DOI: 10.2478/ie-2023-0068

sciendo

Intereconomics, 2023, 58(6), 333-341

JEL: M21, O16

Volker Zimmermann and Fritzi Köhler-Geib*

Impact of the COVID-19 Pandemic on Different Groups of SMEs in Germany and Their Recovery

Using Germany as an example, this article examines how different groups of small and medium-sized enterprises were impacted by and recovered from the COVID-19 pandemic. The study found that at the onset of the pandemic, turnover losses were experienced not just by enterprises regarded as poor performers, i.e. small businesses or those with low credit ratings, but also, and in particular, by high-performing companies. However, the latter recovered faster from the impact of the pandemic than other businesses. This suggests that this group developed the capacity to successfully respond to changes in the business environment and seize possible opportunities even before the pandemic hit. Such enterprises show themselves to be particularly crisis-proof. Thanks to the wide range of enterprises' adaptation measures and state support measures, the financial capacity of small and medium-sized enterprises in Germany was hardly diminished by the pandemic.

In many countries, the COVID-19 pandemic had a profound impact on people's lives (Brodeur et al., 2021) and the economy (Almeida et al., 2021; Juranek et al., 2021; Palomino et al., 2020; Coad et al., 2022; Bloom et al., 2022). The pandemic influenced businesses deeply in Germany as well. Figure 1 shows that 66% of small and medium-sized enterprises (SMEs) suffered turnover losses, particularly at the beginning of the pandemic. By September 2021 that share dropped to 28%. Enterprises were impacted much less often by other effects of the pandemic or its containment measures, such as worker absences (e.g. due to sickness, having to care for children), supply chain disruptions, business closures or difficulties in implementing hygiene protocols. What almost all consequences had in common was that they occurred frequently at the outset and that the situation eased during its further progression. An opposing trend could be observed only for supply chain disruptions. After improving up until September 2020, supply chain disruptions worsened again until the end of 2021, i.e. the end of the period covered by the study.

Open Access funding provided by ZBW – Leibniz Information Centre for Economics.

* This paper is the sole responsibility of the authors and does not necessarily represent the views of KfW Group.

Volker Zimmermann, KfW Research, Frankfurt, Germany.

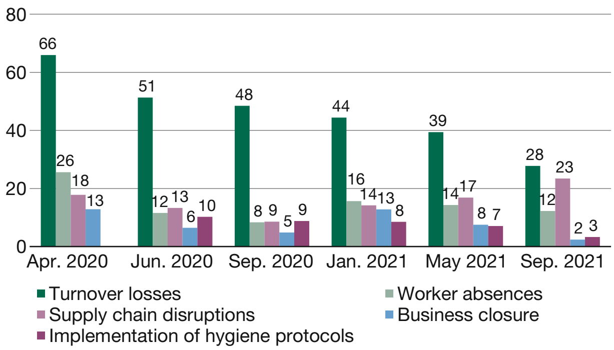
Fritzi Köhler-Geib, KfW Research, Frankfurt, Germany.

Economic crises are often expected to have a "cleansing effect" because less productive businesses close down while highly productive ones are better able to get over such crises (Kozeniauskas et al., 2022). However, with respect to the COVID-19 pandemic, concerns have also been voiced that businesses with high potential and those situated at the upper end of the performance distribution in particular could suffer (Benedetti Fasil et al., 2021; Coad et al., 2022). In the following, we therefore investigate which segments of Germany's SME sector were impacted by turnover losses, how quickly they recovered from the initial shock, how their financial capacity developed up to the end of 2021 and what lessons can be learned in general with regard to the crisis resilience of SMEs.

SMEs and the database for investigating the crisis impact

In this study, the term "SME" follows the definition laid out by the KfW Group. It applies to small and medium-sized enterprises but is expanded moderately upwards in comparison with the EU definition. The definition of SME used here includes commercial enterprises and self-

Figure 1
Impact of the COVID-19 pandemic on SMEs in Germany
in % of enterprises



Note: "Implementation of hygiene protocols" not included in April 2020 survey.

Sources: KfW SME Panel, 1st to 6th supplementary coronavirus survey.

employed professionals with an annual turnover of up to €500 million.

The analysis is based on the KfW SME Panel, a representative longitudinal data section for SMEs in Germany in this turnover class. A special feature of the KfW SME Panel is that it also covers businesses with fewer than five employees. The survey omitted agriculture and fishery, the public sector, as well as banks and non-profit organisations. Responses were received from around 10,000 to 12,000 businesses in each survey wave. The survey findings can be extrapolated to the basic population of the SME sector according to headcount, sector (any of six classes),[1] region of company headquarters (eastern or western Germany) and KfW support status (KfW-supported vs. non-KfW-supported) (Schwartz, 2022). The surveyed businesses' credit ratings were also provided thanks to a broad-based partnership with Vereine Creditreform. In order to be able to monitor the consequences of the COVID-19 crisis, another six supplementary online surveys were conducted up to the end of 2021 which were linked to the main survey of 2020 and extrapolated to the basic population of SMEs. Depending on the wave of the survey conducted during the year, between 2,000 and 2,800 responses from businesses were evaluated for the present study.

