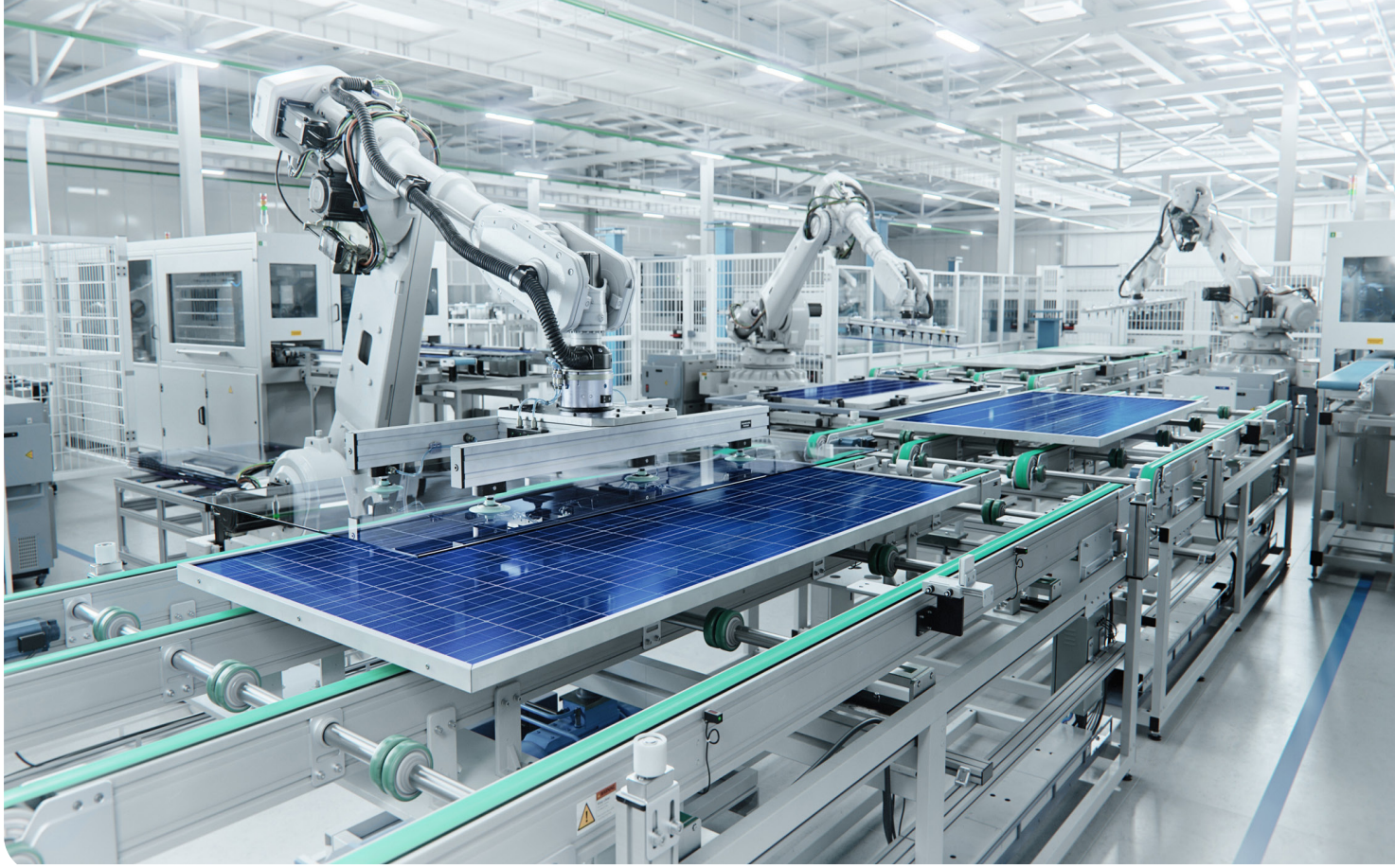


KfW Research

KfW SME Innovation Report 2024

Economic activity puts the brakes on innovation activity

Imprint

Published by
KfW Research
KfW Group
Palmengartenstrasse 5-9
60325 Frankfurt am Main
Phone +49 69 7431-0, Fax +49 69 7431-2944
www.kfw.de

Edited by
KfW Research
KfW Group
research@kfw.de

Author
Dr Volker Zimmermann
Phone +49 69 7431-3725

Frankfurt / Main, January 2025

Contents

The share of innovators in Germany dropped by one percentage point to 39% on the previous year's survey. This decline was due to developments in small businesses with fewer than ten employees. The unfavourable economic situation was likely to blame. At the same time, the share of innovative businesses among larger SMEs grew.

In the medium term, i.e. since the outbreak of the COVID-19 pandemic, the share of innovators in the SME sector has fallen by a total of three percentage points. One major factor contributing to this was that the large group of enterprises with fewer than five employees has consistently brought forth fewer innovations (-4 percentage points). However, many enterprises from the numerically small but generally rich in innovation R&D-intensive manufacturing segment scaled back their innovation activities during this period. By contrast, innovation expenditure in the SME sector remained steady at just under EUR 34 billion during this period. A consistent level of innovation expenditure in a smaller number of innovative enterprises points to a growing concentration of innovation activity in fewer and fewer businesses. Today, 2% of the largest medium-sized enterprises already account for 56% of innovation expenditure in the SME sector.

The current development marks the continuation of a trend that can be observed since the middle of the previous decade. Over this period, small businesses in particular, as well as enterprises without any R&D activities of their own, innovated increasingly less often. To be sure, the retreat of these businesses diminishes the output of innovations with a high degree of novelty to a limited extent only. But it must be feared that Germany's productivity growth and transformative capacity will be weakened overall in the long term if an increasingly larger proportion of enterprises forgoes the periodic renewal of their production processes and product offerings.

Targeted economic policy measures can stimulate innovative activity in peak segments and within the broad business community. As a broad response to the downward trend, one approach would be to focus more closely on the business segments that have previously received less consideration and to address the key impediments to innovation activity across the broad SME sector.

Barriers in obtaining finance are an obstacle for all SMEs. Financing difficulties for pioneering businesses can be mitigated by expanding support for R&D. The vast portion of innovation activity across the broad SME sector, however, is based on experiential skills. Innovations typically emerge from SMEs' normal day-to-day business and without any R&D. Financial support for these enterprises must therefore be provided below the R&D threshold, for example by supporting businesses' expenditure on the design of products and services.

The shortage of skilled the workers constitutes another key innovation barrier in the SME sector. The broad shortage of applicants is the most frequent barrier to filling vacancies. Measures aimed at easing the skilled labour shortage can involve the expansion and mobilisation of the labour force potential, enabling a higher number of young people to engage in vocational training, upskilling unskilled or semi-skilled unemployed people and intensifying continuing education efforts. Specific approaches to address the needs of innovative businesses involve enhancing soft skills and digital skills as well as mathematical/statistical abilities.

More broadly, SMEs need to improve in-house processes of learning and understanding. Possible support measures can include advisory services and, where appropriate, financial support for the introduction of appropriate management practices or for improving incentives for innovation or knowledge flows into and within the enterprise.

Last but not least, an enterprise's strategic alignment is crucial to the implementation of innovation activities. In particular, businesses that do not have a pronounced strategic orientation are unlikely to innovate. Approaches aimed at improving the strategic capabilities of such enterprises include, among other things, awareness-raising campaigns and the provision of low-threshold information on innovation strategies and innovation management. Another measure would be to raise awareness about the significance of strategic considerations by incorporating such aspects more systematically in technical and vocational education and training.

1. Introduction

Innovation promotes growth and prosperity

In developed economies, innovation is regarded as a guarantor of enduring and growing prosperity.[1] From a whole-of-economy perspective, innovation drives economic and productivity growth and speeds up the structural transformation.[2] Germany in particular, a highly developed and export-oriented country with few natural resources to call its own, must therefore secure its technological leadership or take a leadership role in key business areas in order to be internationally competitive. Innovation also contributes to addressing social challenges such as climate change, health care and the consequences of demographic change.

At the same time, innovating is an important lever which businesses apply in order to establish a competitive position in the market. Even if the success of an innovation project is difficult to predict, numerous studies confirm that innovation increases enterprises' headcount, turnover, returns and productivity.[3] Successful innovation activity not only secures business success but benefits the employees of the enterprises involved. Thus, innovative businesses pay higher wages[4] and offer better working conditions,[5] as well as more stable employment relationships than those that do not innovate, even when the relevant enterprises reduce their workforce.[6]

The German innovation ecosystem in international comparison

Germany's innovation ecosystem is generally quite well positioned in international innovation ranking indices. In the Global Innovation Index, for example, Germany ranks 9th of 132 countries. Other rankings and studies for Germany paint a similar picture.[7] Small and medium-sized enterprises play an important role in Germany's innovation ecosystem. To be sure, large enterprises undertake most of the innovation. Yet even so, small and medium-sized enterprises account for 18% of innovation expenditure. That share even increased since the middle of the past decade.[8]

The strengths of Germany's innovation ecosystem consist in a strong research sector and extensive R&D activities in large enterprises. Over nearly two decades, Germany has actually been able to make significant progress in R&D activities in particular.[9] But it has made no progress in reaching the R&D expenditure target of 3.5% of GDP since the beginning of the COVID-19 pandemic.

At the same time, there is agreement that knowledge and technology transfer in new technologies and through start-ups can be improved. Furthermore, the concentration of innovation activity in increasingly fewer businesses is a sign of weaknesses in the diffusion of knowledge, particularly to small and medium-sized enterprises.[10]

Innovation is more than research and development

Innovations are not limited to novelties based on R&D. Small and medium-sized enterprises, in particular, often develop innovations out of the normal production process or in cooperation with customers and suppliers without conducting any research ('learning by doing, using and interacting').[11] Innovating can also mean adopting innovations from other enterprises and adapting products and services to specific customer requests and usage environments. The further development and adaptation of innovations and the diffusion of new technologies by businesses have an important role to play. Not least, this ensures that the overall economy remains competitive.

Specific examples of innovations are new types of automobile headlights that illuminate the road more effectively without blinding other road users,[12] a new, semiautomatic machine for the trimming of vehicle tyres[13] or a new, self-disinfecting and biologically safe plastic for use in ballpoint pens.[14]

2. Development of the share of innovators among SMEs

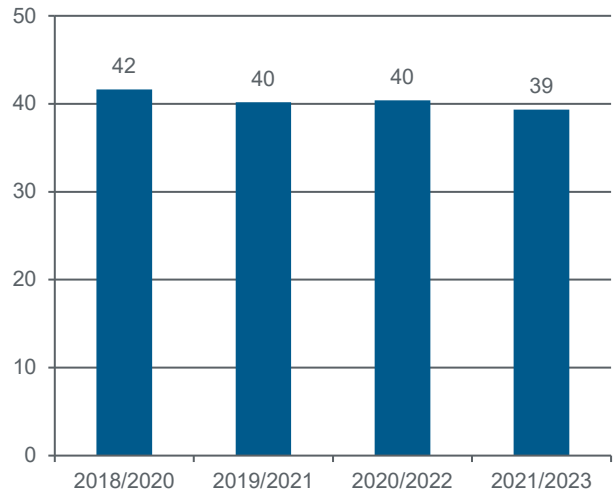
Economic development is slowing innovation

The share of innovators among SMEs has fallen by one percentage point from the previous year's survey and currently stands at 39% (Figure 1). It measures the share of enterprises that have introduced at least one innovation in the past three years (Box: New OECD innovation definition). Thus, there are currently just under 1.5 million small and medium-sized innovators.

