

»» Business performance of different types of small and medium-sized innovators

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Three types of innovators can be identified among the group of small and medium-sized enterprises (SMEs). One group generates a significant portion of its innovation-related expertise from own research and development (R&D) or from scientific sources. In the remaining groups, innovations essentially are based on interactive learning within the enterprise and with its business environment.

This study examines whether there are any differences in business performance between the three innovator types. The focus here is on exploring whether innovators that rely on R&D and scientific findings develop better economically than the other two innovative groups.

The key finding of the analysis is that R&D-based innovators indeed achieve higher growth rates and so are more likely to be found among the group of fast-growing enterprises. However, if we disregard enterprises with extremely high growth rates, there is hardly a difference in business performance between the three groups. This applies to both turnover growth and employment growth.

As long as an enterprise strives to achieve moderate business growth, whether it conducts own R&D or not is therefore not relevant for its growth. For the vast majority of SMEs it is therefore not a disadvantage if they do not conduct R&D or use scientific findings for their own innovation activity. Instead, SMEs can be successful innovators even without own R&D and without making use of scientific findings. This indicates that support measures for SMEs in the field of innovation should go beyond a narrow R&D focus and also address enterprises' general innovative capacity.

Innovation is generally regarded as a source of business success and business growth. This study examines how different types of innovative small and medium-sized enterprises achieve different degrees of business performance.¹ The analysis was conducted on the basis of the 2017 survey of the KfW SME Panel.

Three types of innovators

The first step was to identify different types of innovators. This was guided by a theoretical approach based on the distinction into the modes of 'Learning by Doing, Using and Interacting (DUI)' and the 'Science, Technology and Innovation (STI)' (Box 1: Two ways of generating

innovations). These two ways of generating innovations differ essentially according to whether the enterprises acquire the knowledge they need for innovation through informal, experiential processes of learning and understanding (DUI mode) or through systematic and formalised research and development (R&D) activity (STI mode). The work of identifying various innovator types with the aid of statistical methods arrived at the conclusion that three types of innovators exist among small and medium-sized enterprises (SMEs) which differ in terms of the role of internal R&D and other characteristics.

The first group of innovators uses a high degree of industry-specific practical knowledge for their innovation activity. Own R&D, by contrast, hardly plays a role for their innovations. This innovator type can therefore be assigned to the DUI mode. Enterprises of this type make relatively little effort to innovate. This is true in monetary terms – but also in regard to the interactions within the enterprise and with its business environment. The main innovative impetus comes from suppliers, trade fairs and trade publications. This type of innovator is therefore referred to as 'innovators specialising in industry expertise'.

The second group of innovators is characterised by high innovation activity but only a small portion of it consists of R&D. To this end, these innovators mainly draw on their proximity to their customers as a source of innovation. Besides, these enterprises learn from a wide range of internal interactions and a well-developed in-house error management culture. This type can also be assigned to the DUI mode, although these enterprises also possess certain STI skills. Because of the high significance of knowledge gained from the sales market, these enterprises are referred to as 'sales market oriented innovators'.

Box 1: Two ways of generating innovations

The economic literature distinguishes between two different modes of generating innovations.² The first mode is based on R&D, which is typically performed by dedicated departments within the company. It involves generating new scientific-technical knowledge with the aid of systematic and formalised activities. This new knowledge – supplemented where necessary by scientific findings obtained outside the enterprise – forms the basis for generating innovations in the R&D-oriented mode that carries the label 'Science, Technology and Innovation (STI) mode'.

The second mode, by contrast, is based on experiential skills acquired through ‘Learning by Doing, Using and Interacting’ (DUI mode). Given the key importance of practical skills, informal processes of learning and understanding dominate here in the generation of innovations. Innovations result from the normal production process or through the employees’ interaction within the enterprise and with the business environment. The ability to generate innovations therefore is strongly based on accumulated, practical and personal experiential knowledge.

In practice, however, enterprises often do not concentrate solely on any particular mode of generating knowledge but usually combine elements of both types of innovation with varying intensity.