Turnover losses at the outset of the pandemic

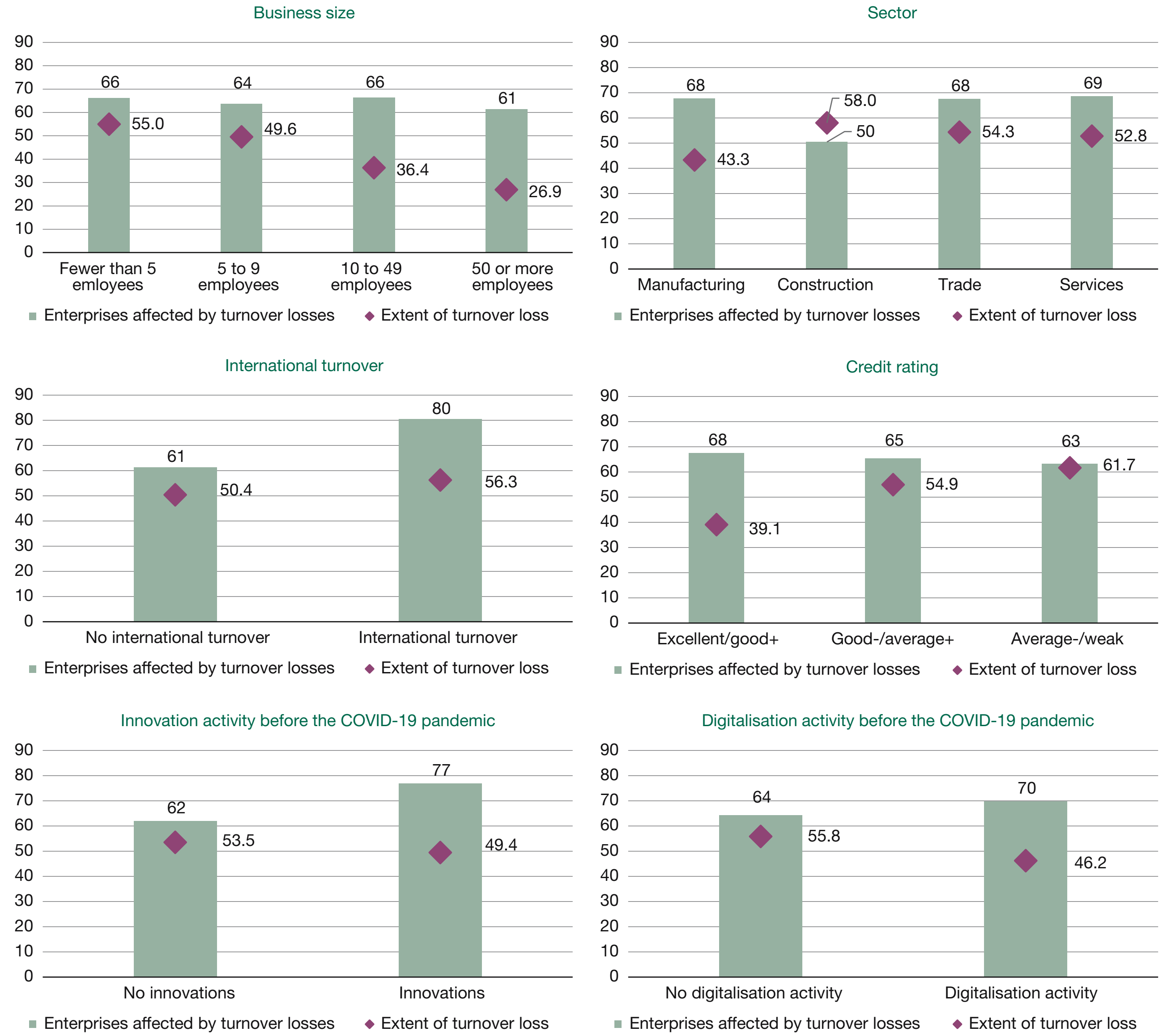
Figure 2 shows different enterprise groups to illustrate how broadly and deeply the turnovers of SMEs were affected by the consequences of the pandemic and the containment measures in April 2020. The impact of turnover losses differs only minimally by enterprise size and the economic sector to which it belongs, with shares of 60% to just under 70%. The construction sector is the only exception, where 50% of companies – a significantly lower share than other enterprises – suffered turnover losses. The magnitude of turnover losses differed mainly by enterprise size. The larger the enterprise, the lower the losses (Schwartz and Gerstenberger, 2020; Brink et al., 2022). With an average downturn in turnover of 27% (in businesses that had turnover losses), large SMEs experienced significantly lower turnover losses than small businesses, where the share averaged 55%. One likely reason is that larger enterprises tend to have more diversified sales markets and internal processes and that the shock caused by the pandemic often did not affect all their parts equally. Averaging 43%, the share of manufacturing firms that suffered turnover losses was also lower than in commerce or the services sector. Asymmetrical impacts by economic sectors and enterprise size classes were already identified in various studies (Juergensen et al., 2020; del Rio-Chanona et al., 2020; Brink et al., 2022). Retail trade and personal services were hit particularly hard by the first lockdown and further pandemic containment measures. The lockdown affected manufacturing, construction, wholesale and business services less directly. In these sectors, the worsening economic prospects, worker absences and other measures adopted to contain the pandemic likely played a more important role. Furthermore, companies engaged in foreign trade were likely affected more often by disruptions to supply chains. The extremely positive business situation in the construction sector was the least impaired by the COVID-19 pandemic.

