can often be brought to market relatively quickly without long periods of development and in a favourable market situation. That is why the overall share of product imitators tends to be rather volatile.¹⁰ The share of enterprises with new-to-market innovations has, in turn, remained nearly steady for a long time, with fluctuations ranging from 4 to 7%. One contributing factor may be that these types of innovations are more often introduced by enterprises that conduct R&D. Besides, it is an activity that fluctuates less with the business cycle.¹¹ Instead, such innovations are more often brought to market for strategic reasons after more extended development periods.¹²

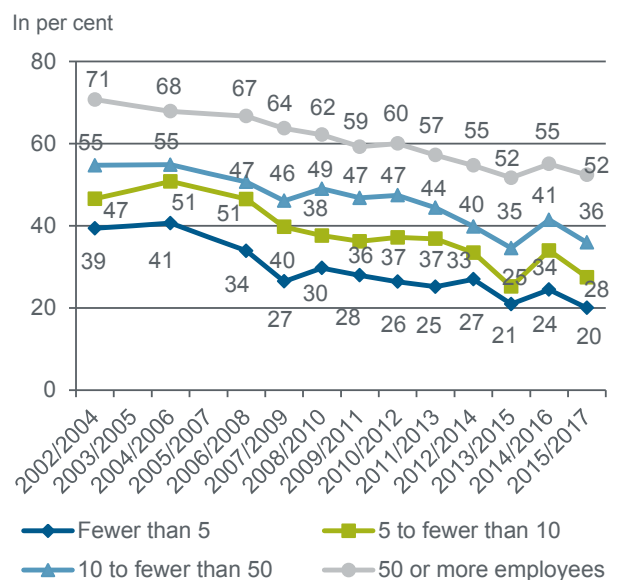
Under the current survey, that share dropped to 3% for the first time. Thus, both imitative and original product innovators experienced declines in the period under review. In absolute figures, some 460,000 SMEs developed imitative product innovations and 100,000 new-to-market (product) innovations in 2015/2017.

Innovator rates are dropping in all company size classes

Innovator rates are declining on the previous year in all company size classes (Figure 4).¹³ For businesses in the medium size classes (five to fewer than 50 employees) the decline is somewhat stronger, at five and six percentage points, than for small and large SMEs (-4 and -3 percentage points, respectively). In the previous period the innovator rate grew most strongly among businesses in the medium size classes. The innovator rates in the individual company size classes thus remain roughly within the same range of the period 2013/2015.

The innovator rate dropped significantly from its peak in the middle of the last decade across all size classes. The smaller the surveyed companies are, the greater the loss of innovators is in the long term. For businesses with fewer than five employees the decline is a good half. For enterprises with five to fewer than ten and ten to fewer than 50 employees the innovator rate dropped by just under one half and one third, respectively. By contrast, the decrease in the innovator rate was lowest among enterprises with 50 or more employees, at a good one quarter (compared with 2004/2006). The pronounced decline in the share of innovators among small businesses presumably reflects the diminishing share of innovators with (product) imitations set out above.

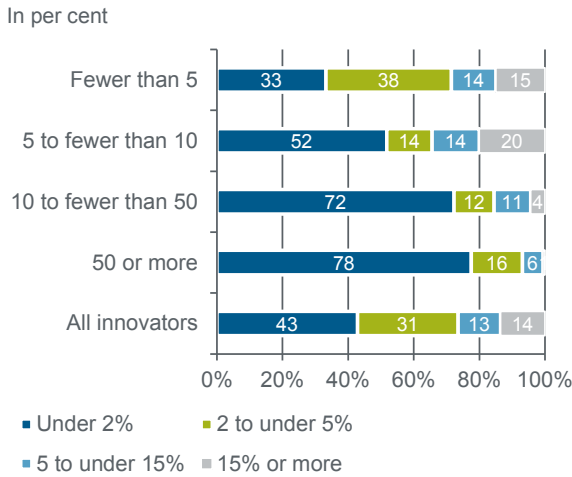
Figure 4: Innovators by company size



Note: Figures extrapolated to the number of enterprises.

Source: KfW SME Panel, own calculations

Figure 5: Innovation expenditure by enterprise size in 2017



Note: Figures extrapolated to the number of enterprises.

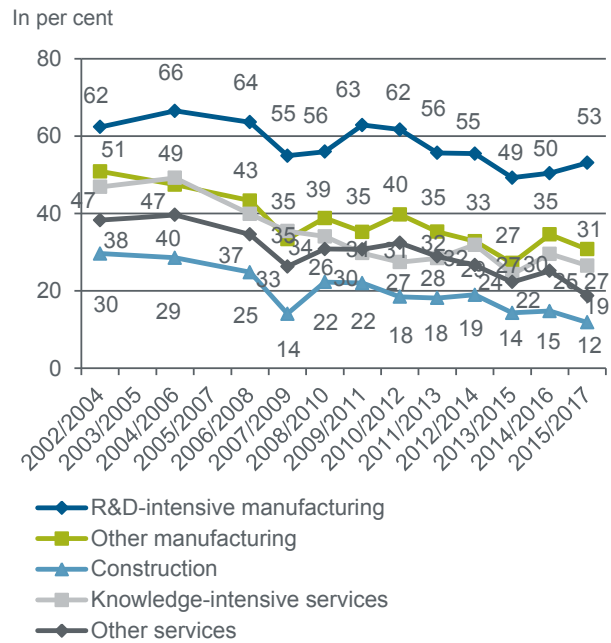
Source: KfW SME Panel, own calculations

Throughout the period under review, it was evident that small enterprises are less likely to innovate than large ones. The reasons for this are that small businesses have fewer resources and cover smaller markets. That makes it harder for them to innovate and reduces profits which they could generate from innovating. These disadvantages are exacerbated by the fact that innovation projects often cannot be split up at will.¹⁴ Minimum project sizes and high fixed costs mean that innovations place a higher financial strain on small businesses than on large ones (Figure 5). As a result, small SMEs can carry out fewer projects at the same time. For example, 78% of large SME innovators (with 50 or more employees) spend less than 2% of annual turnover on innovation. For SMEs with fewer than five employees, however, that rate is a mere 33%.

