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The productivity puzzle in business services*

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ABSTRACT

In Germany, the productivity of professional services, a sector dominated by micro and small firms, declined by 40 percent between 1995 and 2014. This productivity decline also holds true for professional services in other European countries. Using a German firm-level dataset of 700,000 observations between 2003 and 2017, we analyze this largely uncovered phenomenon among professional services, the 4th largest sector in the EU15 business economy, which provide important intermediate services for the rest of the economy. We show that changes in the value chain explain about half of the decline and the increase in part-time employment is a further minor part of the decline. In contrast to expectations, the entry of micro and small firms, despite their lower productivity levels, is not responsible for the decline. We also cannot confirm the conjecture that weakening competition allows unproductive firms to remain in the market.

Keywords: business services, labor productivity, productivity slowdown
JEL Codes: L84, O47, D24, L11

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1. Introduction

The decline in labor productivity growth has become a central puzzle of the slowed economic progress in many industrialized countries. The potential reasons range from a lack of competition (De Loecker et al., 2020), mismeasurement (Syverson, 2017; Byrne et al., 2016), a lack of knowledge diffusion (Andrews et al., 2015, 2016, 2019), to the structural changes toward more services (Hartwig and Krämer, 2019; Duernecker et al., 2016; Nordhaus, 2015; Oulton, 2013, 2001). In this context, the productivity development of one major part of the service sector, professional services, an industry dominated by micro and small firms, stands out: professional services not only experienced a reduction in labor productivity growth, but a severe drop in productivity over two decades. This decline is observable in several continental European countries and amounts, *inter alia*, to 40 percent in Germany in the 1995 to 2014 period before it started to slightly recover.

This dramatic decline is worrying for various reasons. Professional services have a considerable economic weight. With a growth of almost 50% in the number of persons employed since the millennium, this sector shows a substantial growth among all sections of the European business economy.[1] Thus, they are particularly important for the labor market. Furthermore, nearly 10 percent of total value added of the business economy is produced by professional services, which makes them the fourth largest sector in the EU15 by 2017. Moreover, as the professional services provides important intermediate inputs to the whole economy, negative productivity effects in this sector have critical repercussions for the productivity of the rest of the economy.

This study is, to the best of our knowledge, the first to empirically assess various potential causes for the productivity decline in professional services. Thus, it adds to the understanding of the overall slowdown in productivity growth. Specifically, we analyze whether, and to what extent, *composition* and *competition* effects are the driving forces behind the falling labor productivity. The former includes changes in the workforce, the vertical supply chain, and the firm size composition of the sector. During the observation period, professional services experienced a massive entry of small and micro firms. At the same time, empirical studies show that micro and small firms have lower productivity levels than large firms (Medrano-Adán et al., 2019; Moral-Benito, 2018). Therefore, we study whether the growing number of micro and small firms depresses aggregate productivity growth in professional services. Firm size is also relevant when considering potential *competition* effects. The literature assumes a positive relationship between productivity and competition (Backus,

[1] The business economy captures economic activities in which market forces are predominant. Statistically, this includes all NACE Rev. 2 sections from Mining (B) to Administrative Services (N), with the exception of some financial branches. See also https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Business_economy

2020a; Grullon et al., 2019; Hsieh and Rossi-Hansberg, 2019). Declining competitive pressures could lead to unproductive firms remaining in the market or to reducing overall incentives to increase productivity. Using firm-level markups over marginal costs as a proxy for market power, we analyze whether competitive pressure has declined during the observation period and may have had dampening effects on aggregate labor productivity. We distinguish between firms of different size classes in our analysis, as micro and small firms might face a different competitive environment than medium and large firms.

In our analysis, we focus on Germany using an official and representative firm-level dataset with 706,140 observations for the 2003 to 2017 period collected by the Federal Statistical Office. We find that about half of the productivity decline can be explained by changes in the firms' vertical integration and the growing usage of intermediate goods and services, while the increase in part-time employment is responsible for a further minor part of the decline. Against expectations, the massive entry of small and micro firms plays no role in explaining the decline in aggregate productivity. Put differently, micro and small firms are not to blame for the drop in productivity in professional services. Moreover, markups decreased in the majority of the industries, suggesting that competitive pressure rather increased over the observation period and is unlikely to have caused the productivity decline.

As the picture of the main drivers of this massive drop remains incomplete, we close our analysis by outlining further explanations that need to be evaluated by future research. Among other things, suggestive evidence points to price mismeasurement in some of the industries, which affects measured labor productivity growth. Another question that deserves further attention and requires appropriate data sources is whether increasing complexity and bureaucracy necessitates additional labor input, this way driving average labor productivity down.