Enterprises with international turnover were significantly more likely to suffer turnover losses and in a slightly higher order of magnitude than companies doing business in the domestic market alone. This is likely because the international turnovers of SMEs plunged by a particularly steep 10.5% in the year 2020 (Abel-Koch, 2022). Germany's trade in goods dropped most sharply at the onset of the COVID-19 pandemic. Supply chain disruptions also affected internationally active enterprises most often from the moment the pandemic erupted, which was likely due to their broader geographic coverage and higher complexity.

Businesses with a good credit rating were affected by turnover losses at a slightly higher rate (68%) than those with a medium to low credit rating. In return, the extent of their turnover losses averaged 39%, which was significantly lower than among the latter, where losses amounted to just under 62%. This is likely due, among other

1 Manufacturing, construction, wholesale trade, retail trade, services, other.

Figure 2
Impact of turnover losses on SMEs in Germany at the outset of the COVID-19 pandemic
in %



Sources: KfW SME Panel, 1st supplementary coronavirus survey (May 2020), own calculations.

things, to the fact that large enterprises in particular tend to have a good credit rating.

Past studies found that innovators or enterprises with advanced levels of digitalisation have weathered crises more successfully (Dachs et al., 2017; Bertschek et al., 2019, Dachs et al., 2020). In this study, innovation is defined as technical innovation, i.e. product or process innovation in accordance with the definition of OECD and Eurostat (2005). Businesses that innovated before the pandemic also suffered turnover losses more often than non-innovators at the onset of the pandemic. The average decline in turnover among innovators, however, was slightly lower than among non-innovators. The picture around digitalisation activities tells a similar story. Businesses that successfully completed digitalisation projects before the outbreak of the COVID-19 pandemic were impacted by turnover losses at a slightly higher rate but with lower average declines in turnover than businesses without digitalisation projects.

The distinction based on international sales, innovation and digitalisation activity prior to the outbreak of the pandemic and, to a lesser degree, credit ratings thus shows that turnover losses often affected not just small businesses and those that were already struggling before the crisis (that were typically regarded as most vulnerable), but in particular those that were high performers. This observation is consistent with the findings of Coad et al. (2022), who determined that negative consequences of the pandemic were more likely to affect fast-growing enterprises and those that conducted R&D. With respect to the severity of the impacts, however, a mixed picture emerges. While enterprises that were conducting innovation and digitalisation activities before the outbreak of the pandemic or had a good credit rating experienced lower turnover losses, small and internationally active companies on average suffered higher turnover losses.

Further progression of the pandemic

As the crisis unfolded, the share of companies affected by sales slumps declined overall (Figure 1). This was likely due not just to the relaxation of restrictions but also in part to the government support measures and far-reaching adaptation measures undertaken by small and medium-sized enterprises, which likely had an immediate effect on their sales situation, ability to stay in business and financial scope. A large number of businesses implemented adaptation measures at the onset of the crisis. These involved the products and services offered – internal processes and sales channels, for example (Zimmermann, 2020a). Thus, digitalisation measures such as the expansion of remote working capacities and measures aimed at improving digital communication are also likely to have helped limit employee absences, stay in business and continue interacting better with customers and business partners overall.

Figure 3 shows how the number of companies affected by turnover losses among the groups of SMEs studied here developed over the course of the crisis. The recovery from the turnover slump that happened at the onset of the pandemic occurred almost in synchrony across all enterprise sizes, with progression rates differing only marginally between size classes. The share of enterprises with pandemic-induced turnover losses decreased by around 60% by September 2021. This almost parallel progression seems surprising at first glance, as though companies of different sizes were affected by turnover losses with similar frequency; yet the intensity of the impact was significantly higher in smaller enterprises. The fact that small companies recovered at a similar rate to large SMEs despite this higher degree of affectedness is due to their lower diversification.