The third group of innovators builds its innovations primarily on own R&D and scientific findings. They also use information from the business environment (e.g. universities and other research facilities), intensive in-company knowledge exchange, a pronounced error management culture and management practices aimed at stimulating innovation activity. This type of enterprise thus combines knowledge generated through the STI mode with the approach followed under the DUI mode. In the following we therefore refer to it as the ‘STI/DUI combiner’. The results of this study and the methodology applied for this categorisation have already been published in a study conducted by KfW Research.³

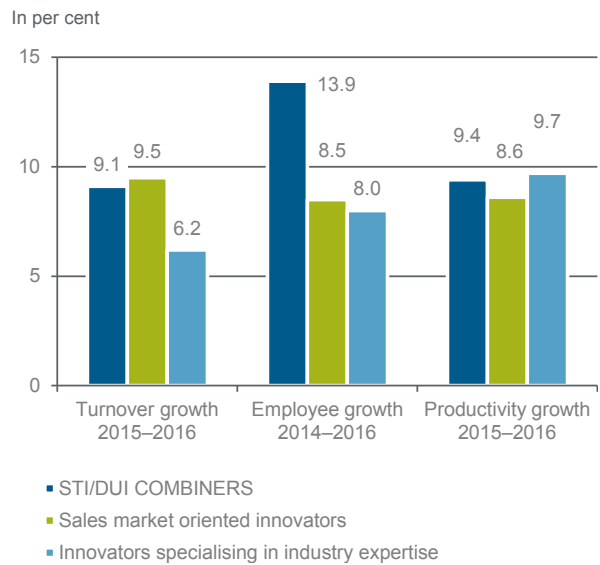
Analysis of business performance with the aid of statistical methods

Business performance was analysed using two multivariate methods. One of them was the least squares regression, which involved examining how the performance of innovator types differs on average.⁴ The other was the quantile regression method, which enables the measurement of performance differences between the innovator types at any given stage of growth distribution. For example, it can be established whether performance differences tend to be more prevalent in shrinking or in fast-growing enterprises (Box 2: Dataset and methodology). Performance is measured on the basis of turnover and employment growth as well as productivity⁵ development.

All innovator types exhibit high performance

On average, business performance is high in all innovator types (Figure 1).⁶ Turnover growth is nearly equal for both the ‘sales oriented innovators’ and the ‘STI/DUI combiners’, with rates of slightly above 9%. The growth rate of ‘innovators specialising in industry expertise’ is lower at 6.2%. With respect to employment growth, ‘STI/DUI combiners’ stand out from the other innovator types. At 13.9% they achieve significantly stronger employment growth than the other two categories, where growth is around 8%. Finally, productivity development is relatively similar across all three groups, with rates ranging from 8.6 to 9.7%.

Figure 1: Performance of innovator types



Note: Model calculations for a typical enterprise based on the regression results from Table 1.

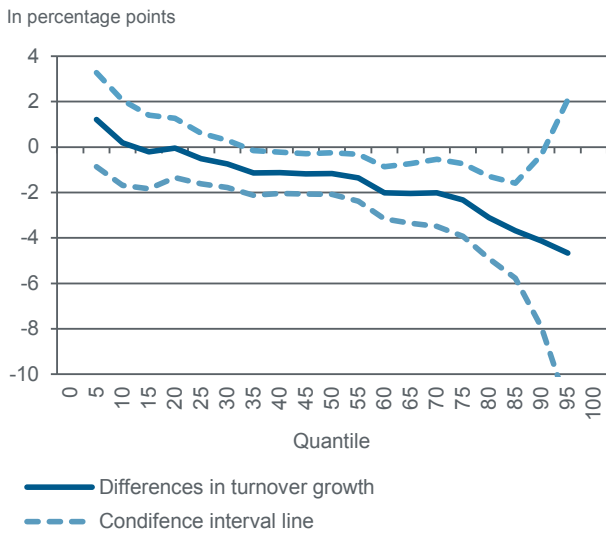
Source: KfW SME Panel 2017, own calculations

Growth differences primarily among fast-growing enterprises

Figure 2 shows the differences in turnover growth between the ‘STI/DUI combiners’ and the ‘sales market oriented innovators’. The ‘STI/DUI combiners’ serve as a basis of reference in the following evaluations. Turnover growth hardly differs between the two groups in the lower range of the distribution. Up to the 20% quartile, the line that denotes the difference in turnover growth between the two groups runs along the zero line or slightly above it. It is only from the 60% quartile, which corresponds to an annual turnover growth of just under 8% for the overall sample, that this difference drops to -2 percentage points. From the 75% quartile (around 13% turnover growth) the growth rate achieved by the ‘sales market oriented innovators’ is increasingly lower than that of the ‘STI/DUI innovators’. The growth difference widens up to a value of -4.6 percentage points.