The current decline in the share of innovators probably has to do with the state of the German economy. The KfW-ifo SME Barometer, for example, shows that the business climate deteriorated sharply in the course of the year 2023.[15] SMEs' turnover growth and profit margins were also lower in 2023 than in the previous year.[16]

Figure 1: Development of innovators among SMEs

In per cent



Note: Figures extrapolated on the basis of the number of enterprises; new OECD definition: Innovators inclusive of marketing and organisational innovations.

Source: KfW SME Panel, own calculations

In past surveys, the development of the business cycle, as reflected in the turnover expectations surveyed by the KfW SME Panel or in the trend in profit margins, for example, has shown itself to be an important determinant of innovation activity throughout the business cycle.[17] Thus, businesses are most likely to innovate when they have positive economic expectations. In an optimal case, a business innovates during an economic upswing. The reason is that in such phases it is easier for product innovations to penetrate the market and (novel) processes tend to be more profitable because they run at higher capacity during such phases. Besides, innovation activities can be funded more easily in such phases, for example from higher business profits and through better access to bank loans.[18]

New OECD innovation definition

The accepted definition of innovation was developed by the OECD in collaboration with Eurostat. It forms the basis for measuring innovation activity in the EU and many other countries and it is also used in the KfW SME Panel.[19]

According to this definition, innovation is characterised by three key features: A product innovation must be introduced in the market, or a process innovation in the enterprise ('implementation'). Second, the innovation must be new or significantly improved from the viewpoint of the innovating enterprise ('subjective view'). Finally, the innovation must clearly stand out from the company's previous practice or offerings ('noticeable difference').

The definition of innovation was revised in the year 2018. Organisational and marketing innovations now also count as product or process innovations. The vast majority of marketing and organisational innovations are classified as process innovations. Substantial changes in design, however, are considered to be product innovations.

The KfW SME Panel has taken this definition into account since the 2021 survey. The expansion of the concept of innovation means that the share of innovators measured is higher than before the definition was modified. A direct comparison with the survey results from before the 2018–2020 period is therefore not possible.

The share of innovators has dropped by three percentage points from the 2018–2020 period. One factor that is likely to play a role for the medium-term trend in the share of innovators is that the COVID-19 pandemic initially triggered and innovation surge that also translated into a higher share of enterprises with innovations during the respective period.[20] In the following years, companies that were in a tight liquidity situation and those expecting a prolonged crisis were most likely to roll back their innovation activities. The heightened uncertainty about the further development was also likely to have led many enterprises during the pandemic to defer decisions about the implementation of innovation projects, even when they were not directly affected by the pandemic.[21] A recent study has shown

that the pandemic likely hampered the development of innovative ideas through further channels as well, so that not only was there no innovative activity in the short term but the development of innovation was adversely affected over a prolonged period of time.[22] The authors of the study referred to long-COVID symptoms with regard to innovation activity in this context.

Not least, the development since the pandemic is also likely to see a continuation of the long-term trend to less innovation in the SME sector. Since the peak reached in the 2004/2006 period, the share of technical innovators[23]decreased in two waves, particularly in the second half of the 2000s and in the second half of the 2010s.[24]

Share of innovative businesses without R&D is currently steady

The majority of SMEs that innovate have no R&D activities of their own. As mentioned above, these businesses develop innovations out of the normal production process or in cooperation with customers and suppliers (‘learning by doing, using and interacting’). They do this using external knowledge and informal learning processes based on intensive exchange within the enterprise, for example. Most of these innovations are incremental enhancements or imitative innovations. This type of innovations drives the diffusion of innovations across the broad economy. Only relatively rarely do these enterprises generate new-to-market innovations. Thus, the share of enterprises with new-to-market products among innovators without own R&D oscillated between only 2% to just under 6% in the past four years.

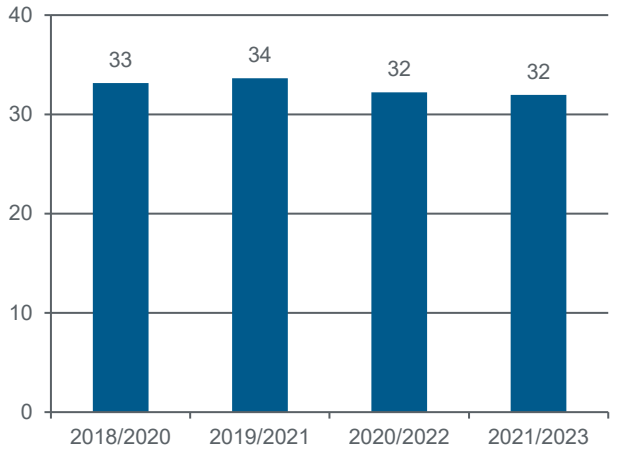
The share of innovators without R&D in the SME sector stands unchanged at 32% (Figure 2). With a decline of 2 percentage points from the 2019–2021 period and one percentage point from the first year of the COVID-19 pandemic, this is a moderate decline from a medium-term perspective. But it, too, signifies the continuation of a trend that has been ongoing for quite some time. According to calculations made on the basis of the innovation survey conducted by the Centre for European Economic Research in Mannheim, the share of SME innovators without R&D fell by around one sixth between the years 2010 and 2020.[25]

Development of innovator rate varies by company size

The share of innovators in the various enterprise size classes is developing unevenly (Figure 3). While the share of innovators among smaller businesses with fewer than 10 employees is decreasing, the share of innovators among larger SMEs with 10 or more employees is growing. The share of innovators among enterprises with fewer than five employees has continuously fallen by a total of 4 percentage points from the 2018–2020 period.

Figure 2: Development of innovators without R&D

In per cent



Note: Figures extrapolated on the basis of the number of enterprises; new OECD definition: Innovators inclusive of marketing and organisational innovations.

Source: KfW SME Panel, own calculations

The decline in innovation activity among small businesses is consistent with the observation that they, in particular, were affected more severely and overall more frequently by turnover losses at the beginning of the pandemic.[26] In addition, turnover expectations of smaller SMEs in particular have deteriorated in the wake of the economic downturn of the year 2023.

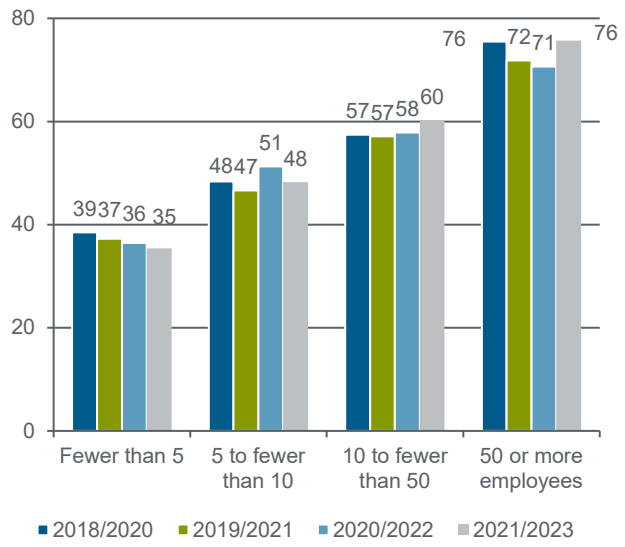
Large enterprises innovate more often

With respect to the level of innovation activity, it can be observed that the share of innovators grows with increasing enterprise size. The share of innovators in the group of companies with 50 or more employees is today more than twice as high as in the group of small businesses with fewer than five employees (76 vs. 35%).[27]

This is because small businesses have fewer resources and cover smaller markets.[28] 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.[29] Minimum project sizes and high fixed costs mean that innovating places a higher financial strain on small enterprises than on larger ones.

Figure 3: Innovators by company size

In per cent



Note: Figures extrapolated on the basis of the number of enterprises; new OECD definition: Innovators inclusive of marketing and organisational innovations.

Source: KfW SME Panel, own calculations

Thus, just under one fifth of small innovative enterprises spend 15% and more of their turnover and a further one fourth spends between 5 and 15% of turnover on innovation. In large SMEs with 50 and more employees, on the other hand, it is a mere 1 and 6%.[30] The higher relative burden also means that small SMEs cannot carry out as many innovation projects at the same time. That means they have fewer options to spread their innovation risks across a broader innovation portfolio than large enterprises, which hampers their innovation activity further.

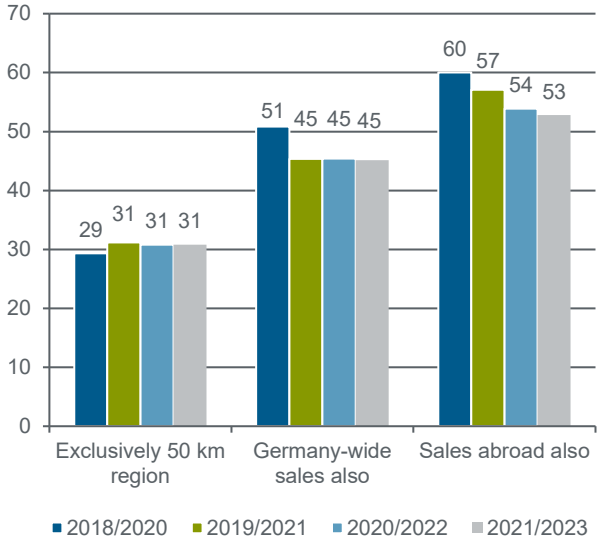
Innovation activity of internationally operating enterprises continues to fall

In the period under review, the share of innovators among businesses that also operate abroad fell for the third time in a row. At the same time, that share remains steady among companies that do business exclusively in their home region and across Germany (Figure 4).

The drop in the share of innovators among internationally active businesses is likely due to the fact that they were hit by turnover losses particularly often and somewhat harder than other enterprises at the beginning of the COVID-19 pandemic.[31] So it is safe to assume that a particularly large share of enterprises is susceptible to 'long COVID' symptoms in this group, too. At the current margin, another factor that likely plays a role is that the export expectations of SME manufacturers clouded over further in the year 2023 as well, according to the KfW-ifo SME Barometer.[32]

Figure 4: Innovators by sales region

In per cent



Note: Figures extrapolated on the basis of the number of enterprises; new OECD definition: Innovators inclusive of marketing and organisational innovations.

Source: KfW SME Panel, own calculations

Despite the declining trend among internationally active businesses, the pattern remains that the larger the geographic extension of the sales region, the higher the innovator rate.

That link was already established in various studies.[33] One of the likely drivers of this is the more intensive competition in supra-regional sales markets. International markets are deemed to be particularly fiercely contested. Intense competition forces German enterprises to offer products with superior attributes and keep their processes efficient.

