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Mechanical engineering: medium-sized companies with highest savings potential

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The German mechanical engineering industry, dominated by medium-sized companies, is greatly successful—both on the domestic and on the international market. A first analysis conducted by DIW Berlin reveals that this success cannot be attributed to a better exploitation of potential efficiencies—mechanical engineering is about as efficient as other key sectors (for instance the chemical industry). In fact, despite their obvious success medium-sized mechanical engineering businesses have larger savings potential than bigger companies and even than smaller enterprises in this industry.

Mechanical engineering remains one of the pillars of the German economy. Measured in gross value added until the year of 2006, as a comparative tool, mechanical engineering has a top position among the country's manufacturing industries. Furthermore, mechanical engineering drives German exports. By 2006, the industry had doubled its export volume within a decade.

Interestingly enough, the sector's growth between 1995 and 2006 went hand in hand with a simultaneous drop in the number of large mechanical engineering companies. At the same time, the number of small and medium-sized enterprises experienced a significant boost. All in all, the industry's restructuring process cut employment by around ten per cent, although the overall number of businesses in the sector rose by eight per cent during the test period.[1]

Therefore, we analyze in this report i) whether the economic success of mechanical engineering can be attributed to an exceptionally efficient use of resources, ii) whether medium-sized companies have a particularly efficient production given the above-mentioned structural changes, and iii) whether this industry was able to increase its performance and efficiency over the test period?

Expanding industry and declining employment

A first glance at the gross value added reveals the importance of the mechanical engineering industry. In 2006, the sector produced goods worth 74 billion euros or approx. 15 per cent of the manufacturing industry's total gross val-

1 Calculations by DIW Berlin based on Fachserie 4.1.1. of the Federal Statistical Office.

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C40, L60

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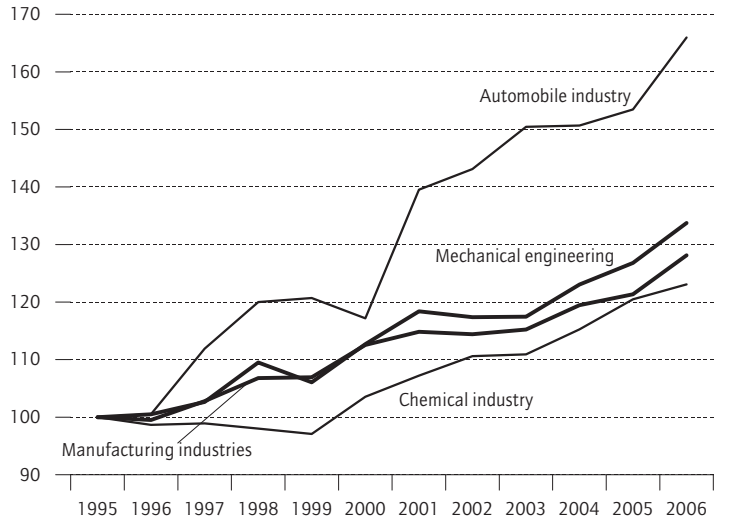
Figure 1

Gross value added in the manufacturing industries

Index 1995 = 100



Source: Federal Statistical Office. DIW Berlin 2010

ue.[2] In a ranking of manufacturing sectors, mechanical engineering comes second place—ahead of metal production and metal working (14 per cent) and the chemical industry (10 per cent). With 17 per cent, only the automobile industry continues to be the leading industry. Moreover, the success of mechanical engineering shows similar figures for the last ten years: between 1995 and 2006, the value of the sector's manufactured products rose by around 34 per cent, while the average growth of all manufacturing industries reached 28 per cent. Again, among the key sectors of the German industry only the automobile industry demonstrated higher growth rates (Figure 1).

The development of exports also serves to underline the importance of mechanical engineering for the German economy. In 2006, mechanical engineering accounted for approx. 13 per cent of all German exports and played a major role in helping Germany to regain the title of export champion at least in that year. Again, only the automobile industry contributed a larger export share (at 16 per cent), while the chemical industry remained the third pillar of German exports with 12 per cent of the country's total export production. This export success was boosted by a lasting positive trend on the global markets—as a result, mechanical engineering exports more than doubled between 1995 and 2006.