R&D-intensive manufacturing industries are bucking the downward trend

A sector analysis reveals that innovation activity has recently fallen in all business sectors – with the exception of R&D-intensive manufacturing (Figure 6). In this segment (e.g. mechanical engineering, electronics and chemicals), the innovator rate already increased for the second time in a row. Throughout the period under review, R&D-intensive manufacturing industries displayed a clearly undulating trend curve in the innovator rate, with slumps always followed by recovery phases. In the long term, however, the innovator rate has declined in R&D-intensive manufacturing as well (-20%).

Figure 6: Innovators by industry



Note: Figures extrapolated to the number of enterprises.

Source: KfW SME Panel, own calculations

The innovator rate experienced a sharper drop in other (non-R&D-intensive) manufacturing, such as food and animal fodder production and metal products industries, for example. Here it dropped by around one third on 2004/2006.

Innovation activity in manufacturing thus remained the steadiest overall, however. In the services sector, by contrast, the innovator rate in knowledge-based services (e.g. IT and information service providers, law firms, tax accountants and management consulting firms) fell by 45% and in the remaining (non-knowledge-based) services such as hospitality, transport and storage by as much as 53% since 2004/2006. The sharpest drop in the innovator rate – 59% – was recorded in the construction industry.

Innovator rate has dropped most sharply among businesses with a domestic focus

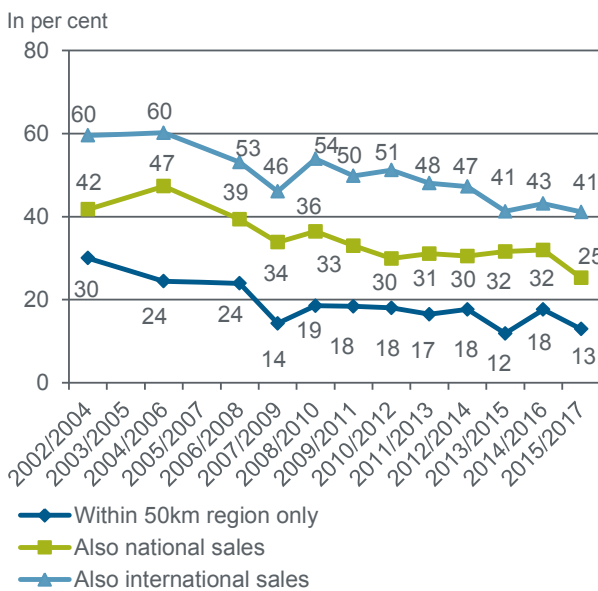
The innovator rate experienced the sharpest drop among enterprises that exclusively serve the domestic market (-7 and -5 percentage points). By contrast, the innovator rate among enterprises with international business dropped only slightly by -2 percentage points (Figure 7).

The long-term trend by sales region is definitely the most distinct, followed by the trend by company size and economic sector. Until the height of the economic and financial crisis, the innovator rate dropped most sharply among regionally operating enterprises, although those with business across Germany and

beyond also recorded significant decreases.

Then, between 2008/2010 and 2013/2015, internationally operating enterprises, in particular, scaled back their innovation activity. During this period the growth weakness in Europe may have adversely impacted these enterprises' innovation activity. Within this timeframe, businesses that exclusively supplied the domestic market experienced phases of nearly unchanged innovation activity. This occurred between 2009/2011 and 2014/2016 among businesses with operations across Germany and between 2008/2010 and 2012/2014 among those operating regionally, for example. Particularly in the latter enterprises, the variations in the innovator rate increased sharply in the past years without indicating a clear trend.

Figure 7: Innovators by sales region



Note: Figures extrapolated to the number of enterprises.

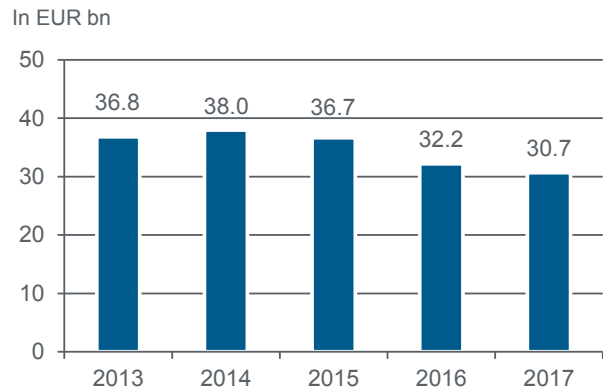
Source: KfW SME Panel, own calculations

Since 2004/2006, enterprises operating internationally exhibited a drop of just under one third, the lowest decline in the innovator rate. Among businesses that operated exclusively within Germany, the rate declined by just under one half. Across the entire observation period, enterprises with only regional operations exhibited a decline of well over one half.