In addition, doing business abroad also provides access to new, outside knowledge from which the businesses operating there can learn.[34] For small and medium-sized enterprises in particular, given their limited own resources, external sources are an important input to their business activity.[35]

Declining trend in share of innovators in highly innovative sectors persists

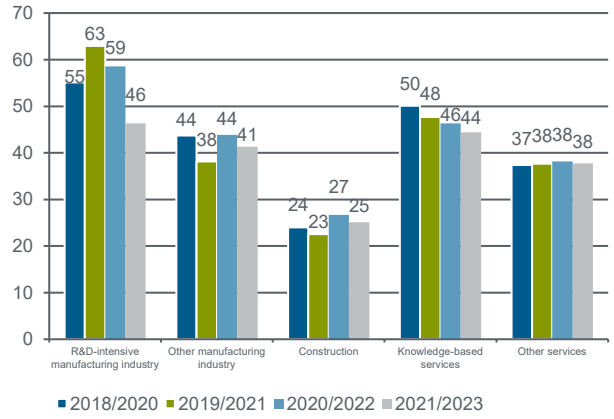
Economic sectors that typically are strong innovators continue to experience declining innovator rates (Figure 5). The share of innovative enterprises in R&D-intensive manufacturing (e.g. mechanical engineering, electrical engineering and chemicals) has recently dropped by 13 percentage points and by 2 percentage points in knowledge-based services (e.g. IT and information service providers, law firms, tax consultancies and management consulting firms). In both groups of economic sectors, the share of enterprises

with innovations thus fell for the second time in a row. Particularly in R&D-intensive manufacturing, the share has fallen by a significant -17 percentage points overall since peaking in the second year of the COVID-19 pandemic. In the other sectors, however, a clear trend occurred during the period under review. At the current margin – in line with the overall trend –, the share of innovators has also fallen in other manufacturing enterprises (such as food and animal fodder production and metal products) and in the construction industry, after recovering in the previous year's survey.

The likely reason for this is that expectations regarding business development have deteriorated in all economic sectors under consideration here. Furthermore, knowledge-based services have also experienced a sharp drop in profit margins since 2021.[36] The drop in the share of innovators in R&D-intensive manufacturing was mostly driven by the development of innovation activity in small businesses with fewer than ten employees. The business expectations of these enterprises in particular have fallen sharply. As businesses in these sectors – including small ones – do business abroad very often, the flagging export performance is likely to slow down innovation activity particularly in these sectors.

Figure 5: Innovators by industry

In per cent



Note: Figures extrapolated on the basis of the number of enterprises; new OECD definition: Innovators inclusive of marketing and organisational innovations.

Source: KfW SME Panel, own calculations

Still, R&D-intensive manufacturing and knowledge-based services continue to have the highest innovator rate

Despite these developments, R&D-intensive manufacturers and knowledge-based service providers are the most productive innovators, at 46 and 44%, respectively. However, the sectors that follow are not as far behind as they used to be in previous years. Other manufacturing industries and other services such as hospitality, transport and storage come in next at 41 and 38%, respectively. Construction is in fifth place, at some distance (25%).

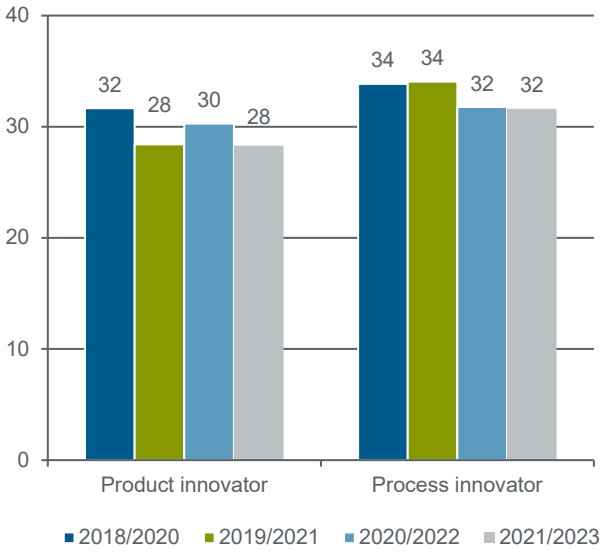
Economic development is slowing product innovations most of all

In the breakdown by product and process innovators, the corresponding shares are 28 and 32%, respectively (Figure 6). Thus, almost 1.1 million SMEs currently bring new or improved products (including services) to market. A good 1.2 million have modernised their processes or introduced organisational innovations or new marketing methods.

The pandemic-induced slowdown of innovation activity[37] saw SMEs scale back product innovations in particular. After a brief recovery, this development has continued at the current margin as a result of the economic downturn. The proportion of businesses that introduced product innovations dropped by 4 percentage points overall since the outbreak of the COVID-19 pandemic. By contrast, the share of businesses with process innovations has remained steady. Compared with the situation at the outset of the COVID-19 pandemic, that share fell by a mere 2 percentage points.

Figure 6: Development of SME product and process innovators

In per cent



Note: Figures extrapolated on the basis of the number of enterprises; new OECD definition: Innovators inclusive of marketing and organisational innovations.

Source: KfW SME Panel, own calculations

Generating product innovations – and, in particular, introducing them to the market, typically depends more heavily on the state of the economy than the introduction of process innovations.[38] This is because the

market success of product innovations is heavily dependent on rapid dissemination driven by strong demand, something that businesses take into account when deciding when to introduce them to the market.

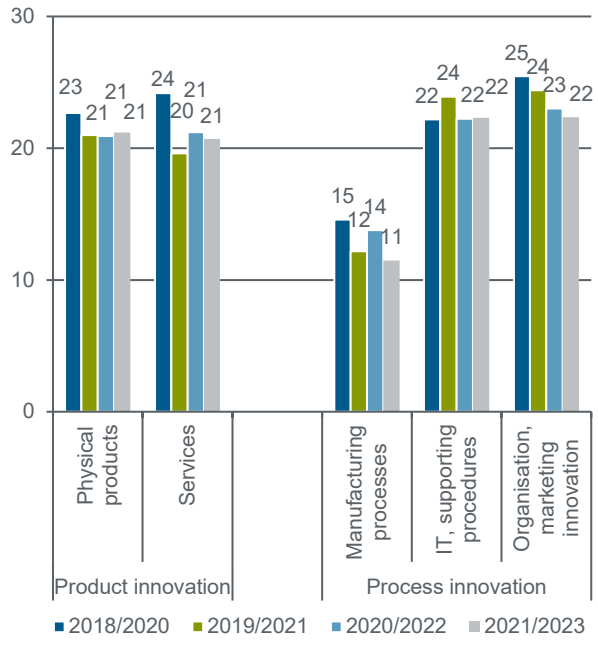
To be sure, businesses also have greater difficulty generating process innovations in times of economic weakness – for example because of reduced access to finance. But process innovations can be partly deployed as 'rationalisation measures' in response to unfavourable economic developments. This slows the decline in process innovations compared with product innovations in times of economic weakness.

Individual types of innovation saw different rates of development

Since the survey was adapted to take into account the new innovation definition, the types of innovations generated can be examined in more detail with the aid of the KfW SME Panel. Figure 7 illustrates that the innovator rates currently sit at similar levels – between 21 and 22% – with regard to physical products (i.e. goods including digital products), service innovations (including digital services), data processing methods including supporting administrative procedures as well as non-technical innovations such as organisational and marketing innovations. Only the rate of innovations in manufacturing processes was much lower at 11%.

Figure 7: Development of SME product and process innovators

In per cent



Note: Figures extrapolated on the basis of the number of enterprises; new OECD definition: Innovators inclusive of marketing and organisational innovations.

Source: KfW SME Panel, own calculations

The development over time shows that nearly all types of innovation were generated most frequently at the outset of the COVID-19 pandemic. Only for IT including supporting processes in administration does the most frequent mention appear in the survey one year later. This finding is consistent with the highest value measured for the (total) share of innovators for the period at the outset of the pandemic. This is likely due to the fact that the particular circumstances of the pandemic required businesses to make a wide range of adjustments despite the unfavourable economic environment.

The shares of enterprises with innovations in physical products and services stood at 23 and 24% at the outset of the pandemic. In the following years, the shares were lower at around 21%. From that moment onward, no significant variations in the relevant share of innovators have been observable for both physical products and services.

This means that the development of the share of product innovators at the current margin is not so much influenced by the fact that a lower share of enterprises has generated innovations in physical products or services. Rather, this share is due to the fact that both types of innovations are more likely to be carried out by the same business and that product innovation activities are therefore concentrated more strongly on fewer enterprises.

With respect to IT including supporting processes in administration, too, the share of innovators remained steady on a slightly lower level in the ensuing surveys (22%) after peaking in the second year of the pandemic (24%). By contrast, noticeable fluctuations can be observed over time in innovations involving production processes. After the decline by 3 percentage points in the second year of the pandemic, a rebound was observable in the course of the economic recovery of the year 2022 (+2 percentage points), before the relevant share of innovators dropped again by 3 percentage points at the current margin to now 11%. The rate of non-technical innovations (that is, organisational and marketing innovations), on the other hand, has been trending downward continuously since peaking at the outset of the pandemic. It has fallen from 25 to 22% throughout the period under review.

As already described, the share of process innovations has remained steady overall despite the general decrease in some facets. This means that the individual facets of process innovation are currently spread out more evenly across different enterprises and individual firms have simultaneously carried out multiple

innovation facets at a lower rate than in the previous year. Process innovation activity is thus currently less heavily concentrated in individual enterprises than in the previous period.

Overall, the analysis of the individual types of innovations shows that developments in the shares in the aggregate do not necessarily need to be reflected in the developments of the individual types of innovation. Rather, the developments in the aggregate can also be influenced by the distribution of the individual types of innovation across the enterprises.

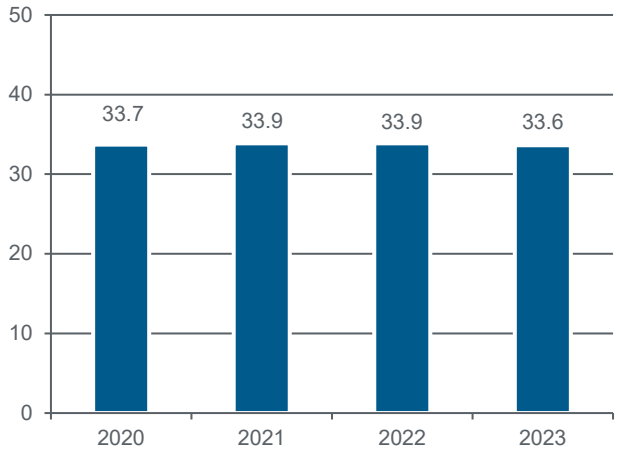
3. Development of innovation expenditure

Innovation expenditure has remained steady

Businesses' expenditure on innovation has remained steady. Aggregate innovation expenditure of SMEs currently sits at just under EUR 34 billion (Figure 8). This includes all spending on innovation including personnel costs and capital expenditure related to developing innovations and bringing them into the market.[39] Thus, innovation expenditure remained unchanged on the previous year in nominal terms. If we take price increases into account, innovation expenditure has dropped minimally to EUR 32.8 billion.[40] The weak economic performance in 2023 and subdued business expectations have thus had only a minor negative impact on SMEs' innovation expenditure.

Figure 8: Aggregate innovation expenditure in the SME sector

In EUR bn



Note: Nominal values, extrapolated on the basis of the number of employees, new OECD definition: Innovation expenditure inclusive of marketing and organisational innovations.