The crucial role of the industry is also reflected in the employment statistics. In 2006, the mechanical engineering sector employed almost one million people. With around 16 per cent of all employees, mechanical engineering overrides even the automobile industry (13 per cent) and the chemical industry (eight per cent), making mechanical engineering a particularly labour-intensive line of business in the manufacturing sector.

Another factor is still more important: the actual composition of the mechanical engineering industry differs from that of Germany's two other export pillars. While the automobile and the chemical industry have a large share of their workforce (80 per cent the former and 60 per cent the latter) employed by companies with more than 500 employees, this holds only for 37 per cent of all employees in mechanical engineering.

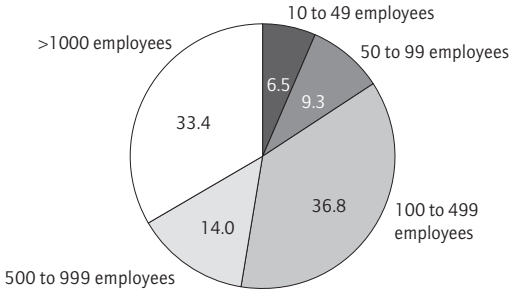
Sales percentages across the different company size classes confirm this unique industry structure. In mechanical engineering, large corporations generated approx. 33 per cent of the industry's overall sales volumes in 2006. In comparison, large companies achieve sales shares of 81 per cent in the automobile industry and account for 47 per cent of all sales in the chemical industry. In mechanical engineering, on the other hand, medium-sized companies, i. e. enterprises with more than 50 employees, not only make up 53 per cent of all companies in their segment, but also generate 60 per cent of the industry's total sales—more than most other sectors in the manufacturing industries. In terms of sheer numbers, small companies still make up the largest share—around 45 per cent of all businesses in mechanical engineering—yet they only contribute 6.5 per cent to the industry's total sales, an outcome in line with the sales distribution of other industries (Figure 2).

In terms of total employment, mechanical engineering has experienced a decline over the years, a development which can be observed in all manufacturing industries (Figure 3). Between 1995 and 2006, employment decreased by around ten per cent, reflecting the broader trend across manufacturing. However, statistics highlight differing dynamics within the industry. While employment figures at companies with 500 to 999 employees decreased by around 28 per cent and large corporations with more than 1 000 employees reported reductions of approx. 18 per cent, small (10 to 49 employees) and small-to-medium (50 to 99 employees) companies experienced employment growth rates of 13 and 9 per cent respectively.