Innovation expenditure down slightly again

Innovation expenditure in the SME sector also dropped slightly yet again, after falling moderately already in the previous years. It is currently at EUR 30.7 billion (Figure 8).¹⁵ Innovation expenditure includes all spending on innovation including personnel costs and capital expenditure related to developing innovations and bringing them into the market.¹⁶

Figure 8: Aggregate innovation expenditure



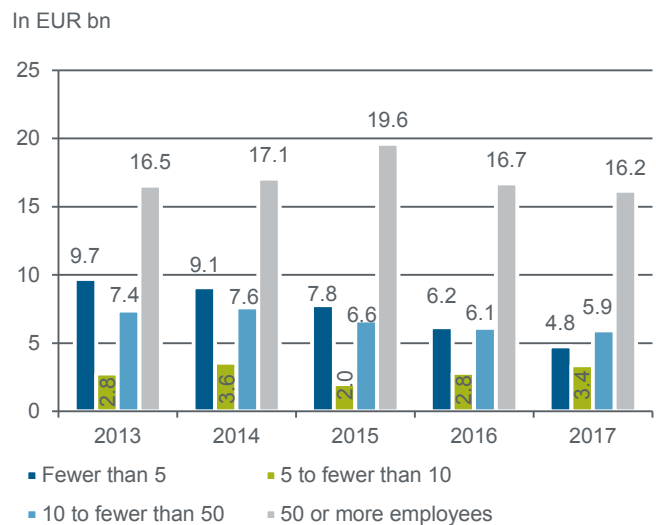
Note: Values extrapolated from the number of employees.

Source: KfW SME Panel, own calculations

Innovation expenditure of small businesses is trending downward

Small businesses with fewer than five employees accounted for most of the decrease in innovation expenditure. With a EUR 1.4 billion drop on 2016, the downward trend in this group continued (Figure 9).

Figure 9: Aggregate innovation expenditure by enterprise size

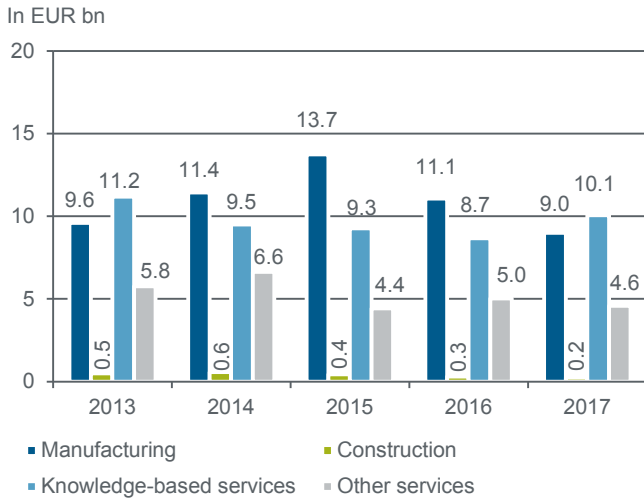


Note: Values extrapolated from the number of employees.

Source: KfW SME Panel, own calculations

Innovation expenditure of large SMEs with 50 and more employees, on the other hand, remained within the range observed at the beginning of the survey period. There was little variation in enterprises with ten to fewer than 50 employees in the past three years as well, after innovation expenditure had decreased slightly in the prior years. Finally, no clear trend is discernible across the analysis period among businesses with five to fewer than ten employees.

Figure 10: Aggregate innovation expenditure by economic sector



Note: Values extrapolated from the number of employees.

Source: KfW SME Panel, own calculations

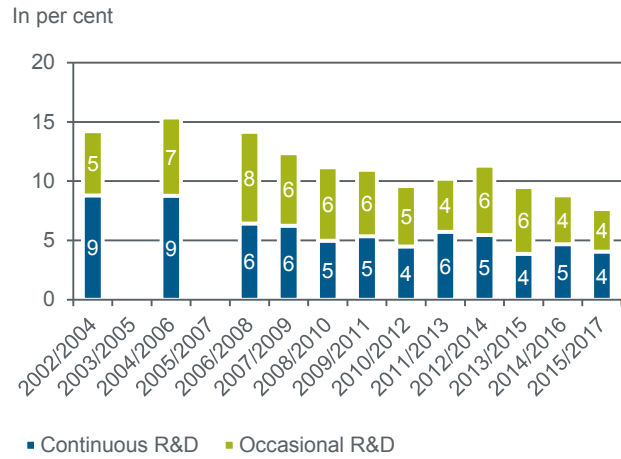
The variations in innovation expenditure by economic sector are only minor (Figure 10). If we ignore the outliers in the year 2015, investment expenditure in manufacturing varied between EUR 9 billion and a good EUR 11 billion, with the current level again approaching that of 2013. In knowledge-based services, innovation expenditure grew slightly in the period under review, likewise closing in on the 2013 level. Only in the segment of other services were the levels of 2013 and 2014 not matched any more in the past three years. Innovation expenditure thus also exhibited the pattern seen in the innovator rate, with small businesses and those operating in generally rather low-investment sectors in particular withdrawing from innovation activity.

SMEs rarely carry out their own R&D

As mentioned at the beginning, own R&D plays a rather minor role for the innovation activity of many SMEs. R&D is defined as ‘systematic creative work aimed at expanding existing knowledge [...] and using it with the objective of finding new potential applications’.¹⁷ Instead, innovations are more often developed out of the normal production process or in collaboration with customers and suppliers.¹⁸ In the period of 2015/2017, a mere 4% of SMEs conducted R&D of their own on a continuous basis and a further 4% did so occasionally (Figure 11). That was the lowest level since the KfW SME Panel was started. In absolute figures, a total of around 300,000 small and medium-sized enterprises conducted R&D of their own. In terms of innovation activity, that means a total of

around two thirds of SMEs introduce new products and processes without conducting their own R&D.

Figure 11: Enterprises with research and development activities of their own



Note: Figures extrapolated to the number of enterprises.