Source: KfW SME Panel, own calculations

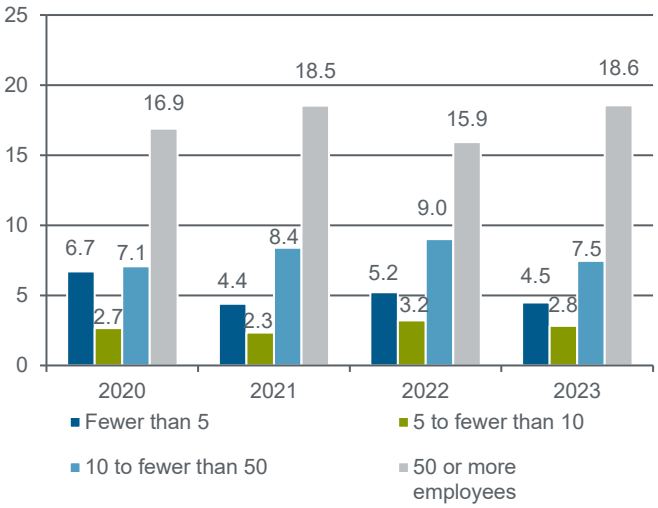
SMEs' innovation expenditure evolved in a similar way as their investment in fixed assets in the period under review. The latter increased slightly in nominal terms in 2023 but fell in real terms as well.[41] That means SMEs spent significantly more than seven times more in physical assets than on innovation projects, which was almost unchanged from the previous year.

Large SMEs increased their innovation expenditure

In line with the development of the share of innovators, the almost unchanged total innovation expenditure in the SME sector masks different developments in small and large SMEs (Figure 9). In parallel to the growth in the share of innovators, large SMEs with 50 and more employees are currently increasing their innovation expenditure as well. At just under EUR 19 billion, the innovation expenditure of these enterprises is back on the level of 2021. Smaller SMEs, on the other hand, have slightly reduced their innovation expenditure.

Figure 9: Aggregate innovation expenditure by enterprise size

In EUR bn



Note: Nominal values extrapolated on the basis of the number of employees, not counting enterprises of the remaining economic sectors, new OECD definition: Innovation expenditure inclusive of marketing and organisational innovations.

Source: KfW SME Panel, own calculations

That means SMEs' innovation expenditure remains heavily concentrated in the group of large SMEs (Figure 10). Thus, large companies with 50 and more employees account for 56% of innovation expenditure in the SME sector even though this group represents only 2% of small and medium-sized enterprises. A further 22% of innovation expenditure is attributable to the group of businesses with 10 to fewer than 50 employees, which makes up 8% of SMEs. At the opposite end of the distribution, 81% of enterprises with fewer than five employees account for a mere 13% of SMEs' innovation expenditure.

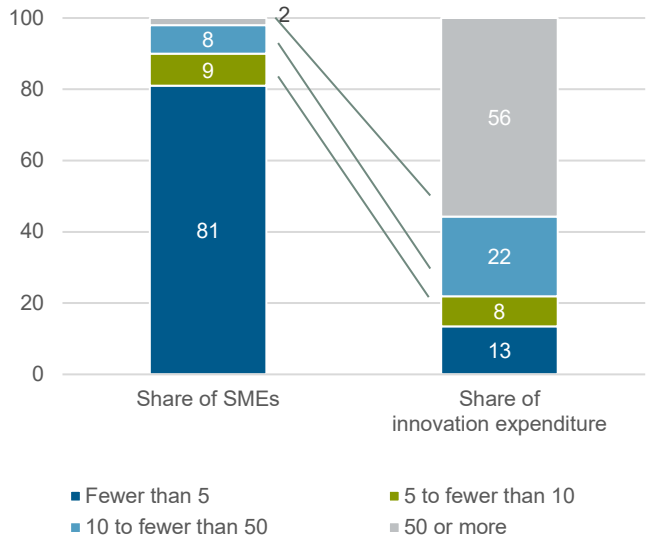
Manufacturers and knowledge-based service providers spent the most on innovation

By sector, manufacturers spent the highest amounts on innovation, almost EUR 13 billion, closely followed by knowledge-based service providers with EUR 10 billion (Figure 11). The strong contribution of knowledge-based services to SMEs' innovation expenditure corresponds with the high share of small and medium-sized enterprises active in these industries (39%). Manufacturers, on the other hand, make up only 5% of SMEs. Thus, in relation to the number of enterprises,

manufacturers in particular inject high financial resources into the businesses' innovation activities. Ranked third at some distance are other services, with approx. EUR 5 billion. Innovation expenditure was lowest in the construction sector, at EUR 0.6 billion.

Figure 10: Concentration of innovation expenditure in the SME sector

In per cent



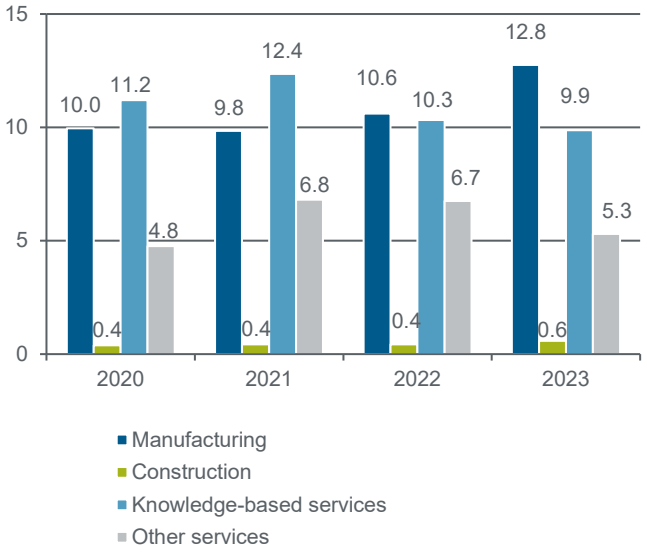
Note: Nominal values; extrapolated on the basis of the number of employees, not counting enterprises of the remaining economic sectors, new OECD definition: Innovation expenditure inclusive of marketing and organisational innovations.

Source: KfW SME Panel, own calculations

Compared with the previous year, there was little variation in the level of expenditure between the various economic sectors. The most significant change was the increase in innovation expenditure by manufacturers, which has now occurred for the second time in a row. In contrast, innovation expenditure in the services sector has been on the decline since 2021.

Figure 11: Aggregate innovation expenditure by sector

In EUR bn



Note: Values extrapolated on the basis of the number of employees; not counting businesses with fewer than five employees, new OECD definition: Innovation expenditure inclusive of marketing and organisational innovations.

Source: KfW SME Panel, own calculations

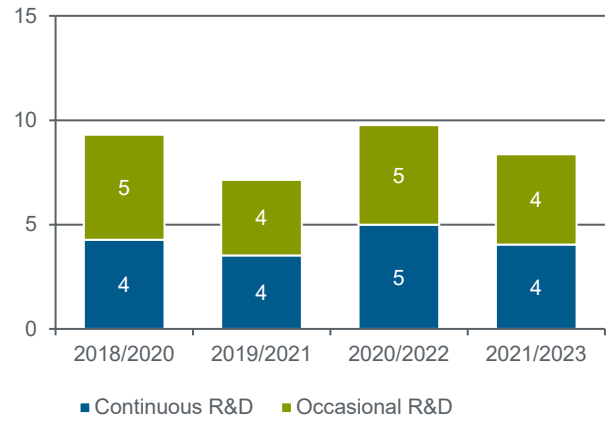
4. Development of R&D activity

SMEs rarely conduct own R&D

As described at the outset, a large number of SMEs develop innovations out of the normal production process or in cooperation with customers and suppliers ('learning by doing, using and interacting').[42] They rarely undertake any R&D of their own. R&D is defined as 'systematic creative work aimed at expanding existing knowledge [...] and using it with the objective of finding new potential applications'.[43] Behind it is a targeted, formalised activity that is typically carried out by specialised workers in dedicated departments.

Figure 12: Enterprises with research and development activities of their own

In per cent



Note: Figures extrapolated on the basis of the number of enterprises.

Source: KfW SME Panel, own calculations

In the 2021–2023 period, a mere 4% of SMEs conducted R&D continuously and a further 4% occasionally (Figure 12). In absolute figures, that means a good 300,000 SMEs in total conducted R&D of their own. Both shares fell by 1 percentage point since the previous survey. Overall, however, the share of enterprises actively undertaking R&D did not show a clear trend across the period under review.

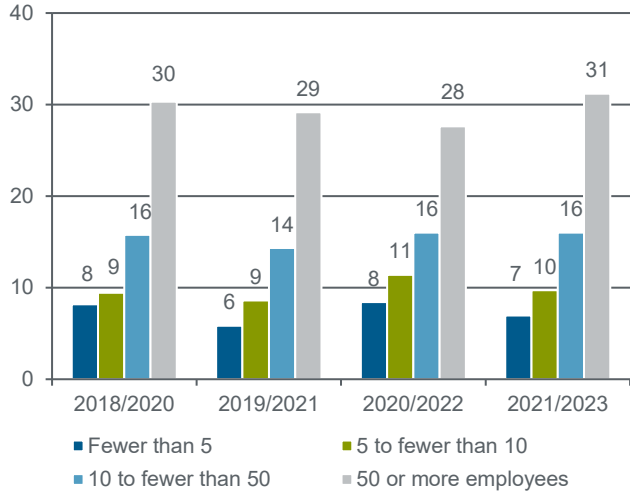
For innovation activity in the SME sector, that means 20% of all SMEs that innovate undertake R&D. However, 80% of innovators generate new or improved products and processes without drawing on own R&D activities (Figure 18 in the Annex).

Downward trend in the number of large SMEs undertaking R&D has ended

Large SMEs are much more likely to carry out R&D themselves than other enterprises. In the period under review, 31% of SMEs with 50 or more employees conducted their own R&D, compared with 7% of businesses with fewer than five employees (Figure 13). In other words, large SMEs just under 4.5 times more likely to conduct R&D than small businesses. This is an indication that larger enterprises undertake innovation activities more systematically and that their innovation processes are more permanent.[44]

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

In per cent



Note: Figures extrapolated on the basis of the number of enterprises.

Source: KfW SME Panel, own calculations

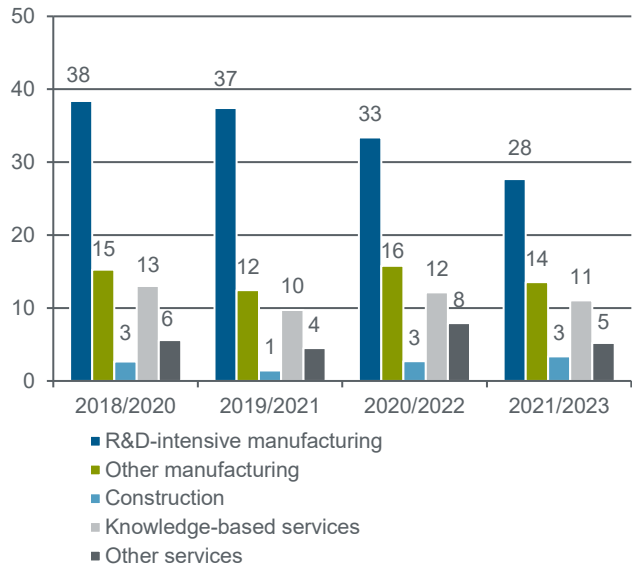
A moderate increase in the share of enterprises with 50 or more employees occurred in the period under review (+3 percentage points). Thus, the downward trend that could be observed in the past years has ended for now. The other enterprises size classes, on the other hand, exhibit only minor variations in the share of enterprises undertaking R&D. The share is trending downward in businesses with fewer than 10 employees.