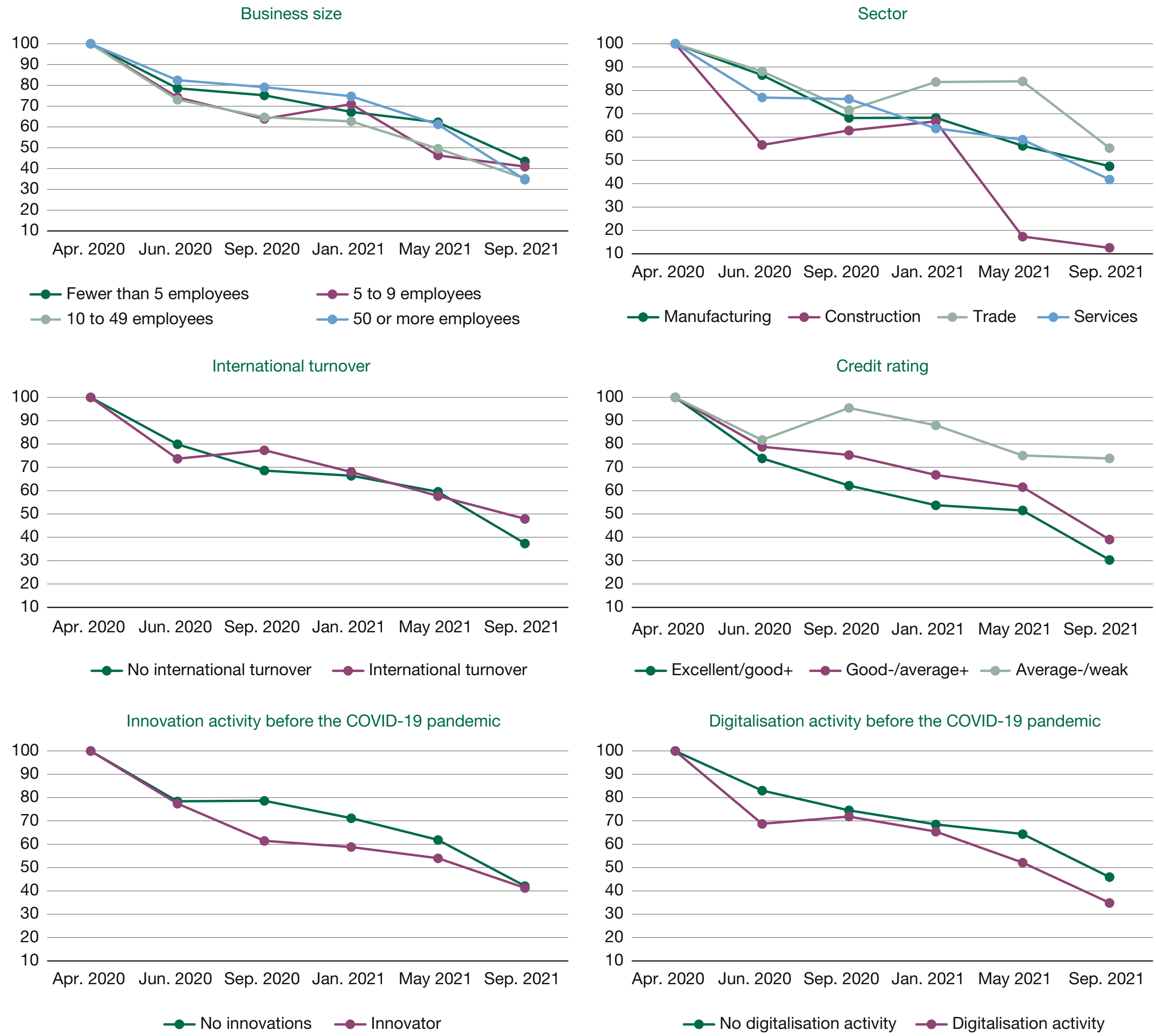
Enterprises of different economic sectors, on the other hand, are shown to exhibit significantly greater differences in the speed of recovery. In the construction sector, the recovery began early. Already in mid-2020, the share of enterprises suffering turnover losses in this group fell by 40%. A second stage of recovery began in the spring of 2021. With the share of companies impacted by turnover losses falling by 82% by September 2021, construction firms in particular emerged from the COVID-19 crisis much more quickly than businesses of all the other economic sectors investigated here. This observation is consistent with the fact that the vigorous construction activity in Germany continued throughout the course of the pandemic.

Companies in the trade sector are situated at the opposite end of the distribution. After a swift recovery during the summer of 2020, disruptions to turnover continued into the spring of 2021. This was likely due to the pandemic containment measures imposed in the retail sector during the renewed pandemic waves. Turnover losses continued in the winter of 2020/2021. It was not until the September 2021 survey that trading companies were able to catch up with manufacturers and service providers in terms of reducing the impact of the crisis. Enterprises in the two aforementioned sectors recovered almost in synchrony across the period under review. The measures adopted to overcome the crisis and the overall economic recovery had an effect here, reducing turnover losses. To be sure, pandemic-induced restrictions to business operations were in place for consumption-related services in the winter of 2021 as well. But these did not have a strong enough effect on the overall development in the services industries to become discernible in the aggregate view.

Across vast stretches of the period covered by the study, the recovery of enterprises with international sales also hardly differed from that of businesses without international sales. It is true that enterprises with international operations are typically larger than others, have a higher credit rating and are more likely to innovate and implement digitalisation measures (Zimmermann, 2021a, 2023). These factors would suggest a quicker recovery. However, the previously mentioned slump in global economic output and disruptions to supply chains – which are more often international for these firms – have likely hampered the recovery. At the end of the period covered by the study, enterprises without international sales actually performed somewhat better than internationally active ones, highlighting the important role of supply chain disruptions, which intensified again in the course of 2021 (Abel-Koch, 2022).

With respect to the credit rating, it was found that enterprises with a higher credit rating also recovered more quickly from the consequences of the outbreak of the pandemic in Germany. One likely reason for this is that

Figure 3
Number of SMEs in Germany affected by turnover losses during the COVID-19 pandemic
Relative decline in % compared with May 2020



Sources: KfW SME Panel, 1st to 6th supplementary coronavirus survey, own calculations.

while enterprises with a good credit rating were slightly more often affected by turnover losses in the spring of 2020, a higher credit rating also meant less severe turnover losses. Enterprises with a higher credit rating also likely had broader financial scope for implementing adaptation measures – particularly with regard to external finance. Not least, the fact that the rating score is also an indicator of business management quality (Peters et al., 2017) also likely played a major role. After all, the past and long-term business success of a company – on which a good credit rating is based – would not be achievable without high management quality. This factor in particular may also help make it easier to manage the COVID-19 crisis more successfully than would be possible for enterprises with less developed management skills. Those that had the highest credit rating in particular were the quickest to recover in the period under review. They were closely followed by companies in the group with a medium credit rating. The group of enterprises with a relatively low credit rating exhibited stronger fluctuations in crisis impact over the course of time. A significant weakening in impact did not set in until the spring of 2021. These enterprises therefore have much greater difficulties overcoming the crisis than those with a higher credit rating.