Source: KfW SME Panel, own calculations

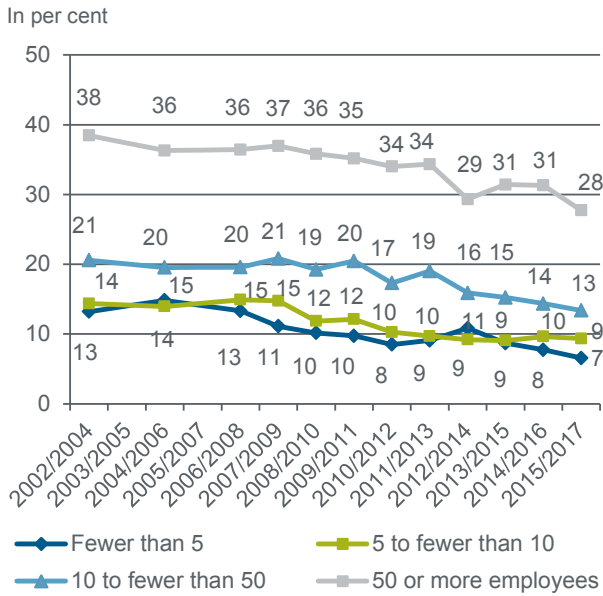
After the economic and financial crisis, the share of SMEs conducting R&D remained without a clear trend for several years. Since 2012/2014, however, that share has continuously fallen to now 8%. The proportion of SMEs with their own R&D has thus decreased by around half from the peak of 2004/2006.

The decline in SMEs that conduct R&D is cause for concern because they are, to a certain extent, at the spearhead of innovation in the SME sector. With the high degree of novelty in their innovations, these enterprises in particular bring new ideas to the market (see below), thereby driving technological progress and structural transformation.

Share of SMEs engaged in R&D is falling across all size classes

Large SMEs continue to be the ones that undertake own R&D most often. In the period under review, 28% of SMEs with 50 or more employees conducted their own R&D. In other words, these large SMEs conduct around twice as much R&D as enterprises with ten to fewer than 50 employees (Figure 12). That proportion is even four times higher than in businesses with fewer than five employees. This is an indication that larger enterprises undertake innovation activities more systematically and make innovation processes more permanent.¹⁹ A long-term downward trend in the shares of enterprises conducting R&D, however, can be observed in all size classes.

Figure 12: Enterprises with own (occasional or continuous) R&D by size



Note: Figures extrapolated to the number of enterprises.

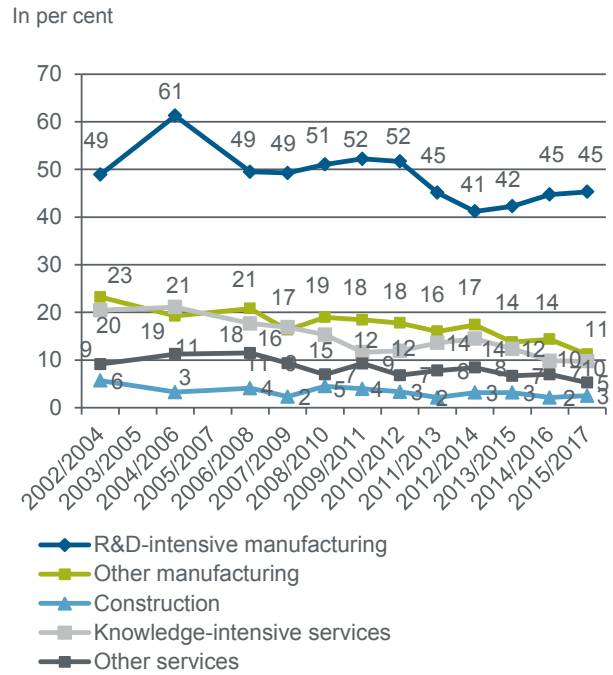
Source: KfW SME Panel, own calculations

R&D-intensive manufacturing SMEs conduct own R&D most often

R&D-intensive manufacturers are by far the most active in conducting own R&D, leading all other sectors by a wide margin (Figure 13). This forms the basis on which their innovator rate was higher than in the other sectors throughout the period under review. By contrast, the shares of SMEs conducting their own R&D exhibit few differences between other manufacturers and knowledge-based service providers across much of the period under review. Other service providers conduct R&D of their own even less frequently. R&D is least common in the construction industry.

The sector comparison also shows that, against the general trend, the share of SMEs conducting R&D in R&D-intensive manufacturing has increased again in the past years. In these sectors, 45% of SMEs conduct occasional or continuous R&D. The decrease in this share is also the lowest in R&D-intensive manufacturing across the period under review – even if we take the exceptionally high level of 2004/2006 as a point of reference. By contrast, the shares of enterprises conducting R&D in the other economic sectors fell much more sharply, although the declines between other manufacturing, knowledge-based and other services as well as construction differed only marginally.

Figure 13: Enterprises with own (occasional or continuous) R&D by sector



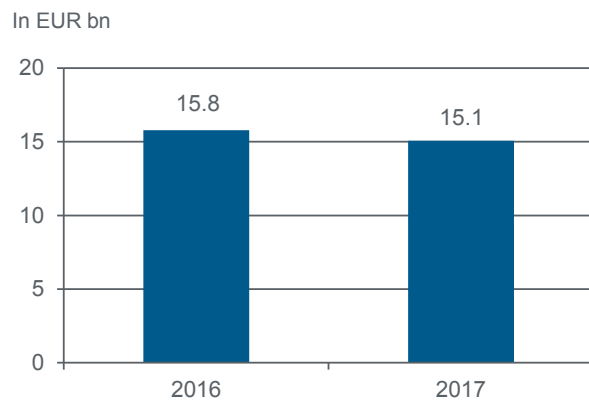
Note: Figures extrapolated to the number of enterprises.

Source: KfW SME Panel, own calculations

R&D expenditure has remained steady

Aggregate R&D expenditure in the SME sector amounted to EUR 15.1 billion in the period under review (Figure 14), remaining almost unchanged from the previous period.