2 Calculations by DIW Berlin based on official data available on the national accounts.

Figure 2

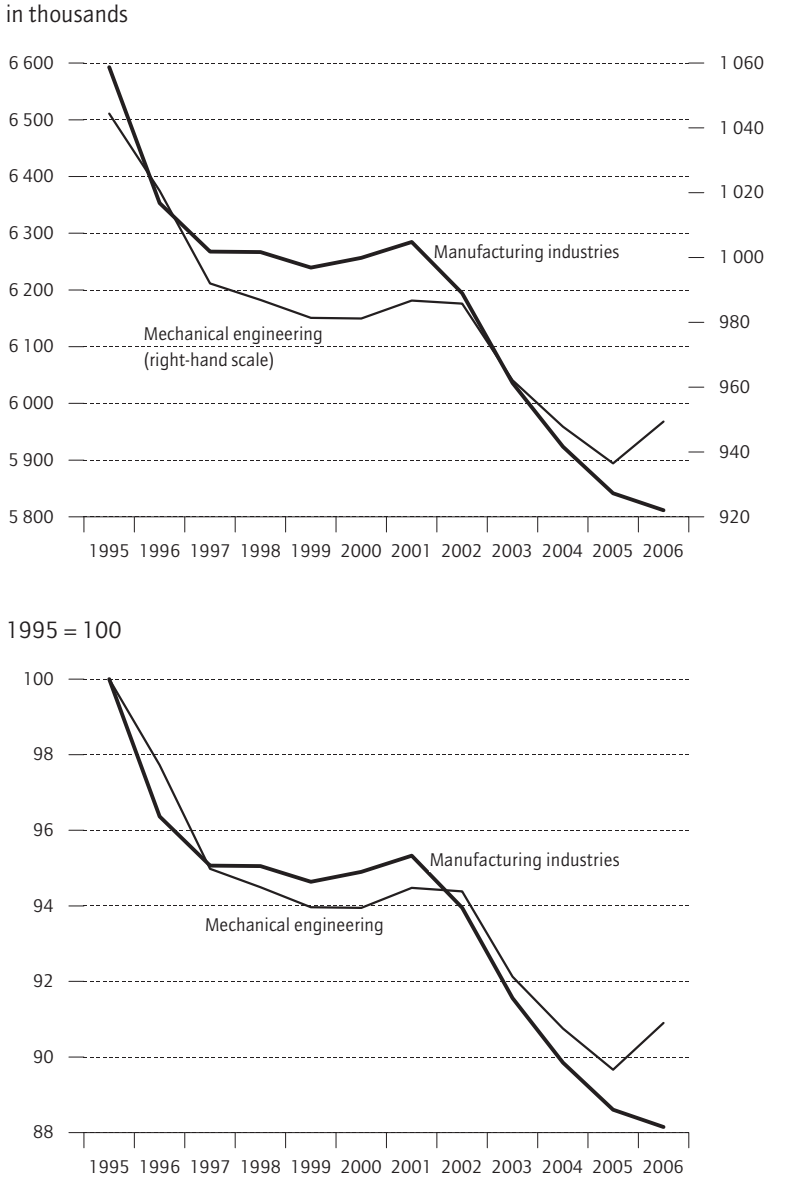
Percentage of sales in mechanical engineering by company size



Source: Federal Statistical Office, Fachserie 4, series 4.1.2. DIW Berlin 2010

Figure 3

Employees in mechanical engineering and the manufacturing industries



Source: Federal Statistical Office, Fachserie 4, series 4.1.1. DIW Berlin 2010

This trend was backed by a rise in the number of small businesses (18 per cent) and a simultaneous drop of large-scale manufacturers (14 per cent). Medium-sized companies went through diverging developments: while the number of enterprises with 50 to 99 employees grew by 10 per cent, the number of companies with 500 to 999 employees dropped by almost 26 per cent.

Moreover, within the above-mentioned categories the average size of a business—measured by the average number of employees—also decreased. At 3.9 percentage points, the drop was most marked in small businesses, while the least affected company size, companies with 50 to 99 employees, dropped only by 1.2 per cent. In all other categories the average size decreased by at least two per cent. That means that the growing share of employees who is working in small and small-to-medium sized companies can be explained by an actual increase in the total number of companies and not by an increase of staff within the companies.

Savings potential across the industry …

Given the positive growth trend and given the observed structural changes in mechanical engineering we will investigate three issues:

- To what extent is it possible to attribute the industry's positive development to an efficient use of resources?
- Are medium-sized companies in mechanical engineering more efficient than other companies?
- Does the drop in employment figures indicate that the performance of the companies increased over the test period?

The following analysis is based on firm micro data from the cost structure survey processed by the Federal Statistical Office (1995 to 2006). The data were examined by means of the data envelopment analysis, a particularly useful type of efficiency analysis (see insert) which is employed to determine the technical efficiency of individual companies. To

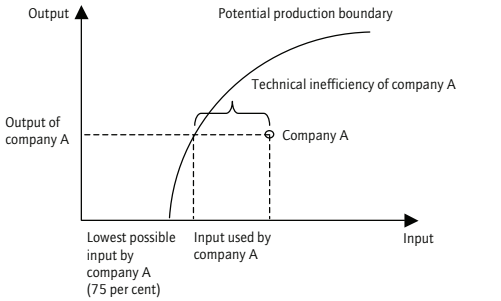
Text box

The efficiency analysis

The efficiency analysis is a method used to evaluate the productive efficiency of a company. Here, productive efficiency describes a company's ability to produce a given product volume with a minimum of resources or, alternatively, the maximum possible product volume at a given set of resource input.

Figure

Technical efficiency



Source: chart by DIW Berlin. DIW Berlin 2010

This is accomplished by means of a data envelopment analysis (DEA), one of the main methods of efficiency analysis – in this particular case employed to determine a company's so-called technical efficiency. Technical efficiency denotes the share by which inputs could be reduced without affecting output volumes (Figure 1).