R&D-intensive manufacturing SMEs are most likely to conduct own R&D

R&D-intensive manufacturers are by far the most active in conducting own R&D, leading all other sectors by a wide margin (Figure 14). At present, 28% of SMEs in this sector continuously or occasionally conduct R&D of their own. This is a higher level than in the other economic sectors and forms the basis for the high share of innovators – despite the negative trend of the past years.

Figure 14: Enterprises with own (occasional or continuous) R&D by sector

In per cent



Note: Figures extrapolated on the basis of the number of enterprises.

Source: KfW SME Panel, own calculations

There are hardly any differences between other manufacturing and knowledge-based services in the shares of SMEs conducting R&D. Both groups of economic sectors rank second and third with values of 14 and 11%. An even lower percentage of other service providers conducts own R&D. R&D is least common in the construction industry.

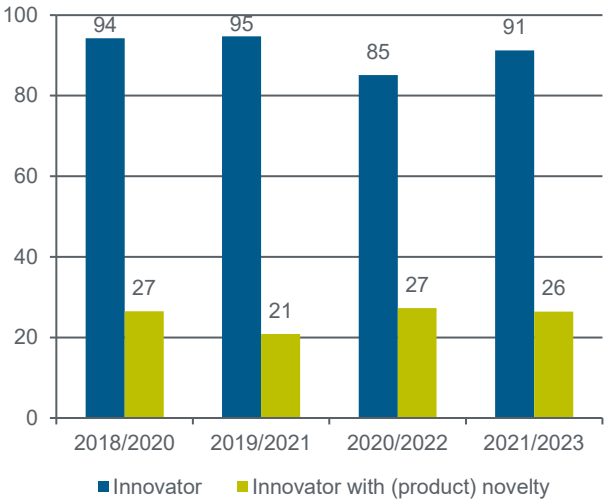
In almost all sectors, the shares of businesses conducting their own R&D decreased at least moderately on the previous period. Only in the construction industry did that share hold steady. What is noteworthy is the downward trend in R&D activity in R&D-intensive manufacturing, which has been ongoing for years now and can also be seen in the share of innovators in these sectors. The decline in R&D activity is also driven by developments that have taken place in small businesses of these sectors. The unfavourable economic situation – particularly the performance of exports, which is particularly important for these sectors – has likely contributed to the fact that small businesses are increasingly switching from continuous to occasional and specific R&D activities and enterprises that used to carry out R&D occasionally are increasingly discontinuing their R&D activity. If this trend endures, it must be feared that high-value innovation expertise will be lost permanently as a result. After all, firms that resume or initiate R&D activities after a longer break face major hurdles.[45]

High innovation output by SMEs conducting R&D

Even if the group of SMEs with R&D activities is comparatively small, it does play an important role in the innovation ecosystem. This is because enterprises with R&D activities are, to a certain extent, at the spearhead of innovation in the SME sector. Thus, SMEs that undertake R&D almost continuously generate innovations (Figure 15). In the past years, the share of innovators among these enterprises ranged between 85 and 95%. It was thus almost three times as high as among those without own R&D (Figure 2).

Figure 15: Innovators with own (occasional or continuous) R&D

In per cent



Note: Figures extrapolated on the basis of the number of enterprises.

Source: KfW SME Panel, own calculations

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 21 and 27% throughout the period under review (Figure 15). That share is thus five to ten times higher than in SMEs that conduct no R&D, where that share sits between 2 and just under 6%. SMEs that undertake R&D thus do not just generate innovations at a higher rate but often with a high degree of novelty as well. Consequently, they often play a pioneer role in the innovation ecosystem.

5. Conclusion

Key findings on the development of innovation activity in the SME sector

In the period under review, the share of innovators dropped by one percentage point to 39%. This was driven by developments in small businesses. Enterprises with fewer than 10 employees were less likely to innovate than in the previous period. The unfavourable economic situation is likely to be the main reason for the recent development. At the same time, the share of innovative businesses among larger SMEs increased.

In the medium term – which means since the new OECD definition was first applied in the KfW SME Panel for the 2018–2020 period – the share of innovators in the SME sector has decreased by a total of three percentage points. One major factor contributing to this was that the large group of enterprises with fewer than five employees has consistently brought forth fewer innovations. However, many enterprises from the from the numerically small but generally rich in innovation R&D-intensive manufacturing segment also scaled back their innovation activities and discontinued their own R&D activities during this period.

By contrast, innovation expenditure in the SME sector remained almost steady at just under EUR 34 billion (in current prices) during this period. The proportion of businesses with own R&D activities did not follow a clear trend in the course of time either. A consistently high level of innovation expenditure in a smaller number of innovative enterprises points to increasing concentration of innovation efforts in few businesses. Today, 2% of the largest medium-sized enterprises already account for 56% of innovation expenditure in the SME sector.

The findings obtained on the basis of the KfW SME Panel are in line with the long-term trend identified with the aid of the innovation survey of the Centre for European Economic Research (ZEW) in Mannheim.[46] It has revealed that the share of innovators (including marketing and organisational innovations) in Germany has almost continuously decreased since its peak in the mid-2000s. This survey also confirms that, in particular, small businesses, businesses from economic sectors in which innovations do not represent a key competition parameter as well as companies that pursue rather moderate innovation activities – i.e. with a low financial input and often on a low innovation level – have stopped innovating.[47] Thus, businesses without own R&D, in particular, are less likely to innovate.[48] To be sure, the retreat of these businesses diminishes the output of high-novelty innovations to a limited extent only. It is to be anticipated, however, that Germany's productivity growth and transformative capacity will be weakened in the long term if an increasingly larger proportion of enterprises forgoes the periodic renewal of their production processes and product offerings.[49]

Impediments to innovation in the SME sector are growing

Over the past one and a half decades, the impact of impediments to innovation has grown in almost all segments of the SME sector. This applies to the group of innovators without R&D to a particular degree. What has not changed, however, is that enterprises with R&D activities are the ones most likely to be affected by impediments.[50] This is probably because they are more likely to encounter barriers and difficulties due to their more ambitious and more extensive innovation activities. The federal government's promotional measures therefore focus on the early stages of the innovation process, and typically on R&D promotion. An aspect that also supports this promotion is that R&D-based innovation projects can be expected to have the greatest spill-over effects and meet with the most pronounced funding difficulties (resulting from an information imbalance between the innovator and a potential provider of capital).[51] Thus, the market failure in the development of innovations is most pronounced among these enterprises.

Lack of expertise and financing-related constraints top the list of innovation barriers in the SME sector. Skilled labour shortages and the high cost of innovating are the most frequent obstacles. However, organisational problems as well as high risks and difficulties in obtaining finance are also mentioned often.[52]

Innovation landscape in Germany is differentiated but focused on R&D

Germany has a differentiated offering of support measures that address all phases and all actors in the innovation process.[53] Major gaps in the promotional landscape are hardly identifiable. Nonetheless, not all segments of the innovation ecosystem are covered by promotional measures to the same extent and with the same intensity. Overall, a clear emphasis on the promotion of R&D activities is evident. As a consequence, the relevant programmes reach only a small proportion of innovative enterprises[54], and various potentials for further enhancing the promotional schemes on offer can be identified. The most important potential starting points for economic policy measures are segments that have so far been given less attention and the key hurdles for innovation activity.

Possible starting points for boosting innovation activity in the SME sector

Target peak segments and the broad business community

Targeted economic policy measures can stimulate innovative activity in peak segments and within the broad business community in Germany. To some extent, this can be understood as a dual strategy. At the peak level, it is important to support businesses' R&D activities. More broadly, the major transformations such as the transition to sustainability, digitalisation and electric mobility, for example, require economic policy to provide direction and coordination, as is currently being pursued by the mission-oriented components of innovation policy. Identifying missions and designing specific, targeted measures places high demands on economic policymakers. In order to avoid misguided decisions, it is necessary to have a good source of information and well-founded advice without becoming exposed to lobbyism.

Germany has succeeded in significantly increasing R&D expenditure for the past almost two decades.[55] However, it lags well behind the leading countries in various technologies that are deemed important for the future.[56] The need to step up efforts in order to make progress at the peak level is exemplified by the fact that no progress was made in the years since the outbreak of the COVID-19 pandemic to move closer to reaching the R&D expenditure target of 3.5% of GDP. Reaching this target before the end of the year 2025, as intended, seems impossible.

With a view to the innovation activities of small and medium-sized enterprises, it would be a good idea to place a greater focus on the needs of businesses that undertake no R&D of their own. After all, the trend towards fewer innovators without R&D activities has continued in recent years as well. This is also suggested by the fact that these enterprises, too, are successful innovators[57] and contribute significantly with their innovations to the diffusion of novelties in the economy. Thus, they, too, make an important contribution to the functioning of the innovation ecosystem.

Small and medium-sized enterprises without own R&D generate 34% of the turnover achieved with product innovations in the SME sector and account for 42% of the cost reductions brought about by process innovations. Their innovation activities are characterised by high efficiency because, at 20% of innovation expenditure in the SME sector, they account for a significantly lower share of innovation expenditure.[58]

The following list provides concrete starting points for economic policy measures to increase innovation activity:

Improve funding opportunities

Financing-related barriers present a hurdle for all SMEs. Financing difficulties can be addressed by expanding the level of R&D and innovation promotion in the context of tried and tested promotional measures.[59] The special role of businesses that undertake continuous research activities suggests that comprehensive incentives should be provided wherever possible to ensure that businesses keep their existing R&D capabilities. Broadly applied measures such as the research grant that was introduced in 2020 can be effective instruments.[60]

Low-threshold promotional modules would be an option for the target group of innovation-oriented small and medium-sized enterprises that do not undertake any R&D. In the past one and a half decades, these companies in particular were increasingly confronted with impediments to innovation. At the same time, their share as recipients of innovation promotion has dropped at a disproportionately high rate, so that they are now clearly underrepresented compared with their contribution to the SME innovation ecosystem.[61]

The vast portion of the innovation activity of these enterprises is based on experiential skills that are acquired through informal processes of learning and understanding and arise from day-to-day working and interacting with the business environment ('learning by doing, using and interacting').[62] Financial support for these enterprises therefore should not address R&D expenditure but must target expenditure on product design and service design.

Ease skilled labour shortages

Easing skilled labour shortages is another matter of urgency. The share of innovative SMEs with hiring problems has grown by around two thirds to 52% in just over 10 years. Besides a general lack of applicants, businesses attribute skills shortages to, among other things, excessive wage demands and insufficient qualifications.[63]

A wide range of measures can contribute to improving the supply of skilled workers in the German labour market. A key starting point which enterprises can influence themselves would be to upskill workers through continuing education and training. Innovative SMEs in particular are already focusing more strongly than other enterprises on enhancing the skills of their workforce.[64] But given the severity of the skilled worker

shortage, it must be feared that measures taken by businesses alone cannot solve the problem. Rather, it has become obvious that economic and educational policymakers must also intervene to ease the shortage of skilled labour.