Figure 14: Aggregate R&D expenditure



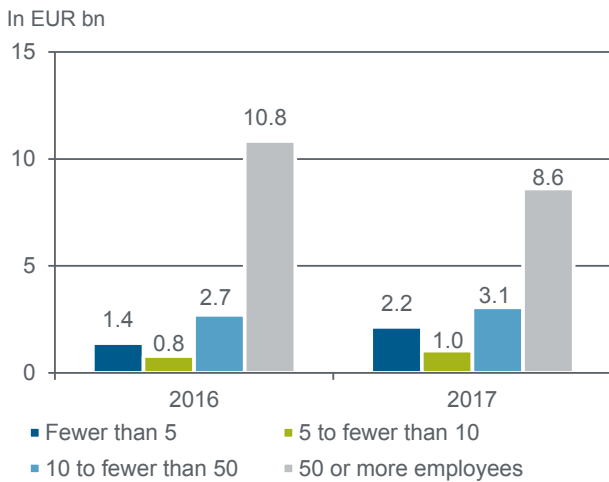
Note: Values extrapolated from the number of employees.

Source: KfW SME Panel, own calculations

Similar to their share of innovation expenditure, large SMEs with 50 or more employees account for most of the aggregate R&D expenditure despite their small number. With around EUR 9 billion out of a total of EUR 15 billion, R&D expenditure is even more concentrated in large SMEs than innovation expenditure.

However, these large SMEs spent slightly less on R&D than in the previous year, which is consistent with the lower share of enterprises conducting R&D in this size class. R&D expenditure of small businesses, on the other hand, remained steady and even showed a minimal increase (Figure 15).

Figure 15: Aggregate R&D expenditure by company size

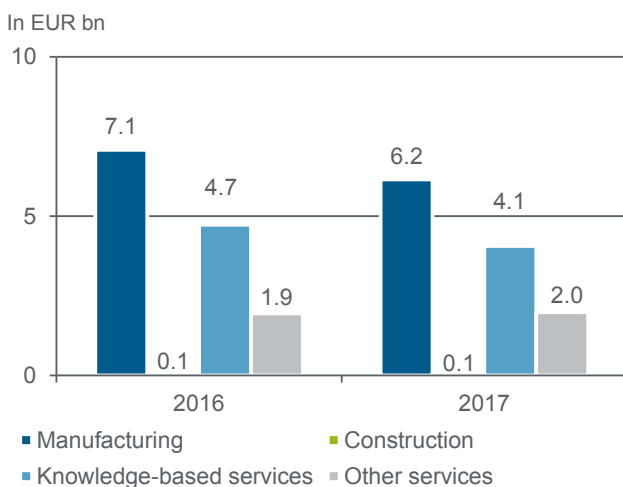


Note: Values extrapolated from the number of employees.

Source: KfW SME Panel, own calculations

As expected, manufacturers are at the top of all sectors, having spent EUR 6 billion (Figure 16). But their R&D expenditure, too, fell slightly on the previous year. This is likely due to the trend in other manufacturing, where the share of enterprises conducting R&D also declined in the period under review. The other sectors exhibit only minor variations in R&D expenditure on the previous year.

Figure 16: Aggregate R&D expenditure by sector



Note: Values extrapolated from the number of employees.

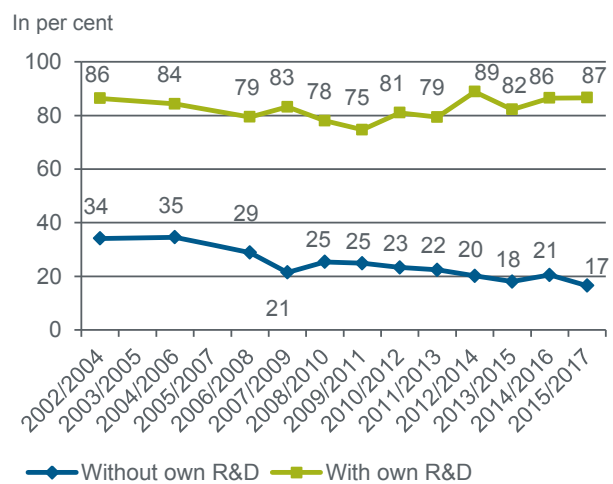
Source: KfW SME Panel, own calculations

High innovation output by SMEs conducting R&D

The distinguishing feature of enterprises conducting R&D is that they introduce innovations particularly often. With percentages usually well in excess of 80%, SMEs that conduct R&D produce innovations two and a half to five times more often than those that do not (Figure 17).²⁰

Enterprises that conduct R&D also show no trend towards less innovation. On the contrary: the innovator rate among those that conduct R&D grew again after the economic and financial crisis. Among SMEs that conduct no R&D, on the other hand, the innovator rate dropped almost consistently.

Figure 17: Innovators with and without R&D of their own



Note: Figures extrapolated to the number of enterprises.

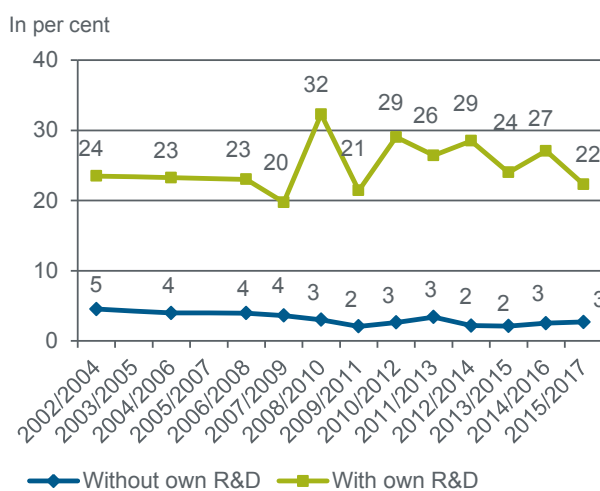
Source: KfW SME Panel, own calculations

Enterprises that conduct R&D have ambitious innovation strategies

Companies that conduct R&D introduce innovations not just more frequently. Many of their innovations also feature a higher degree of novelty. The share of enterprises conducting R&D with new-to-market products hovered between 20 and 32% throughout the period under review. That share is thus five to ten times higher than among SMEs that conduct no R&D (Figure 18). While annual variations have been slightly higher after the economic and financial crisis than before, a downward trend cannot be identified. Quite the opposite is true: the shares of enterprises conducting R&D with new-to-market products were usually higher after the economic and financial crisis than in the preceding years.