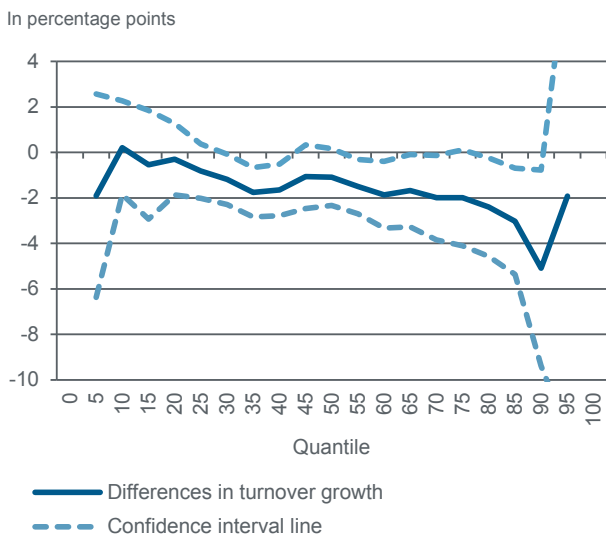
Figure 3 also largely confirms this finding for the differences in turnover growth between the ‘innovators specialising in industry expertise’ and the ‘STI/DUI combiners’. Here, the line that denotes the growth difference drops from the 20% quartile to a difference of -2 percentage points before rising again; only from the 75% quartile does it drop significantly below the value of -2 percentage points. Here, too, major differences in turnover growth exist only where growth rates are relatively high.⁷ The limit of the confidence interval confirms this as well. Up to the 75% quartile the limit of the confidence interval mostly touches or overlaps the zero line. This demonstrates that the measured differences lie in the uncertainty area of the analysis and are not significant in a statistical sense.

Figure 2: Differences in turnover growth between ‘STI/DUI combiners’ and ‘sales market oriented innovators’



Source: KfW SME Panel 2017, own calculations

Figure 3: Differences in turnover growth between ‘STI/DUI combiners’ and ‘innovators specialising in industry expertise’



Source: KfW SME Panel 2017, own calculations

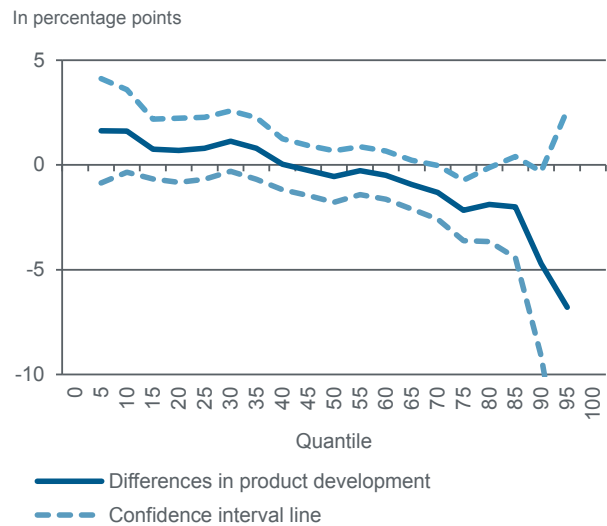
This progression is even more pronounced with respect to employment growth (Figures 6 and 7 in the annex). From the bracket of the 60 or 70% quartile (employment growth between 8 and 14%) the growth rates of the innovators that do not rely on the STI mode drop significantly. Up to that point they have developed nearly in parallel with the ‘STI/DUI combiners’ towards these performance quantiles.

No differences in productivity development

The analysis of productivity development across the distribution confirms the findings of Figure 1. Both the difference between ‘STI/DUI combiners’ and ‘sales market oriented innovators’ and the difference between the former and ‘innovators specialising in industry expertise’ runs near the zero line across vast stretches (Figure 4 and Figure 5). Only the productivity development of the ‘sales market

oriented innovators’ drops sharply from the 85% quartile compared with the ‘STI/DUI combiners’. However, the confidence bands in both figures overlap the zero line across almost the entire range. The measured differences are thus within the area of uncertainty of the analysis. They are not significant in a statistical sense.