The impact of innovation activities

From mid-2020, enterprises that already innovated before the outbreak of the COVID-19 pandemic saw their turnover recover up to 17 percentage points faster from the consequences of the pandemic than those that did not innovate before the pandemic (September 2020). This indicates that a company's innovation activity significantly influences the way in which it manages a crisis.

Past studies already found that enterprises that were severely affected by the crisis and those that successfully innovated before the pandemic were more likely to undertake adaptation measures and innovate at the onset of the pandemic than those without innovation (Zimmermann, 2020a, 2020b). The higher frequency of innovation activity at the start of the pandemic by businesses that previously innovated shows that the ability to successfully respond to changes in the market situation is specific to the enterprise and closely linked to successful past innovation activity.

By May 2020, 27% of SMEs had completed innovation projects to manage the crisis (Zimmermann, 2020b). Figure 4 shows how these businesses further evolved. The development of these enterprises is compared with that of non-innovators and with those that innovated both before and at the onset of the crisis. From autumn of 2020, enterprises that innovated at the beginning of the pandemic were much less likely to suffer turnover losses than those that did not innovate. In the surveys of September 2020 and January 2021, the shares of businesses impacted by turnover losses were 13 percentage points and 17 percentage points lower (September 2020) and around 22 percentage points lower (January 2021) among innovators than non-innovators. Innovation thus clearly contributed to faster crisis management.

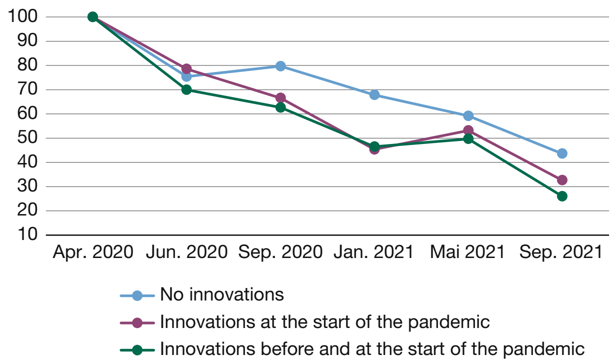
In the further course of the pandemic, the trajectories between innovators and non-innovators converged again slightly but without overlapping. This may be due to the fact that the boost from successful innovation activity is subsiding and some enterprises that innovated at the start did not continue with further innovations. This explanation is consistent with the observation that innovation activity among SMEs decreased as the pandemic progressed (Zimmermann, 2021b).

Enterprises that innovated at the onset of the pandemic and introduced innovations in-house before the pandemic

Figure 4

Impact of turnover losses on SMEs in Germany in the course of the pandemic by innovation activity

Relative variation in %



Sources: KfW SME Panel, 1st to 6th supplementary coronavirus survey, own calculations.

developed slightly more favourably over almost the entire period of the study than those that innovated only at the beginning of the crisis. The difference between the two groups of enterprises widened to 7% by September 2021. This finding can be explained by the fact that enterprises that innovated already before the pandemic were likely to be more experienced in successfully implementing innovation projects than other businesses. They were also likely to be more successful in improving their business situation by introducing innovations even under pandemic conditions (Brink et al., 2022). Another likely contributing factor is that businesses that have permanent processes in place for developing and introducing innovations, in particular, are more likely to continue or even grow such activities – even in a crisis situation – than other enterprises (Zimmermann, 2021b). The more positive development of these enterprises towards the end of the period covered by the study could therefore also be attributable to their continuous innovation activity during the entire pandemic duration.

Digitalisation activities and the pandemic

Digitalisation measures can also be seen as a helpful tool for managing the impact of the COVID-19 pandemic. For example, working from home was developed and expanded within a short period of time in response to the pandemic (Abel-Koch, 2020; Demmelhuber et al., 2020). Online transactions also increased strongly (Federal Statistical Office, 2020). The use of online trade, cashless payment systems, virtual communication forms and e-health services experienced strong growth. It was crucial for businesses to respond flexibly to decreasing demand and supply bottlenecks, to ensure distancing and remain visible for customers and cooperation partners. Under the pandemic conditions, digitalisation measures in particular were able to make a critical contribution to this development (Köhler-Geib and Zimmermann, 2022; Bertschek, 2020).

Digitalisation activities undertaken at the onset of the COVID-19 pandemic were not explicitly covered in the supplementary surveys of the KfW SME Panel. We therefore examine whether an enterprise completed digitalisation projects before the outbreak of the pandemic, specifically between 2017 and 2019. This information can be used as an approximation for determining that a business under consideration is familiar with the implementation of digitalisation projects. Furthermore, a previous study determined that enterprises that successfully completed digitalisation projects before the outbreak of the pandemic expanded their digitisation activities more frequently than other companies in the first year of the pandemic (Zimmermann, 2021c).

Figure 3 shows that enterprises with digitalisation activities recovered more quickly from the outbreak of the pandemic than those without. In June 2020, a 16 percentage points faster recovery can already be determined. After the gap narrowed in the autumn of 2020 and the winter of 2020/2021, it widened again to 12 percentage points (May 2021) and 11 percentage points (September 2021). In the second pandemic year, enterprises increasingly transitioned from acute crisis management to longer-term efforts and, in part, strategically oriented projects (Zimmermann, 2023). The more positive development of turnover experienced by digitally active enterprises at the end of the period may therefore be an indication that this allowed them to achieve a longer-lasting competitive advantage over those without digitalisation activities.