Thus, SMEs that conduct R&D innovate more often and are more likely to pursue innovation strategies aimed at introducing new-to-market innovations. So they increasingly play a pioneer role.²¹ Even if R&D projects in particular are typically fraught with high uncertainty about success,²² various studies show that such a strategy can definitely be worthwhile. Various studies demonstrate that companies which conduct R&D grow faster and create more employment than others.²³ Most notably, high growth rates, which are typical of fast-growing enterprises, are often achieved only by enterprises that conduct R&D.²⁴

Figure 18: New-to-market (product) innovations of enterprises with and without own R&D



Note: Figures extrapolated to the number of enterprises.

Source: KfW SME Panel, own calculations

Conclusion

After a slight recovery in the previous period, the innovator rate dropped again in the period under review. The decline was relatively sharp at -4 percentage points. The proportion of SMEs with product innovations posted the sharpest downward trend. Their share fell to the lowest level ever measured by the KfW SME Panel. By contrast, the share of enterprises with process innovations grew for the second time in a row in the period under review, surpassing that of product innovators for the first time. One possible reason for this is that small and medium-sized enterprises are allocating more resources to digitalisation while scaling back their traditional innovation activity, particularly the introduction of product innovations.

Since 2004/2006, when the innovator rate peaked, the share of SMEs with imitative product innovations fell

most sharply. The share of enterprises with new-to-market product innovations, in turn, remained nearly steady over a long time, although that share, too, was slightly higher before the economic and financial crisis than afterwards.

Over the long term it is apparent that small businesses and SMEs in sectors outside R&D-intensive manufacturing, in particular, have discontinued their innovation activities.²⁵ In the course of this development, innovation expenditure in the SME sector also decreased in the past five years. The long-term trend also shows a decline in the proportion of SMEs that conduct R&D. However, the share of companies conducting R&D in the R&D-intensive manufacturing sector has bucked the trend, increasing again in the past years. This is another indication that innovation activity is increasingly concentrating on a 'hard core' of enterprises with high innovation affinity. Enterprises conducting R&D, in particular, form a relatively small group of currently 8% of SMEs but one that continually generates innovations with a high degree of novelty.

Thus, a polarisation is emerging with respect to innovation activity among SMEs. On the one hand, more and more enterprises from the mainstream of the SME sector with no R&D of their own are no longer innovating. On the other hand, the remaining enterprises are continuing to invest undiminished in innovation and in most cases continuing their own R&D as well.

This polarisation into two groups has implications for innovation policy: In order to counteract the decline in the innovator rate, innovation activities should be strengthened across the breadth of the predominantly imitative SMEs, for example by providing organisational and human resources support. These innovators are important because they ensure that new technologies are diffused across the economy. Innovations will not have economic benefits such as economic growth and the hoped-for renewed increase in productivity until technological progress is realised across the economy as a whole.

What is also needed are policies that further reinforce the development of new technologies and support for pioneer enterprises. This is important to safeguard Germany's technological leadership and occupy new fields of technology. Given the ambitious innovation strategies being pursued by other countries, this will require greater innovation efforts. Policymakers are aware of this. They have committed to the target of

allocating 3.5% of GDP to R&D expenditure by the year 2025. Providing initiatives and promotional measures with sufficient financial resources will play a crucial role in whether this goal will actually be achieved.²⁶

Innovation policy therefore has to address both groups. Redoubled efforts are needed to both support

innovation activity across the SME sector and establish new technologies in Germany. This is particularly urgent in the face of the current business cycle phase which is set to exert a dampening effect on innovation activity. ■

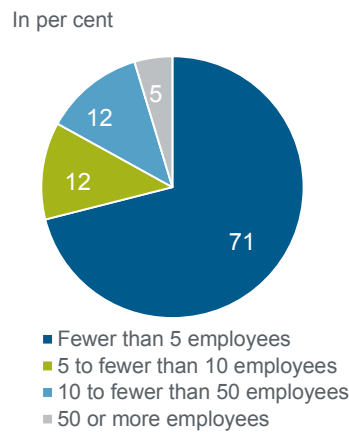
The structure of innovative SMEs in 2015/2017

The SME sector, according to KfW's definition, covers all enterprises in Germany whose annual turnover does not exceed EUR 500 million. By this definition, around 3.76 million SMEs exist in Germany. The SME sector thus accounts for 99.95% of all enterprises in Germany. A good 850,000 of these enterprises are innovators.

Most innovative SMEs are small enterprises. The majority of innovative SMEs (610,000 enterprises, or 71%) have fewer than five employees. This high proportion of small innovators is due to the overall structure of small and medium-sized enterprises. Eighty-one per cent of SMEs have fewer than five employees. The manufacturing industry accounts for 12% of innovators while the service sector represents 82%.

Ninety-six per cent of innovative SMEs do not conduct any R&D of their own. A mere 16% research continuously, while 15% undertook own R&D activities only occasionally in the past three years.

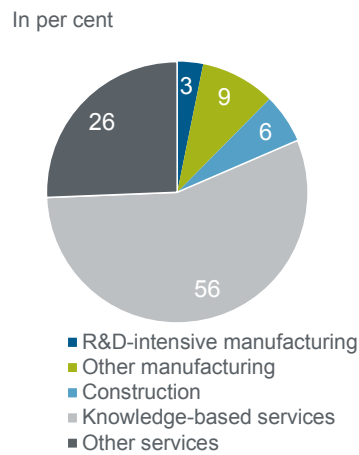
Figure 19: Innovative SMEs by company size



Note: Figures extrapolated to the number of enterprises.