Figure 4: Differences in productivity development between ‘STI/DUI combiners’ and ‘sales market oriented innovators’



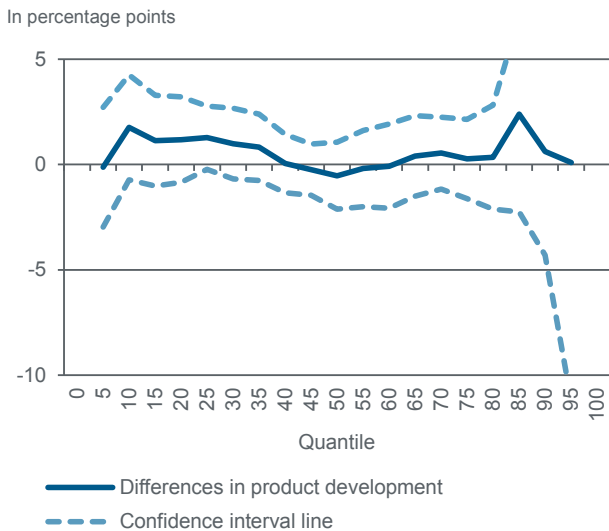
Source: KfW SME Panel 2017, own calculations

Conclusion

Three types of innovators can be identified in Germany’s small and medium-sized enterprises (SMEs). These three groups of enterprises differ in business performance only in the range of exceptionally high business growth. This applies to both turnover growth and employment growth. In the upper range of growth distribution the innovators that generate their innovation-relevant expertise from own R&D or external scientific sources perform better than the other two innovator types. Across broad stretches of growth distribution, however, there are no significant differences. With regard to productivity development, no performance differences can generally be established between the three innovator types.

In summary, this finding can be taken to mean that SMEs which undertake R&D are more often fast-growing enterprises. In the range of low to medium growth rates, however, there are no differences between SMEs that conduct R&D and those that do not. It is therefore not relevant for the economic success of an innovative enterprise whether it conducts own R&D or not so long as it strives to achieve moderate business growth. This shows that it is not a disadvantage for the bulk of SMEs to not undertake R&D. On the contrary, SMEs can be successful innovators even without own R&D. This shows the relevance of support measures for SMEs in the field of innovation that go beyond a narrow R&D focus and address small enterprises’ general innovative capacity.⁸ ■

Figure 5: Differences in productivity development between ‘STI/DUI combiners’ and ‘innovators specialising in industry expertise’



Source: KfW SME Panel 2017, own calculations

Box 2: Dataset and methodology

The analysis is based on the survey of the KfW SME Panel from the year 2017. This survey covered a wide range of questions on the basis of which the sources of knowledge for innovations in the SME sector can be described. The first step was to identify different types of innovators with the aid of a cluster analysis. The second step was the analysis of the business performance presented here.

The performance analysis was conducted using two different methods. The performance differences were measured using the least squares regression method based on the mean value of growth distribution. The quantile regressions method was also applied,⁹ enabling a more complete picture to be drawn. The performance differences can thus be established in any given quantile of the growth distribution. For example, it can be established whether performance differences are rather more prevalent in shrinking, moderately growing or fast-growing enterprises.

In both methods the differences in performance are adjusted for further factors such as enterprise size and age, industry in which it operates, international sales, employment of graduates, etc. (Table 1). Performance is measured on the basis of turnover growth from 2015 to 2016, employment growth between 2014 and 2016 and productivity growth from 2015 to 2016. Productivity development is defined as labour productivity (= annual turnover per employee in full-time equivalents¹⁰).

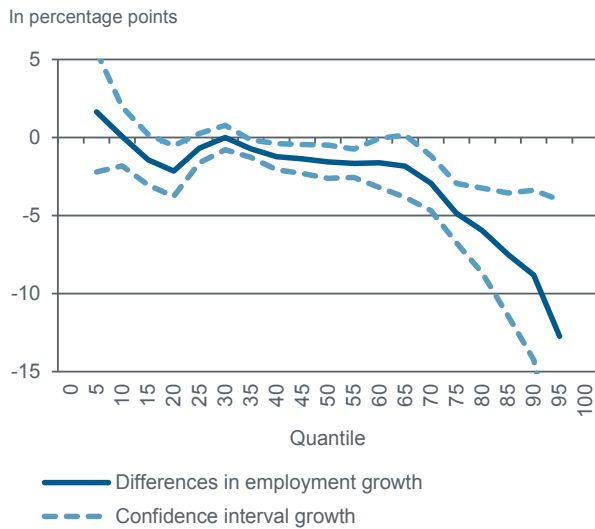
Table: Business performance of innovators Findings of least squares regressions