Financial capacity during the pandemic

To examine how the financial capacity of enterprises developed during the pandemic, we use the credit rating issued by Vereine Creditreform. This credit rating is based on information about financial status and liquidity (information reported in the annual statements), structural risks (sector, size and age of enterprise, productivity) and soft factors (payment history, volume of existing orders, order intake, management quality). Creditworthiness is measured on a scale of 100 to 600 points, with 100 representing the best achievable creditworthiness score, 500 being a massive default in payment and 600 the suspension of payments. For example, a rating index of between 250 and 299 points is defined as a 'medium credit rating' (Vereine Creditreform, n.d.). Credit ratings are updated in half-yearly intervals. Not only can the pandemic be expected to have had a direct impact on the credit ratings as a result of how business evolved and the potential need to use financial reserves to bridge liquidity bottlenecks, but it must be presumed that, especially over the course of the pandemic, the credit rating of enterprises was also influenced by possible borrowing and the use of state support measures provided to secure liquidity.

The average credit rating of enterprises dropped only marginally overall in the course of the pandemic. In January 2022, it was slightly more favourable (268.4) than in mid-2021 (269.9). Compared with the level before the outbreak of the pandemic, the credit rating score in January 2022 was a mere 4.1 points higher. A mild credit rating deterioration was also identified for almost all groups of enterprises examined here (Figure 5). The only exceptions were enterprises in the construction sector, which were only slightly affected by the pandemic, enterprises whose credit rating were relatively low before the pandemic and internationally active enterprises. For most of the groups of enterprises studied here, the changes in credit ratings occurred in a narrow corridor. Larger enterprises saw a moderately steeper decline in credit ratings than small businesses. With the exception of construction, the differences between sectors are negligible. The credit rating of enterprises that are typically counted among the higher performers, such as those with international turnover, innovators or enterprises with digitalisation activities, developed slightly more favourably than among businesses that did not have these activities. The credit ratings of companies that had a relatively low credit rating at the onset of the pandemic in particular deviate from this pattern. As the pandemic progressed, they experienced a noticeable improvement in their credit rating of almost 18 points. The likely reason for this was that the state support measures introduced in Germany for managing the crisis were aimed at preventing liquidity constraints and the departure of businesses from the market (without keeping those in business that were in financial distress already before the pandemic). The pandemic posed the greatest threat to companies whose credit rating was already lower before it broke out, so they likely signed up to corresponding support schemes more often than others.

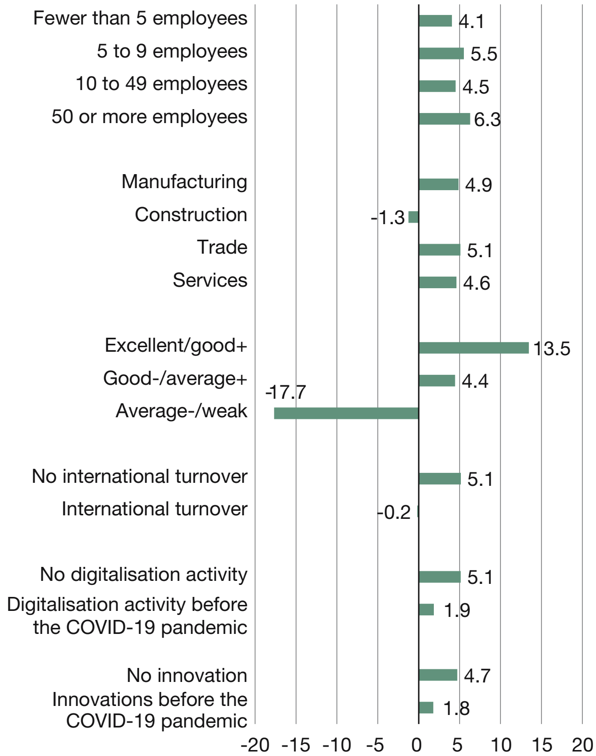
Conclusion

The SME sector broadly suffered from the consequences of the pandemic but the frequency, intensity and recovery varied between SME segments. A notable discovery is that enterprises typically regarded as high performers – such as innovative, digitally or internationally active enterprises or companies with a high credit rating – grappled with turnover losses more often than others at the onset of the pandemic but that their turnover losses were often less severe.

Figure 5

Credit ratings in the course of the COVID-19 pandemic in different groups of SMEs in Germany

Change in credit rating in index points (January 2022 vs. January 2020)



Sources: KfW SME Panel, own calculations.

Those enterprises were also characterised by the fact that, with the exception of internationally active companies, they recovered more quickly from turnover losses than others. This observation fits in with the ideas debated under the catchphrase “opportunity recognition”, which refers to the abilities of businesses to identify and capitalise on opportunities that present themselves. This ability is associated with particular personality traits of the entrepreneur but also with existing networks and the knowledge and skills previously acquired as an institution (Ardichvili et al., 2003; Kuckertz et al., 2017; Zouaghi et al., 2018). As this shows, enterprises that innovated and were digitally active before the pandemic and those that had a good credit rating in particular developed and successfully applied such skills in managing the crisis. Developing these skills thus played a crucial role in building the resilience of those enterprises.