Source: KfW SME Panel, own calculations

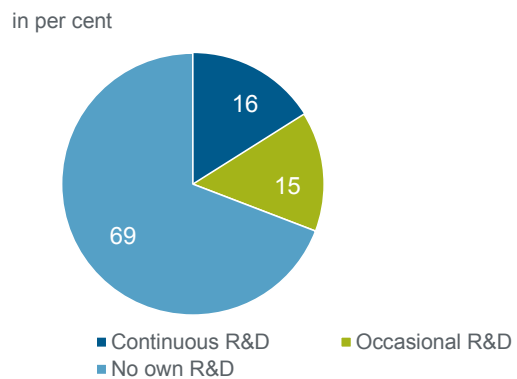
Figure 20: Innovative SMEs by industry



Note: Figures extrapolated to the number of enterprises.

Source: KfW SME Panel, own calculations

Figure 21: Innovative SMEs by own R&D activity



Note: Figures extrapolated to the number of enterprises.

Source: KfW SME Panel, own calculations

KfW SME Panel

The KfW SME Panel (KfW-Mittelstandspanel) has been conducted since 2003 as a recurring postal survey of small and medium-sized enterprises in Germany with annual turnover of up to EUR 500 million.

With data based on up to 15,000 companies a year, the KfW SME Panel is the only representative survey of the German SME sector, making it the most important source of data on issues relevant to the SME sector. Due to the fact that it is representative of all SMEs of all sizes and across all branches in Germany, the KfW SME Panel offers projections for even the smallest companies with fewer than five employees. A total of 9,666 SMEs took part in the current wave.

Analyses of long-term structural developments in the SME sector are performed on the basis of the KfW SME Panel. It gives a representative picture of the current situation and the needs and plans of SMEs in Germany. It focuses on annually recurring information on companies' performance, investment activity and financing structure. This tool is the only way of determining quantitative key figures for SMEs such as investment spending, loan demand and equity ratios.

The basic population used for the KfW SME Panel comprises all SMEs in Germany. These include private-sector companies from all sectors of the economy with an annual turnover of no more than EUR 500 million. The population does not include the public sector, banks or non-profit organisations. Currently there are no official statistics providing adequate information on the number of SMEs or the number of people they employ. The survey used the German Company Register (Unternehmensregister) and the official employment statistics (Erwerbstätigenrechnung) to determine the current population of SMEs.

The KfW SME Panel sample is designed in such a way that it can generate representative, reliable data that are as precise as possible. The sample is split into four groups: type of promotion, branches, firm size as measured by the number of employees, and region. In order to draw conclusions on the basic population based on the sample, the results of the survey are weighted/extrapolated. The four main stratification criteria are used to determine the extrapolation factors. These factors look at the distribution in the net sample (in line with the four group characteristics) in relation to their distribution in the population as a whole. Overall, two extrapolation factors are determined: an unlinked factor for extrapolating qualitative parameters to the number of SMEs in Germany, and a linked factor for extrapolating quantitative parameters to the number of employees in SMEs in Germany.

The survey is conducted by the Financial Services Division of GfK SE on behalf of KfW Group. The project received expert advice from the Leibnitz Centre for European Economic Research (ZEW) in Mannheim. The main survey of the 16th wave was conducted in the period from 12 February to 22 June 2018.