	Turnover growth	Employment growth	Development of labour productivity
Innovator type (reference category: STI/DUI combiners)			
Sales market oriented innovators	0.388 (1.93)	-5.339 (1.58)***	-0.840 (1.74)
Innovators specialising in industry expertise	-2.941 (1.70) *	-5.857 (2.12) ***	0.244 (2.19)
Log (employees)	-3.627 (1.01) ***	-3.680 (0.99) ***	-2.567 (0.774) ***
Log (age)	-7.013 (1.39) ***	-8.719 (1.24) ***	-4.484 (1.08) ***
Share of graduates	0.132 (0.073)*	0.030 (0.036)	0.038 (0.05)
International sales	-2.663 (2.33)	0.884 (1.68)	-3.180 (1.78) *
Economic sector (reference category: manufacturing)			
Construction	-1.528 (2.74)	1.354 (2.61)	-3.666 (2.45)
Retail	-4.614 (2.25) **	2.025 (2.030)	-6.615 (1.74) ***
Services	-4.225 (2.99)	-2.675 (2.17)	-2.971 (2.48)
Other economic sectors	21.661 (28.45)	-5.997 (4.50)	10.877 (18.11)
Legal form: Limited liability	4.523 (2.26) **	1.805 (2.38)	0.957 (2.16)
Group affiliation: Subsidiaries	2.826 (2.79)	2.619 (2.00)	0.903 (1.89)
Region of registered office: Eastern Germany	-5.126 (2.43) **	-5.028 (1.65) ***	-1.736 (1.85)
KfW support status: supported	1.454 (2.04)	1.334 (1.711)	1.883 (1.62)
Constant	42.489 (7.05) ***	53.100 (5.92) ***	31.53 (5.61)
F-statistics	3.50 ***	8.03 ***	3.00 ***
Number of observations	2,356	2,487	2,327

Note: *** significance level of 1%; ** significance level of 5%; * significance level of 10%; robust standard errors in brackets

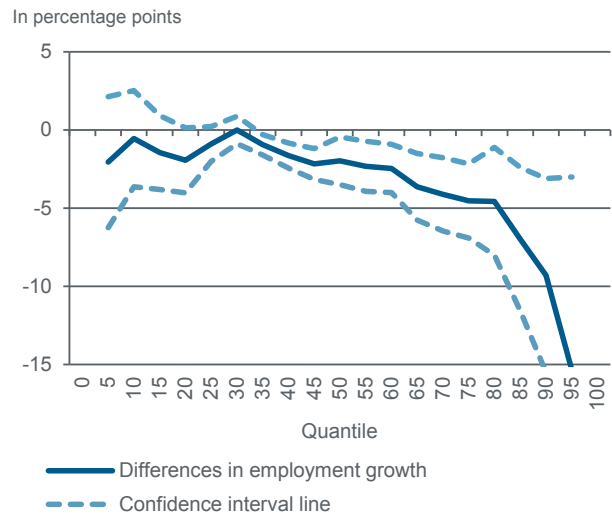
Source: KfW SME Panel 2017, own calculations

Figure 6: Differences in employment growth between ‘STI/DUI combiners’ and ‘sales market oriented innovators’



Source: KfW SME Panel 2017, own calculations

Figure 7: Variation of employment growth between ‘STI/DUI combiners’ and ‘innovators specialising in industry expertise’



Source: KfW SME Panel 2017, own calculations

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¹ Cf. Thomä, J. and Zimmermann, V. (2019): Non-R&D, interactive learning and economic performance: Revisiting innovation in small and medium enterprises, ifh Working Paper No. 17/2019.

² Cf. Jensen, M. B.; Johnson, B; Lorenz, E. and Lundval, B. A. (2007): Forms of knowledge and modes of innovation; Research Policy 36(5): p. 680-693 and Thomä, J. (2017): DUI mode learning and barriers to innovation - A case from Germany. Research Policy 46 (7), p. 1327–1339

³ Cf. Zimmermann, V. and J. Thomä: (2019): **Interactive learning or R&D: How do small and medium-sized enterprises generate innovations?** Focus on Economics No. 264, KfW Research. ⁴ The least squares regression measures the performance differences based on the mean value of growth distribution.

⁵ Productivity development is defined as labour productivity (= annual turnover per employee in full-time equivalents).

⁶ The values refer to an enterprise that is typical of the sample. This is defined as follows: The enterprise has 40.5 employees (in full-time equivalents) and has been operating for 40.8 years. These values represent the mean in the sample. It belongs to the manufacturing sector, is not part of a group, does not employ any graduates and does not generate any international turnover. Moreover, because of its legal status the enterprise does not have limited liability, has never received financial support from KfW and is domiciled in western Germany.

⁷ The measured difference does not prove to be statistically significant across broad stretches of the distribution either. This can be seen from the fact that the confidence interval crosses the zero line.

⁸ 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.

⁹ Cf. Koeneker and Bassett (1978): Regression Quantiles, Econometrica 46, p. 33–50.

¹⁰ 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.