In the area of school education, for example, this includes reducing dropout rates, improving basic competencies by supporting students with learning difficulties and improving basic literacy and numeracy skills. As before, educational success in Germany still depends on students' family background.[65] In particular, insufficient social and digital skills and mathematical-statistical skills, the foundations of which are also laid already at school, constitute major barriers to recruitment for innovative firms. Specific further training measures that address the needs of innovative firms must target these shortcomings as well. With regard to digital expertise, one angle of attack is to mitigate the shortage of IT specialists on the one hand and to improve digital skills across the breadth of the workforce. Such content needs to be more closely integrated into school, vocational and academic courses as well.

It is important to realise the guiding principle of 'lifelong learning' so that the skills of working-age people keep pace with changing requirements. Increasing further training activities will require setting effective training incentives in the form of financial support. The cost of further training and employees' absence from work as well as loss of income sustained during extended qualification measures constitute major hurdles for further training activities.[66] Measures for the certification of qualifications and improving the navigation and quality assurance in the confusing market for continuing education and training are also useful starting points.[67] At the level of vocational training, existing hurdles must be lowered for small and medium-sized enterprises in particular, and they must be made more attractive as businesses that provide training.

In order to reduce the shortage of skilled labour, more people must be available to the labour market. To achieve this, the domestic labour force must be mobilised, for example by increasing labour force participation of women and older people, and migration must be understood as a potential source of skilled labour.[68]

Build innovation skills

Starting points for economic policy responses include not just increasing the overall availability of skilled labour but developing the specific skills required to carry out innovation projects.[69] In general, four areas of measures can be distinguished here.

Measures can aim to empower businesses to initiate own R&D activities. To achieve this, it will be necessary to address the specific prerequisites which they must fulfil to carry out innovation projects and initiate R&D. This means acquiring technical expertise and market information as well as developing strategic capabilities and the ability for businesses to cooperate with academia and other businesses. Appropriate measures must broadly aim to build scientific and technological competencies.[70] Advisory services and specific offers of funding for initiating R&D can constitute possible measures.

As laid out above, the use of external knowledge and informal learning processes based on, for example, intensive exchange within the enterprise and a corresponding business organisation constitute important sources of innovative strength for enterprises without own R&D activities.[71]

With respect to improving access to external knowledge, integration into regional innovation ecosystems plays an important role because the enterprises without R&D , in particular, often act locally, and these innovation ecosystems differ from one region to another.[72] Promoting regional innovation clusters is therefore an important measure for improving ways in which they internalise external knowledge. In order to address the needs of SMEs without R&D, it is particularly useful to expand cluster promotion below the threshold of clusters of excellence.

In-company processes of learning and understanding can be improved by modifying the work and business organisation[73] and by introducing appropriate management practices. They can be aimed at facilitating knowledge flows within the enterprise, giving workers scope for decision-making and introducing ideas, and providing incentives for generating innovations. Not least, they also include a living risk culture that promotes new ideas and accepts failure.[74] One option for supporting these aspects could consist in combining advisory services with financial solutions for their implementation.

Another approach would be to support small and medium-sized enterprises in developing capacities for organising innovation activities. This should benefit enterprises without own R&D in particular. The primary aim here is to increase the availability of staff who are able to design and drive innovation projects. Important aspects here include promoting continuing education schemes around innovation management and more closely integrating innovation aspects into vocational education and training.[75]

Improve strategic skills

Last but not least, a company's innovative activities can be increased by strengthening its strategic skills. Thus, an enterprise's strategic orientation crucially determines its innovation activities. Strong innovation efforts are undertaken particularly by enterprises that pursue the competition strategy 'growth through innovation', but also by those that focus on customer-specific solutions and high quality as well as those that concentrate on a small number of core products and services. Companies that do not have a pronounced competition strategy, on the other hand, have decidedly reduced innovation activities.[76]

Small businesses with well-established but not very innovative business models, in particular, pay little attention to the aspect of strategic business development. These businesses often do not employ university graduates and operate only within their own region. Limited resources and the prioritisation of day-to-day business often prevent them from seeing the need to focus on innovation and the further development of their business as a whole.[77] Therefore, the main target group is composed of enterprises that are not orientated towards innovation, which usually can hardly be reached with direct measures to promote innovation.

Approaches aimed at improving the strategic capabilities of these businesses include, among other things, awareness-raising campaigns that highlight specific role models and best-practice examples, providing more long-term offers of low-threshold information for SMEs on innovation strategies and innovation management and continuous monitoring and further development of the quality of advisory services in existing advisory programmes and infrastructures. Another measure would be to raise awareness about the significance of strategic considerations by incorporating such aspects more systematically in technical and vocational education and training, i.e. in the training of specialists and master tradespeople. Not least, explicitly incorporating strategic aspects in the context of innovation promotion, such as an innovation audit that can be used in modular form and accounted for as a reimbursable cost, could be another helpful approach.[78]

Annex

The structure of innovative SMEs

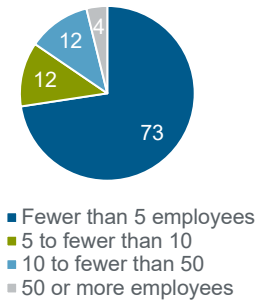
The SME sector, according to KfW's definition, covers all enterprises in Germany whose annual turnover does not exceed EUR 500 million. By this definition, around 3.84 million SMEs exist today. The SME sector thus accounts for 99.95% of all enterprises in Germany. Nearly 1.5 million of these enterprises are innovators.

The majority of innovative SMEs are small enterprises. Jjust under 1.1 million enterprises, or 73% 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 7% of innovators while the service sector represents 87%.

Eighty per cent of innovative SMEs do not conduct any R&D of their own. In the past three years, only 10% have undertaken research continuously or on an ad-hoc basis.

Figure 16: Innovative SMEs by company size

In per cent

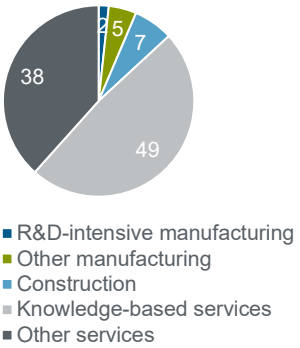


Note: Figures extrapolated on the basis of the number of enterprises.

Source: KfW SME Panel, own calculations

Figure 17: Innovative SMEs by industry

In per cent

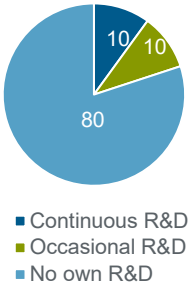


Note: Figures extrapolated on the basis of the number of enterprises.

Source: KfW SME Panel, own calculations

Figure 18: Innovative SMEs by own R&D activity

In per cent



Note: Figures extrapolated on the basis of 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 9,556 SMEs took part in the current wave.

The KfW SME Panel is used as the basis for analyses of long-term structural developments in the SME sector. 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, innovation and digitalisation activities and financing structure. This tool provides a unique 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 annual turnover of not 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 as a starting point.

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 GfK GmbH 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 22nd wave of the KfW SME Panel was conducted in the period from 12 February to 21 June 2024.

Further information can be obtained at **www.kfw-mittelstandspanel.de**.

[1] Cf. Bravo-Biosca, A.; Marston, L.; Mettler, A.; Mulgan, G. and Westlake, S. (2013), Plan I – Innovation for Europe, Nesta and the Lisbon Council.

[2] Cf. Ulku, H. (2004): R&D, Innovation, and Economic Growth: An empirical Analysis, IMF Working Paper 04/195; OECD (2007) (ed.): Innovation and Growth. Rationale for an Innovation Strategy (https://www.oecd.org/edu/ceri/40908171.pdf), retrieved on 16 June 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 or Dachs, B., Hud, M., Koehler, C., and Peters, B. (2017): Innovation, Creative Destruction and Structural Chance: Firm-level Evidence from European Countries, Industry and Innovation 2(4):346–381.

[3] Cf. Zimmermann, V. (2024): Unternehmen mit Wettbewerbsstrategie sind erfolgreicher und haben höhere Innovations- und Digitalisierungsaktivitäten (Enterprises that have a competition strategy are more successful and conduct more innovation and digitalisation activities – in German only), Focus on Economics No. 467, KfW Research; Zimmermann, V. (2022), Investitionen in immaterielles Kapital steigern die Produktivität (Investment in intangible capital enhances productivity – in German only), Focus on Economics No. 408, KfW Research, Zimmermann, V. (2021), Innovationen steigern Wachstum und Produktivität und verbessern die Qualifikationsstruktur der Beschäftigten in mittelständischen Unternehmen (Innovation boosts growth and productivity and improves the structure of workforce qualifications in small and medium-sized enterprises – in German), Focus on Economics No. 361, KfW Research; Zimmermann, V. (2017), Success factors of high-growth enterprises, Focus on Economics No. 177, KfW Research. 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 and Employment. Die Beschäftigungswirkung verschiedener Arten von Innovationen in expandierenden und schrumpfenden mittelständischen Unternehmen (*The employment effect of different types of innovation in expanding and contracting SMEs*), Journal of Business Economics, ZfB-Special Issue 4/2013 (in German): 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 – our title translation, in German), DIW Wochenbericht 27, p. 755–761.

[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: 208–212.

[5] Cf. Chan, M. et Al (2023): The Effect of R&D on Quality, Productivity, and Welfare, NBER Working Paper No. 30950 and Antonioli, D. et Al. (2011): Innovation, Industrial Relations and Employee Outcomes: Evidence from Italy, Journal of Economic Studies 38(1), p. 66-90.

[6] Cf. Dauth et al. (2017): German Robots – The Impact of Industrial Robots on Workers, IAB Discussion Paper 30/2017.

[7] Cf. Kulicke, M.; Beckert, B. and Stolz, C. (2023): Studie zum Förderfeld „Digitalisierung und Innovation" im Auftrag der Kreditanstalt für Wiederaufbau (KfW) (*Study on the promotional area of 'Digitalisation and innovation' on behalf of KfW* – our title translation, in German), Fraunhofer Institute for Systems and Innovation Research ISI, OECD (2022), OECD reports on innovation policy: Germany 2022: Building Agility for Successful Transitions, OECD Publishing and Zimmermann, V. (2023): Wo steht Deutschland bei Innovation und Digitalisierung im internationalen Vergleich? (*Where does Germany stand in innovation and digitalisation in an international comparison?* – in German only), Focus on Economics No. 412; KfW Research.

[8] Cf. Hottenrott, H. et al. (2024): Wie steht es um die Innovationsfähigkeit Deutschlands? (*How is Germany's innovative capacity doing?* – Our title translation, in German) Wirtschaftsdienst 104(4), p. 230–235.

[9] Cf. Zimmermann, V. (2022), Die Entwicklung der FuE-Ausgaben in Deutschland im internationalen Vergleich (The development of R&D expenditure in Germany in international comparison – in German), Focus on Economics No. 404, KfW Research, and Rammer, C. and Trunschke, M. (2022): Studie zur Entwicklung der Forschungs- und Entwicklungsausgaben in Deutschland im internationalen Vergleich (*Study on the development of research and development expenditure in Germany in an international comparison* – our title translation, in German), Study commissioned by KfW Group, Leibniz Centre for European Economic Research.