- ¹ Cf. e.g. Ulku, H. (2004): R&D, Innovation, and Economic Growth: An empirical Analysis, IMF Working Paper 04/195; OECD (2007) (Hrsg.): Innovation and Growth. Rationale for an Innovation Strategy (<https://www.oecd.org/edu/cei/40908171.pdf>), retrieved on 16 Jun 2016, or Westmore, B. (2013): R&D, Patenting and Growth: The Role of Public Policy, OECD Economics Department Working Papers, No. 1047, OECD Publishing, Paris.
- ² Cf. Dachs, B., Hud, M., Koehler, C., and Peters, B. (2017): Innovation, Creative Destruction and Structural Change: Firm-level Evidence from European Countries, *Industry and Innovation* 2(4):346–381.
- ³ Cf. e.g. Zimmermann, V. (2015): **What are the hallmarks of consistently successful businesses?** Focus on Economics No. 113, KfW Research. Zimmermann, V. (2015): **KfW SME Innovation Report 2014: Standstill in Europe is slowing down innovation.** KfW Research, Zimmermann, V. (2014): Innovation und Beschäftigung. Die Beschäftigungswirkung verschiedener Arten von Innovationen in expandierenden und schrumpfenden mittelständischen Unternehmen (*Innovation and Employment. The employment effect of different types of innovation in expanding and contracting SMEs* - our title translation, in German only), *Journal of Business Economics, ZfB-Special Issue 4/2013*: p. 131–149, Kritikos, A. S., Hafenstein, M. and Schiersch, A. (2017): Auch kleinste Betriebe stoßen erfolgreich Innovationen an, sie tun es nur seltener (*Micro-businesses, too, stimulate innovation successfully, they just do it less often*), *DIW Wochenbericht 27*, p 755–761 (in German only) and Gerstenberger, J. (2017): **Productivity of German SMEs has fatlined – time to act** (our title translation, in German only), Focus on Economics No. 172, KfW Research.
- ⁴ Cf. Aghion, P., Akcigit, U., Hyytinen, A. and Toivanen, O. (2018): On the returns to invention within firms: Evidence from Finland. *The American Economic Association Papers and Proceedings* 108: 208–2012.
- ⁵ Cf. Jensen, M. B., Johnson, B., Lorenz, E. and Lundvall, B. A. (2007): Forms of knowledge and modes of innovation. *Research Policy* 36(5): 680–693, or Thomä, J. and Zimmermann, V. (2019), Non-R&D, interactive learning and economic performance: Revisiting innovation in small and medium enterprises. ifh Working Paper No. 17/2019.
- ⁶ Cf. OECD (2005) (Hrsg.): Oslo Manual. Guidelines for collecting and interpreting innovation data, and OECD (2018) (publisher), Guidelines for collecting, reporting and using innovation data. The 2018 Oslo Manual is the first one to also define marketing and organisational innovations as process innovations. This broader definition is not applied in this report, whose database goes back to 2017.
- ⁷ The KfW SME Panel captures whether an enterprise has introduced innovations for a three-year period using the method commonly applied across Europe. Initially the KfW SME Panel surveyed innovative activity only every two years.
- ⁸ Cf. Zimmermann, V. (2019): **KfW SME Digitalisation Report 2018: Digitalisation has reached broad areas of the SME sector – average expenditure on digitalisation remains low**, KfW Research.
- ⁹ A rapid spread of innovations can also have negative effects, however. It can reduce the profitability of new-to-market innovations, so that the earnings they generate may be insufficient to recoup the (usually high) development costs. That can lower the incentive to develop new-to-market innovations. Patent laws and other intellectual property rights (e.g. models, copyrights) should therefore provide adequate protection for the interests of pioneer businesses.
- ¹⁰ Cf. Poschen, K. and Zimmermann, V. (2014): **Falling sales expectations curb SME innovation activity in Germany.** Economics in Brief No. 58, KfW Research; Zimmermann, V. (2017): **SME Innovations: Seven reasons for the decline in the share of innovators.** Focus on Economics No. 185, KfW Research and for more details Zimmermann, V. (2010): Innovation und Konjunktur (Innovation and economic activity). Points of View No. 10, June 2010, KfW Economic Research
- ¹¹ Cf. Mansfield, E.; Schwartz, M. and Wagner, S. (1981): Imitation costs and patents: an empirical study, *Economic Journal* 91, p. 907–918, and Peters, B. et al. (2014): Firm Growth, Innovation and the Business Cycle. Background Report for the 2014 Competitiveness Report.
- ¹² It must be noted, however, that a new-to-market innovation does not necessarily mean that the product is being offered for the first time in the world. Rather, new-to-market innovation always refers to the market that is relevant for the innovator. Particularly for businesses that operate solely on local markets, new-to-market innovation therefore often cannot be equated to 'new-to-world-market innovation'.
- ¹³ The number of employees is calculated including the active owners but excluding trainees and apprentices. Two part-time employees are counted as one full-time employee.
- ¹⁴ Cf. Galbraith, J. K. (1952): *American Capitalism. The Concept of Countervailing Power.* Boston, Houghton Mifflin, p. 92; Cohen, W. M., Levin, R. C. and Mowery, D. (1987): Firm Size and R&D Intensity. A Re-Examination. *Journal of Industrial Economics* 35, p. 543–563, or Cohen, W. S. and Klepper, S. (1996): Firm Size and the Nature of Innovation within Industries: The Case of Process and Product R&D. *Review of Economics and Statistics* 78(2), p. 232–243.
- ¹⁵ Owing to changes in the structure of the questionnaires, the surveys of innovation expenditure prior to 2013 are not directly comparable with current figures.
- ¹⁶ This includes expenditure on internal and external research and development (R&D), innovation-related expenditure on machinery, equipment, software and external knowledge (e.g. patents and licenses). It also includes expenditure on product design, construction, service design and preparation for the manufacture and sale of innovations. Expenditure on training conducted in the context of innovations and their introduction into the market is included as well.
- ¹⁷ Cf. OECD (2015) (publisher): *Frascati Manual 2015. Guidelines for collecting and reporting data on research and experimental development.*
- ¹⁸ Cf. Thomä, J. and Zimmermann, V. (2019): Non-R&D, interactive learning and economic performance: Revisiting innovation in small and medium enterprises, ifh Working Paper No. 17/2019.
- ¹⁹ Cf. Zimmermann, V. (2017): **KfW SME Innovation Report 2016. Innovation is concentrated in increasingly fewer enterprises**, KfW Research.
- ²⁰ The reason the innovator rate is not even higher is probably that roughly half of those that conduct R&D do it only occasionally (Figure 11) and R&D projects running during the survey period cannot yet be completed.
- ²¹ Cf. Zimmermann, V. (2012): **To be the Leader of the Pack? Innovation strategies in the German SME sector.** Focus on Economics No. 11, KfW Economic Research.
- ²² Cf. Arrow, K. (1962): Economic welfare and the allocation of Resources for invention. In: Nelson (ed.) *The Rate and Direction of Inventive Activity, Economic and Social Factors*, p. 609–626.
- ²³ Cf. Zimmermann, V. (2016), **SME business performance – Research and development pays off.** Economics in Brief No. 106, KfW Research.

²⁴ Cf. Zimmermann, V. (2017), **Success factors of high-growth enterprises**, Focus on Economics No. 177, KfW Research.

²⁵ The reasons for this and possible implications for economic policy have been intensively discussed by KfW Research in the past years. Cf. Zimmermann, V (2018): **KfW SME Innovation Report 2017. Trend towards fewer innovators continues**, KfW Research, Zimmermann, V. (2017): **SME Innovations: Seven reasons for the decline in the share of innovators**, Focus on Economics No. 185, KfW Research, or Zimmermann, V. and Thomä, J. (2016), **SMEs face a wide range of barriers to innovation activity – support policy needs to be broad-based**, Focus on Economics No. 130, KfW Research.

²⁶ Cf. Commission of Experts for Research and Innovation (2019): 2019 Report – Report on Research, Innovation and Technological Performance in Germany.