The analysis of credit ratings over the course of the pandemic shows that the overall SME sector experienced only a minor credit rating downgrade. Credit ratings also moved in a narrow corridor among the groups of businesses covered by the study. It can therefore be concluded that in terms of financial capacity, SMEs emerged from the pandemic barely any weaker.

In addition to the crisis management measures adopted by enterprises, this is likely also the result of the extensive economic policy support measures that were introduced. In this context, it is remarkable that businesses with a relatively low credit rating in particular emerged stronger from the crisis. The principal aim of economic policymakers in Germany was to prevent liquidity bottlenecks and the closure of businesses that were financially healthy before the pandemic. The findings of the study indicate that the support measures successfully reached the intended target group. The fact that the wave of insolvencies feared by some observers (Gourinchas et al., 2021) did not occur (Federal Statistical Office, 2023) and that there is no sign of an increase in enterprises with critical debt sustainability levels (Schwartz, 2023) suggests that, on the one hand, there is no evidence of a “cleansing effect” from the pandemic in Germany. On the other hand, there is also no evidence that the support measures led to an artificial, support-induced continuation of unviable businesses.

These findings allow multiple lessons to be learned for both crisis stabilisation and structural economic policy measures. Whereas the COVID-19 pandemic illustrated once again that crises often emerge unexpectedly and differ significantly from previous crises in their causes, effects and progression, there are skills and abilities that strengthen the resilience of businesses to crises of all types. Enterprises that innovated or successfully completed digitalisation measures already before COVID-19 were affected slightly more by the pandemic but recovered faster. This indicates that innovation capacity and the application and development of digital technologies are either an expression of abilities that also facilitate the adaptation of the business to a crisis situation or strengthen its actual resilience to the crises. These abilities are inherent in enterprises and can be learned. This underscores the importance of economic policy measures aimed at promoting business innovations not just as structural policy but as stabilisation policy. A relevant starting point here is to strengthen the innovative power of small companies in particular, which often produce innovations without the use of R&D (Zimmermann, 2022). This group of businesses has recently received less innovation support. Based on the findings of this study, this trend needs to be reversed.

As innovative strength as well as the development and application of digital technologies are often hampered by a lack of skilled workers, this is a relevant starting point for strengthening crisis resilience. Promising approaches include measures aimed at bringing people into the workforce in Germany, for example by removing disincentives to the participation of women or by providing incentives for extending people's working life, targeted labour migration and measures aimed at increasing productivity such as training and continuing education or automation.

Finally, we found that very high-performing enterprises in particular were also heavily affected by the pandemic, leading to a decline in R&D and innovation activity. This is an indication that stabilisation policy must go beyond mitigating shocks for vulnerable groups to ensure that valuable companies can maintain their forward-looking activities. This is particularly the case in idiosyncratic shocks, that may otherwise entail a shift in a location's competitiveness.

References

Abel-Koch, J. (2020), Coronavirus crisis drives shift to flexible and digital working in SMEs, *Economics in Brief*, 197, KfW Research.

Abel-Koch, J. (2022), KfW Internationalisation Report 2022: Ukraine conflict exacerbates global supply bottlenecks and jeopardises recovery of German SMEs' foreign business, KfW Research.

Almeida, V., S. Barrios, M. Christl, S. De Poli, A. Tumino and W. van der Wielen (2021), The impact of COVID-19 on households' income in the EU, *The Journal of Economic Inequality*, 19(3), 413-431.

Ardichvili, A., R. Cardozo and S. Ray (2003), A theory of entrepreneurial opportunity identification and development, *Journal of Business venturing*, 18(1), 105-123.

Benedetti Fasil, C., C. Domnick, J.-C. del Rio, P. Fákó, F. Flachenecker, J. P. Gavigan, M. L. Janiri, B. Stamenov and G. Testa (2021), *High Growth Enterprises in the COVID-19 Crisis Context. Demographics, environmental innovations, digitalization, finance and policy measures*, EUR 30686 EN, Publications Office of the European Union.

Bertschek, I., M. Polder and P. Schulte (2019), ICT and resilience in times of crisis: evidence from cross-country micro moments data, Economics of Innovation and New Technology, 28(8), 759-774.

Bertschek, I. (2020), Digitalisierung – der Corona-Impfstoff für die Wirtschaft, *Wirtschaftsdienst*, 100(9), 653-656, https://www.wirtschaftsdienst.eu/inhalt/jahr/2020/heft/9/beitrag/digitalisierung-der-corona-impfstoff-fuer-die-wirtschaft.html (16 October 2023).

Bloom, N., P. Bunn, P. Mizen, P. Smietanka and G. Thwaites (2022), The Impact of Covid-19 on Productivity, *NBER Working Paper*, 28233.

Brink, S., S. Nielen and C. Schröder (2022), Die Auswirkungen der Innovationstätigkeit von KMU in Krisenzeiten auf ihre wirtschaftliche Entwicklung, *IfM-Materialien*, 296.

Brodeur, A., A. E. Clark, S. Fleche and N. Powdthavee (2021), COVID-19, lockdowns and well-being: Evidence from Google Trends, *Journal of Public Economics*, 193(2).