[10] Cf. Zimmermann, V. (2022), Types of SMEs in the innovation system: activities, constraints and successes, Focus on Economics No. 394, KfW Research, and Rammer, C. et al. (2022): Drivers and Barriers for Innovation in the German SME sector, Study commissioned by KfW Group, Leibniz Centre for European Economic Research.

[11] Cf. Zimmermann, V. and Thomä, J.: (2019), Interactive learning or R&D: How do small and medium-sized enterprises generate innovations?. Focus on Economics No. 264, KfW Research or 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.

[12] Cf. https://www.deutscher-zukunftspreis.de/de/team-1-2024, last retrieved on 29 November 2024.

[13] Cf. https://www.wirtschaft.nrw/innovationspreis-handwerk, last retrieved on 29 November 2024.

[14] Cf. https://www.spk-swb.de/de/home/ihre-sparkasse/soziales-engagement/Stiftung/innovationspreis.html, last retrieved on 29 November 2024.

[15] Cf. Borger, K. (2024): SMEs start the new year with subdued sentiment KfW-ifo SME Barometer: January 2024, KfW Research.

[16] Cf. Schwartz, M., and Gerstenberger, J. (2024): KfW SME Panel 2024. German SMEs are not immune to the economic slowdown (forthcoming), KfW Research.

[17] Cf. Zimmermann, V. (2018): Determinants of digitalisation and innovation behaviour in the SME sector, Focus on Economics No. 236, KfW Research, Zimmermann, V. (2017): SME innovations: Seven reasons for the decline in the share of innovators. Focus on Economics No. 185, KfW Research, Zimmermann, V. (2017), Research and development (R&D) in SMEs: internal funding capacity determines scope of R&D expenditure, Focus on Economics No. 190 and Poschen, K. and Zimmermann, V (2014): Falling sales expectations curb SME innovation activity in Germany, Economics in Brief No. 58, KfW Economic Research.

[18] Cf. Zimmermann, V. (2010): Innovation und Konjunktur (Innovation and economic activity). Points of View No. 10, KfW Economic Research.

[19] Cf. OECD and Eurostat (2018) (publishers), Oslo Manual 2018. Guidelines for collecting, reporting and using innovation data. OECD Publishing.

[20] Cf. Zimmermann, V. (2020): Innovation during the coronavirus crisis: necessity is the mother of invention, Focus on Economics No. 295, KfW Research; Zimmermann, V. (2021): Coronavirus crisis is hampering innovation, digitalisation sees mixed trend, Focus on Economics No. 312, KfW Research and Zimmermann, V. (2021): KfW SME Innovation Report 2020: Coronavirus crisis is slowing down innovation, KfW Research.

[21] Cf. Bloom, N. et al. (2007): Uncertainty and Investment Dynamics, Review of Economic Studies, 74, 391–415.

[22] Cf. Trunschke, M. et al. (2024): Pandemic Effects: Do Innovation Activities of Firms Suffer from Long-COVID?, Research Policy 53(7).

[23] By the definition valid at the time according to OECD and Eurostat (2018) (publishers), Oslo Manual 2005. Guidelines for collecting and interpreting innovation data. OECD Publishing.

[24] Cf. Zimmermann, V. (2020): KfW SME Innovation Report 2019. Innovator rate drops to 19%, KfW Research and Rammer, V. and Schubert, T. (2018): Concentration of the few: mechanisms behind a falling share of innovative firms in Germany, Research Policy 47(2), p. 379–389.

[25] Cf. Zimmermann, V. (2022): Types of SMEs in the innovation system: activities, constraints and successes, Focus on Economics No. 394, and Rammer, C. et al. (2022): Drivers and Barriers for Innovation in the German SME sector, Study commissioned by KfW Group.

[26] Cf. Zimmermann, V. and Köhler-Geib, F. (2023): Impact of the COVID-19 Pandemic on Different Groups of SMEs in Germany and Their Recovery, Intereconomics 58(6), p. 333–341.

[27] 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.

[28] (1998): Research, Innovation and Productivity: An Econometric Analysis at the Firm Level; Economics of Innovation and New Technology 7(2): 115–158 or Baptista, R. (2000): Do innovations diffuse faster within geographical clusters? International Journal of Industrial Organization 15: 515–535.

[29] Cf. Galbraith, J. K. (1952): American Capitalism. The Concept of Countervailing Power. Boston, Hougthon 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, S. 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.

[30] Cf. Zimmermann, V. (2023): KfW SME Innovation Report 2023. SMEs' innovation activity has flatlined, KfW Research

[31] Cf. Zimmermann, V. and Köhler-Geib, F. (2023): Impact of the COVID-19 Pandemic on Different Groups of SMEs in Germany and Their Recovery, Intereconomics 58(6), p. 333–341.

[32] Cf. Abel-Koch, J. (2024): KfW-Internationalisation Report 2024. International business in times of multiple crises: SMEs achieved a record result in 2022, KfW Research.

[33] Cf. Schlegelmilch, B. (1988): Der Zusammenhang zwischen Innovationsneigung und Exportleistung (*The correlation between innovation propensity and export performance* – our title translation, in German). Ergebnisse einer empirischen Untersuchung in der deutschen Maschinenbauindustrie (*Results of an empiric survey of the German engineering industry* – our title translation, in German), in: Zeitschrift für betriebswirtschaftliche Forschung 50(3), p. 227–269; Lachenmaier, S. and Wössmann, L. (2006), Does Innovation Cause Exports? Evidence from Exogenous Innovation Impulses and Obstacles using German Micro Data, Oxford Economic Papers 58(2), p. 317–350; Greenaway, D. and Kneller, R. (2007): Firm heterogeneity, exporting and foreign direct investment, The Economic Journal 117(517), p. F134–F161, and Wagner, J. (2007): Exports and productivity: A survey of the evidence from firm-level data, World Economy 30(1), p. 60–82 Fryges, H. and Wagner, J. (2010): Exports and Profitability: First Evidence for German Manufacturing Firms, The World Economy 33(3), p. 399–423 and Carboni, O.A. and Medda, G. (2024), Endogenous Innovation and Export Performance in Firms, Journal of Applied Economic Sciences 19, Issue 1(83), p. 48–62.

[34] Cf. Anderson, M. and Lööf, H. (2009), Learning by Exporting Revisited – the role of intensity and persistence, Scandinavian Journal of Economics 111(4), p. 893–913; Harris, R and Li, Q.C. (2009): Exporting, R&D, and Absorptive Capacity in UK Establishments, Oxford Economic Papers 61, p. 74–103; Vendrell-Herrero, F. et al. (2024): When do firms learn? Learning before versus after exporting, Small Business economics, online, sowie. Krieger, B. and Trottner, F. (2024): Trade in Services and Innovation, ZEW Discussion Paper No. 24-056.

[35] Cf. Ugur, M. et al. (2020), What do we know about R&D spillovers and productivity? Meta-analysis on heterogenity and statistical power, Research Policy 49(1); Jirjahn, U. and Kraft, K. (2011): Do Spillovers Stimulate Incremental or Drastic Product Innovations? Evidence from German Establishment Data, Oxford Bulletin of Economics 73(4), p. 509–539 and Czarnitzki, D. and Kraft, K. (2012), Spillovers of innovation activities and their profitability, Oxford Economic Papers 64(2), p. 302-322 and Cappelli, R. et al. (2014): Sources of Spillovers for imitation and innovation, Research Policy 43(1), p. 115–120.

[36] Cf. Schwartz, M., and Gerstenberger, J. (2024): KfW SME Panel 2024. German SMEs are not immune to the economic slowdown, KfW Research.

[37] Cf. Zimmermann, V. (2020): Innovation during the coronavirus crisis: necessity is the mother of invention, Focus on Economics No. 295, KfW Research; Zimmermann, V. (2021): Coronavirus crisis is hampering innovation, digitalisation sees mixed trend, Focus on Economics No. 312, KfW Research and Zimmermann, V. (2021): KfW SME Innovation Report 2020: Coronavirus crisis is slowing down innovation, KfW Research.

[38] Cf. Zimmermann, V. (2017): SME Innovations: Seven reasons for the decline in the share of innovators, Focus on Economics No. 185, KfW Research. and Poschen, K. and Zimmermann, V. (2014), Falling sales expectations curb SME innovation activity in Germany, KfW Economic Research, Economics in Brief No. 58.

[39] Specifically, 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.

[40] The deflation of innovation expenditure is done with a composite deflator made up 25% of the variation in the prices for fixed capital formation in machinery and equipment and 75% of the variation in the prices of other machinery and equipment as reported by the Federal Statistical Office (2023) (ed.) Fachserie 18 Reihe 1.4, Blatt 2.3.11. This deflator can be considered an approximation to the inflation rate of innovation expenditure, because according to calculations made on the basis of the innovation survey conducted by the Centre for European Economic Research in Mannheim, innovation expenditure is composed 25% of physical investments and other machinery and equipment comprises, among other things, expenditure on intellectual property such as research and development.

[41] Cf. Schwartz, M., and Gerstenberger, J. (2024): KfW SME Panel 2024. German SMEs are not immune to the economic slowdown, KfW Research.

[42] Cf. Zimmermann, V. and Thomä, J. (2019), Interactive learning or R&D: How do small and medium-sized enterprises generate innovations? Focus on Economics No. 264, KfW Research or 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 and Thomä, J. and Zimmermann, V. (2020), Interactive learning — The key to innovation in non-R&D-intensive SMEs? A cluster analysis approach, Journal of Small Business Management 58(4):747–776.

[43] Cf. OECD (2015) (publisher): Frascati Manual 2015. Guidelines for collecting and reporting data on research and experimental development.

[44] Cf. Zimmermann, V. (2017): KfW SME Innovation Report 2016: Innovation is concentrated in increasingly fewer enterprises, KfW Research.

[45] Cf. Rammer, C. et al. (2022): Drivers and Barriers for Innovation in the German SME sector, Study commissioned by on behalf of KfW Group, and Peters, B. et al. (2017): Estimating Dynamic R&D Demand: An Analysis of Costs and Long-Run Benefits, RAND Journal of Economics 48(2), p. 409–437.

[46] Cf. Rammer, C. and Schubert, T. (2028): Concentration on the few: Mechanisms behind a falling share of innovative firms in Germany, Research Policy 47, p.379–389.

[47] Cf. Hottenrott, H. et al. (2024): Wie steht es um die Innovationsfähigkeit Deutschlands? (*How is Germany's innovative capacity doing?* – Our title translation, in German), Wirtschaftsdienst 104(4), p. 230–235.

[48] Cf. Zimmermann, V. (2022): Types of SMEs in the innovation system: activities, constraints and successes, Focus on Economics No. 394, and Rammer, C. et al. (2022): Drivers and Barriers for Innovation in the German SME sector, Study commissioned by KfW Group.

[49] Cf. Hottenrott, H. et al. (2024): Wie steht es um die Innovationsfähigkeit Deutschlands? (How is Germany's innovative capacity doing? – Our title translation, in German), Wirtschaftsdienst 104(4), p. 230-235. Andrews, D. et al (2015). Frontier Firms, technology diffusion and public policy: Micro evidence from OECD countries, OECD Background Paper, and Akcigit, U. and Ates, S.T. (2021): Ten facts on declining business dynamism and lessons from endogenous growth theory, American Economic Journal: Macroeconomics 13(1), p. 257–98.