In the following example, company A produces a given output, determined by market demands or other factors. In this particular case, the company utilises more input than strictly necessary according to the boundary (frontier) of the production possibility set. The frontier is determined by all available observations, i. e. its level and gradient is governed by the input/output relationship of comparable companies. Thus, the analysis follows a benchmarking approach.

The amount of the observed inefficiency is measured as the distance between the company's input and its potential input on the frontier. To this end, we calculate the relationship between the best possible input and actual input volumes, resulting in a technical inefficiency value between 0 (completely inefficient) and 1 (complete efficient). A company with an efficiency value of 1 operates at the optimum of input utilisation efficiency and therefore sets the potential production boundary. Values below 1 demonstrate the extent by which a company could reduce its production inputs without affecting its output volumes. In our given example, an efficiency value of 0.75 means that company A could reduce its input by a quarter.

this end, the company's output is contrasted with the resources it uses to generate its output. The resulting efficiency value highlights the company's savings potential in terms of production factors compared with the best companies of the same class size. The efficiency analysis thus enables a direct performance comparison between similar-sized companies in the same industry.[3]

First of all, the analysis reveals that—over the test period—the average technical efficiency of all companies is a lot lower than expected, considering their economic success. On average, companies could potentially save between a quarter and a third of their input resources. This finding correlates with similar levels in the chemical industry.[4] Against this background, the economic success of mechanical engineering cannot be attributed to an exceptionally efficient use of resources.

… but especially in medium-sized companies

When asking which companies use their resources in the most efficient way, we arrive at a remarkable result. First of all, large corporations tend to do better than the rest of the field. However, and this is surprising, there is no linear relationship between company sizes and technical efficiency. On average, small businesses are not the least efficient, but claim second place after large corporations. Medium-sized companies are subdivided: the largest among them (with 500 to 999 employees) still achieve better than industry-average results, while the medium-sized firms (100 to 499 employees) operate at average efficiencies and the smallest companies of the medium-size class (50 to 99 employees) end up with the lowest efficiency values across the scale. As a result, there is a U-shaped relation between company size and efficient use of input resources and the particular importance of medium-sized mechanical engineering businesses cannot be attributed to an above-average use of existing production capabilities.

3 For further investigations of this particular topic, see Schiersch, A.: Inefficiency in the German Mechanical Engineering Sector. Discussion paper by DIW Berlin no. 949, 2009.

4 Badunenko, O.: Small is beautiful: Deutsche Chemieunternehmen schrumpfen sich produktiv. (German chemical companies slim down for productivity) Wochenbericht des DIW Berlin no. 32/2009.

One might expect that these companies have then made efforts to improve the efficient use of their resources over the test period. A glance at the technical efficiency development across the industry reveals that between 1995 and 2006 efficiency values remained more or less the same. While this demonstrates that the companies have undertaken all necessary steps and adjustments to participate in technical advances and keep up with the latest technologies, it also shows that the industry has not made full use of its existing potential for efficiency improvements.

Looking at the development between 1995 and 2006 reveals that there are large efficiency disparities at medium-sized companies. Here, the average technical efficiency of all medium-sized companies with more than 100 employees rose by around two per cent. At the same time, the average efficiency of businesses with 50 to 99 employees—which had already the lowest efficiency scores in 1995 –dropped by three per cent. Thus, during the test period, the U-shaped relationship between company size and efficient use of resources became even more pronounced.

Conclusion

Mechanical engineering remains to be one of the key pillars of the German manufacturing industries. This, however, cannot be assigned to a particularly efficient use of input resources. In fact, mechanical engineering is no more efficient than for instance the chemical industry. Nevertheless, companies have implemented the necessary changes to participate in technical advances and keep up with technological developments.

Unlike the chemical or the automobile industry, mechanical engineering is dominated by medium-sized companies. Their relatively strong standing, however, cannot be explained by a more efficient use of production capabilities. In fact, they are actually among those having the largest savings potential. Our study reveals an U-shaped relation between company size and efficient use of input resources.

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