Coad, A., S. Amaral-Garcia, P. Bauer, C. Domnick, P. Harasztosi and M. Teruel (2022), Investment expectations by vulnerable European firms: A difference-in-difference approach, *EIB Working Papers*, 2022/04.

Dachs, B., M. Hud, C. Köhler and B. Peters (2017), Innovation, creative destruction and structural change: Firm-level evidence from European countries, *Industry and Innovation*, 24(4), 346-381.

Dachs, B. and B. Peters (2020), Covid-19-Krise und die erwarteten Auswirkungen auf F&E in Unternehmen, *ZEW Policy Brief*, 2.

del Rio-Chanona, R. M., P. Mealy, A. Pichler, F. Lafond and J. D. Farmer (2020), Supply and demand shocks in the COVID-19 pandemic: An industry and occupation perspective, *Oxford Review of Economic Policy*, 36, S94-S137.

Demmelhuber, K., F. Englmaier, F. Leiss, S. Möhrle, A. Peichl and T. Schröter (2020), Homeoffice vor und nach Corona: Auswirkungen und Geschlechterbetroffenheit, *ifo Schnelldienst digital*, 1(14), 1-4.

Federal Statistical Office (2023), Business notifications, insolvencies, Federal Statistical Office (Destatis), https://www.destatis.de/EN/Themes/Economic-Sectors-Enterprises/Enterprises/Business-Notifications-Insolvencies/_node.html#sprg229274 (30 March 2023).

Federal Statistical Office (2020, 8 May), Online-Transaktionen: Anstiege im zweistelligen Bereich seit Mitte März, Press Release, 161.

Gourinchas, P. O., Ş. Kalemli-Özcan, V. Penciakova and N. Sander (2021), COVID-19 and Small- and Medium-Sized Enterprises: A 2021 "Time Bomb"?, *NBER Working Paper*, 28418.

Köhler-Geib, F. and V. Zimmermann (2022), Die Auswirkungen der Coronapandemie auf die finanzielle Lage unterschiedlicher Gruppen von mittelständischen Unternehmen und deren Folgen für den Kreditzugang, *Vierteljahreshefte zur Wirtschaftsforschung*, 2 / 2021, 31-48.

Juergensen, J., J. Guimón and R. Narula (2020), European SMEs amidst the COVID-19 crisis: assessing impact and policy responses, *Journal of Industrial and Business Economics*, 47(3), 499-510.

Juranek, S., J. Paetzold, H. Winner and F. Zoutman (2021), Labor market effects of COVID-19 in Sweden and its neighbors: Evidence from novel administrative data, *Kyklos*, 74(4), 512-526.

Kozeniauskas, N., P. Moreira and C. Santos (2022), On the cleansing effect of recessions and government policy: Evidence from Covid-19, *European Economic Review*, 144, 104097.

Kuckertz, A., T. Kollmann, P. Krell and C. Stöckmann (2017), Understanding, differentiating, and measuring opportunity recognition and opportunity exploitation, *International Journal of Entrepreneurial Behavior & Research*, 23(1), 78-97.

OECD and Eurostat (2005), Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition, OECD Publishing.

Palomino, J. C., J. G. Rodríguez and R. Sebastian (2020), Wage inequality and poverty effects of lockdown and social distancing in Europe, *European Economic Review*, 129, 1-25.

Peters, B., M. S. Robert and V. A. Vuong (2017), Dynamic R&D Choice and the Impact of the Firm's Financial Strength, *Economics of Innovation and New Technology*, 26(1-2), 134-149.

Schwartz, M. (2022), KfW SME Panel 2022: SMEs have largely digested the pandemic but the war in Ukraine and the energy crisis are clouding the business outlook, KfW Research.

Schwartz, M. (2023), Don't be afraid of zombies: Debt sustainability is not a problem for 95% of SMEs, *Economics in Brief*, 234, KfW Research.

Schwartz, M. and J. Gerstenberger (2020), SMEs are firmly in the grip of the coronavirus crisis but (still) holding on strong, *Focus on Economics*, 286, KfW Research.

Vereine Creditreform (n.d.), Business information, Creditreform credit rating index.

Zimmermann, V. (2020a), SMEs are responding creatively to the coronavirus crisis, *Focus on Economics*, 291, KfW Research.

Zimmermann, V. (2020b), Innovation during the coronavirus crisis: necessity is the mother of invention, *Focus on Economics*, 295, KfW Research.

Zimmermann, V. (2021a), KfW SME Innovation Report 2020: Coronavirus crisis is slowing down innovation, KfW Research.

Zimmermann, V. (2021b), Coronavirus crisis is hampering innovation, digitalisation sees a mixed trend, *Focus on Economics*, 312, KfW Research.

Zimmermann, V. (2021c), KfW SME Digitalisation Report 2020: Digitalisation activity fell before Corona, ambivalent development during the crisis, KfW Research.

Zimmermann, V. (2022), Types of SMEs in the innovation system: activities, constraints and successes, *Focus on Economics*, 394, KfW Research.

Zimmermann, V. (2023), KfW SME Digitalisation Report 2022: The second year of the coronavirus pandemic brought a significant boost in digitalisation, but the divide between pioneers and latecomers threatens to widen, KfW Research.

Zouaghi, F., M. Sánchez and M. G. Martínez (2018), Did the global financial crisis impact firms' innovation performance? The role of internal and external knowledge capabilities in high and low tech industries, *Technological Forecasting and Social Change*, 132, 92-104.