[50] Cf. Zimmermann, V. (2022), Types of SMEs in the innovation system: activities, constraints and successes, Focus on Economics No. 394, KfW Research, and Rammer, C. et al. (2022): Drivers and Barriers for Innovation in the German SME sector, Study by the Centre for European Economic Research on behalf of KfW Group.

[51] Cf. Zimmermann, V. (2022), Innovationsfinanzierung im Mittelstand: Selbst die externe Finanzierung wenig anspruchsvoller Vorhaben ist schwierig (Innovation

finance in SMEs: even the external financing of less ambitious projects is difficult – in German); Focus on Economics No. 397, KfW Research.

[52] Cf. Zimmermann, V. (2022), Types of SMEs in the innovation system: activities, constraints and successes, Focus on Economics No. 394, KfW Research, and Rammer, C. et al. (2022): Drivers and Barriers for Innovation in the German SME sector, Study commissioned by KfW Group. ZEW.

[53] Cf. Kulicke, M.; Beckert, B. and Stolz, C. (2023): Studie zum Förderfeld „Digitalisierung und Innovation" im Auftrag der Kreditanstalt für Wiederaufbau (KfW) (*Study on the promotional area of 'Digitalisation and innovation' on behalf of KfW* – our title translation, in German), Fraunhofer Institute for Systems and Innovation Research ISI, and Zimmermann, V. (2023): Wo steht Deutschland bei Innovation und Digitalisierung im internationalen Vergleich? (*Where does Germany stand in innovation and digitalisation in an international comparison?* – in German only), Focus on Economics No. 412; KfW Research.

[54] Cf. Hottenrott, H. et al. (2024): Wie steht es um die Innovationsfähigkeit Deutschlands? (*How is Germany's innovative capacity doing?* – Our title translation, in German), Wirtschaftsdienst 104(4), p. 230–235.

[55] Cf. Rammer, C. and Trunschke, M. (2022): Studie zur Entwicklung der Forschungs- und Entwicklungsausgaben in Deutschland im internationalen Vergleich (*Study on the development of research and development expenditure in Germany in an international comparison* – our title translation, in German), Study commissioned by on behalf of KfW Group, and Zimmermann, V. (2022): Die Entwicklung der FuE-Ausgaben in Deutschland im internationalen Vergleich (The development of R&D expenditure in Germany in international comparison – in German), Focus on Economics No. 404, KfW Research.

[56] Cf. Zimmermann, V. (2024): Artificial intelligence in Germany: Status quo, opportunities and options for economic policy measures, Focus on Economics No. 463, and Zimmermann, V. (2024): Deutschlands Position bei der Digitalisierung im internationalen Vergleich (Germany's position in the area of digitalisation in international comparison – in German only), Focus on Economics No. 469, KfW Research.

[57] Cf. Thomä, J. and Zimmermann, V. (2020), Interactive learning — The key to innovation in non-R&D-intensive SMEs? A cluster analysis approach, Journal of Small Business Management 58(4):747-776 and Zimmermann, V. and Thomä, J.: (2019), Interactive learning or R&D: How do small and medium-sized enterprises generate innovations? Focus on Economics No. 264, KfW Research; Zimmermann, V. and Thomä, J. (2019), Business performance of different types of small and medium-sized innovators, Focus on Economics No. 265, or Rammer, C., Czarnitzki, D. and Spielkamp, A. (2009): Innovation success of non-R&D performers: substituting technology by management in SMEs. Small Business Economics 33(1), p. 35–58.

[58] Cf. Zimmermann, V. (2022): Types of SMEs in the innovation system: activities, constraints and successes, Focus on Economics No. 394, and Rammer, C. et al. (2022): Drivers and Barriers for Innovation in the German SME sector, Study commissioned by KfW Group.

[59] Cf. Rammer, C. and Schubert, T. (2018): Concentration on the few: mechanisms behind a falling share of innovative firms in Germany; Research Policy 47(2), p. 379-389.

[60] Cf. Angelino, P. et al. (2024): R&D grants and R&D tax credits in Belgium: Evidence on the policy mix, MSI Discussion Paper No. 2410; Dechezleprêtre, A. et al. (2023): Do Tax Incentives Increase Firm Innovation? An RD Design for R&D, Patents, and Spillovers, American Economic Journal: Economic Policy 15(4):486-521; Guceri, I. and Liu, L. (2019): Effectiveness of fiscal incentives for R&D: quasi experimental evidence. American Economic Journal: Economic Policy 11(1):266-291, Rammer, C. (2021): Ansätze zur Verbesserung der administrativen Umsetzung der Forschungszulage, Ergebnisse einer Befragung des VDMA (*Approaches to improving the administrative implementation of the research grant, findings of a survey by the VDMA* – our title translation, in German) Leibniz Centre for European Economic Research, and Rammer, C. (2023): Erfahrungen mit der Umsetzung der Forschungszulage im Maschinen- und Anlagenbau, Ergebnisse einer Befragung des VDMA (*Experiences with implementing the research grant in engineering and plant production, results of a survey by VDMA* – our title translation, in German), Leibniz Centre for European Economic Research.

[61] Cf. Hottenrott, H. et al. (2024): Wie steht es um die Innovationsfähigkeit Deutschlands? (*How is Germany's innovative capacity doing?* – our title translation, in German), Wirtschaftsdienst 104(4), p. 230-235. Zimmermann, V. (2022), Types of SMEs in the innovation system: activities, constraints and successes, Focus on Economics No. 394, KfW Research, and Rammer, C. et al. (2022): Drivers and Barriers for Innovation in the German SME sector, Study commissioned by KfW Group. ZEW.

[62] 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.

[63] Cf. Zimmermann, V. (2024): High skills requirements make hiring a challenge, especially for innovative enterprises, Focus on Economics No. 451, KfW Research.

[64] Cf. Zimmermann, V. (2023): Mittelständische Unternehmen setzen auf Qualifizierung und allgemeine personalpolitische Maßnahmen zur Sicherung des Fachkräftebedarfs (SMEs focus on training and general HR policy measures to meet their skilled labour needs – in German only) Focus on Economics No. 445, KfW Research.

[65] Cf. Müller, M. (2023): Skills shortage marks a turning point: The times of guaranteed growth are over, Focus on Economics No. 414, KfW Research

[66] Cf. Leifels, A. (2022): Weiterbildung nur bei gut einem Drittel der KMU – neue Weiterbildungskultur nötig (*Only a good one third of SMEs engage in professional development – we need a new continuing education culture* – in German), Focus on Economics No. 362, KfW Research.

[67] Cf. Leifels, A. (2021): German SMEs lack digital skills, need more training, Focus on Economics No. 346, KfW Research.

[68] The aspects mentioned in this section 'Ease skilled labour shortages' are discussed in greater detail in separate studies by KfW Research on securing the supply of skilled labour. Cf. Zimmermann (2024): High skills requirements make hiring a challenge, especially for innovative enterprises, No. 451, KfW Research. Zimmermann, V. (2023): Mittelständische Unternehmen setzen auf Qualifizierung und allgemeine personalpolitische Maßnahmen zur Sicherung des Fachkräftebedarfs (SMEs focus on training and general HR policy measures to meet their skilled labour needs – in German only) Focus on Economics No. 445, KfW Research; Zimmermann, V. (2023): Fehlende Digitalkompetenzen erschweren die Besetzung offener Stellen in digital aktiven Unternehmen (Shortage of digital skills makes it difficult for digitally active firms to fill vacancies – in German only), Focus on Economics No. 420, KfW Research. and Müller, M. (2023): Skills shortage marks a turning point: The times of guaranteed growth are over, Focus on Economics No. 414, KfW Research

[69] Cf. Zimmermann, V. and Thomä J. (2016), SMEs face a wide range of barriers to innovation – support policy needs to be broad-based, Focus on Economics No. 130, KfW Research.

[70] Cf. Zimmermann, V. (2022), Types of SMEs in the innovation system: activities, constraints and successes, Focus on Economics No. 394, KfW Research, and Rammer, C. et al (2022): Drivers and Barriers for Innovation in the German SME sector, Study commissioned by KfW Group. ZEW.

[71] Cf. Thomä, J. and Zimmermann, V. (2020), Interactive learning — The key to innovation in non-R&D-intensive SMEs? A cluster analysis approach, Journal of Small Business Management 58(4):747-776 and Zimmermann, V. and Thomä, J.: (2019), Interactive learning or R&D: How do small and medium-sized enterprises generate innovations? Focus on Economics No. 264, KfW Research.

[72] Cf. Thomä, J. and Bizer, K. (2021), Governance mittelständischer Innovationstätigkeit – Implikationen des Doing-Using-Interacting-Modus (*Governance of SME innovation activity – Implications of the Doing-Using-Interacting Mode* – our title translation, in German), Perspektiven der Wirtschaftspolitik 22(4), p. 350–369.

[73] Cf. Totterdill, P. (2015): Closing the Gap: The Fifth Element and Workplace Innovation, European Journal of Workplace Innovation, 1(1): 55–74.

[74] Cf. Thomä, J. and Zimmermann, V. (2020), Interactive learning — The key to innovation in non-R&D-intensive SMEs? A cluster analysis approach, Journal of Small Business Management 58(4):747-776 and Zimmermann, V. and Thomä, J.: (2019), Interactive learning or R&D: How do small and medium-sized enterprises generate innovations?, Focus on Economics No. 264, KfW Research.

[75] Cf. Zimmermann, V. (2022), Types of SMEs in the innovation system: activities, constraints and successes, Focus on Economics No. 394, KfW Research, and Rammer, C. et al. (2022): Drivers and Barriers for Innovation in the German SME sector, Study commissioned by KfW Group. ZEW.

[76] Cf. Zimmermann, V. (2024): Unternehmen mit Wettbewerbsstrategie sind erfolgreicher und haben höhere Innovations- und Digitalisierungsaktivitäten (Enterprises that have a competition strategy are more successful and conduct more innovation and digitalisation activities – in German only), Focus on Economics No. 467, KfW Research, and Zimmermann, V. (2024): Unternehmen mit Vorreiterstrategien gehen Innovationen und Digitalisierung breiter an und führen ambitioniertere Vorhaben durch (Enterprises with pioneering strategies pursue innovation and digitalisation more broadly and carry out more ambitious projects – in German only), Focus on Economics No. 473, KfW Research.

[77] Cf. Zimmermann, V. (2024): Interne Ressourcen und Umfeld bestimmen die Wettbewerbsstrategie von mittelständischen Unternehmen (Internal resources and environment determine competition strategy of small and medium-sized enterprises – in German only), Focus on Economics No. 464, KfW Research, and Astor, M. et al. (2016): Innovativer Mittelstand 2025 – Herausforderungen, Trends und Handlungsempfehlungen für Wirtschaft und Politik (*Innovative SMEs in 2025 – challenges, trends and recommendations for action for business and policy-makers* – our title translation, in German), Berlin: Federal Ministry for Economic Affairs and Energy.

[78] Cf. Zimmermann, V. (2022), Types of SMEs in the innovation system: activities, constraints and successes, Focus on Economics No. 394, KfW Research, and Rammer, C. et al (2022): Drivers and Barriers for Innovation in the German SME sector, Study commissioned by KfW Group. ZEW.