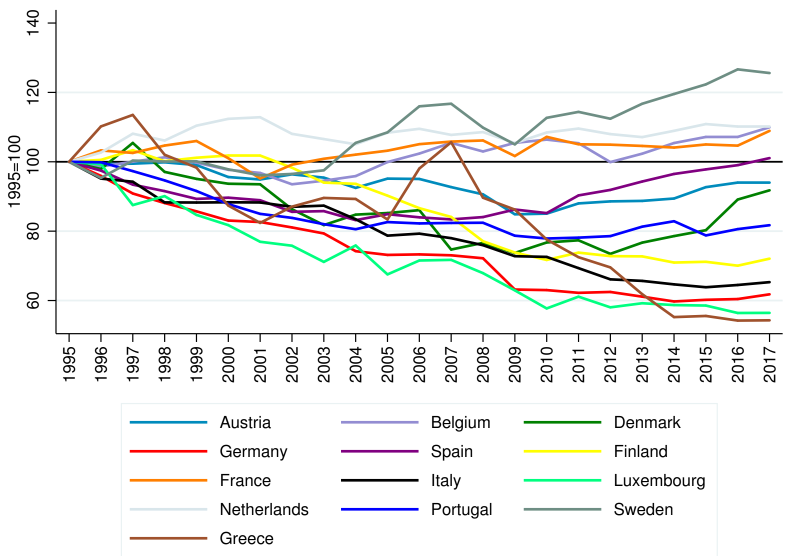
The remainder of the paper is structured as follows. The subsequent section describes the productivity development in professional services and the repercussions on aggregate productivity development in the whole business economy. Section 3 discusses potential reasons for the productivity decline and explains the empirical strategy. Section 4 presents the results. The findings are discussed in section 5 and section 6 concludes.

2. Productivity decline in professional services and its impact

2.1. Productivity development of professional services in Europe

Professional services are a part of business services and comprise a variety of professions; including, for instance, lawyers, consultancy, advertiser, leasing activities, and travel agencies (see Appendix A). The decline in labor productivity in this sector is not just a German phenomenon, rather it is observed in several Continental European economies. Figure 1 shows the development of labor productivity in professional services between 1995 and 2017, the longest period for which data are provided by Eurostat. The figure reveals that labor productivity in 2017 is below the level of 1995 in eight of thirteen countries and has significantly increased only in Sweden. In other words, in many economies professional services are less efficient these days than in the late 1990s. In some countries, the loss in productivity is strikingly large: Greece, Luxembourg, Germany, and Italy stand out with a decline of 46%, 44%, 37%, and 35% by 2017, with the latter two among the Europe's economic heavyweights. These countries are accompanied to some degree by Finland as well as Denmark and Portugal. However, professional services in the latter two states managed to recoup some of their losses in the years after 2009. This points to another pattern in the data: toward the end of the observation period, we observe stagnation or even modest recovery in a number of countries.

Figure 1: Development of labor productivity in professional services in Europe, 1995 to 2017



Source: Eurostat (2020), own calculations

Taking the example of Germany, we can identify two opposing trends that led to the measured decline in labor productivity in Europe. Professional services experienced the second highest employment growth in the German business economy between 1995 and 2017, with the number of employees more than doubling over this period. As a result, the share of professional services in total employment rose from 5.2% in 1995 to 9.6%, making professional services the 4th most important sector in the business economy after manufacturing, trade, and administrative and support services.[2] On the other hand, output, as measured by value added, increased only at the same rate as in the rest of the economy (see the Appendix, Figure D.1, left panel). As a result of these two opposing trends, aggregate labor productivity in professional services – defined as real value added over employees – decreased by about 37% until 2017, which is the most pronounced decline among all sectors of the German business economy (see Figures D.3 and D.4 in the Appendix).

2.2. The effect on overall productivity growth in the economy

This massive decline affected productivity growth for the whole economy, as the aggregate productivity growth is an employment weighted average of labor productivity growth in all industries. Through a simple decomposition approach, we show how the productivity decline in professional services restrains labor productivity in the overall economy. We follow (De Loecker et al., 2020) and decompose aggregate labor productivity growth in the German business economy between 1995 and 2017 at the sector level between professional services and the rest of the business economy. This allows us to determine how much of the productivity growth is attributable to productivity gains within sectors *(within-industry effect)*, to labor force reallocation between sectors *(between-industry effect)*, and to joint changes in productivity and labor force reallocation *(interaction effect)*. The formula is given by

$$\Delta LP = \underbrace{\Delta s^M LP^M_{1995} + \Delta s^{rest} LP^{rest}_{1995}}_{\text{between effect}} + \underbrace{\Delta LP^M s^M_{1995} + \Delta LP^{rest} s^{rest}_{1995}}_{\text{within effect}} + \underbrace{\Delta LP^M \Delta s^M + \Delta LP^{rest} \Delta s^{rest}}_{\text{interaction effect}} \tag{1}$$

with $s^i_t = (L^i_t / L_t)$ denoting sector i's labor share in the business economy at time t, Δs^i is defined as $\Delta s^i = s^i_{2017} - s^i_{1995}$ and ΔLP^i as $\Delta LP^i = LP^i_{2017} - LP^i_{1995}$. The results are listed in Table 1. We observe two main effects: The shift of the labor force toward professional services positively contributed to productivity growth between 1995 and 2017 since average labor productivity in professional services is higher than in the rest of the economy *(between-industry effect)*. The productivity decline in professional services, however,

[2] Perhaps surprisingly, administrative and support services (NACE N) experienced the strongest employment growth among all sectors of the business economy. However, this sector includes temporary agency workers and, thus, is not comparable to the rest of the economy, as its employees work in different brunches of the economy but are statistically part of NACE section N.

restrained overall productivity growth. While productivity growth in the rest of the economy was positive, shifting average productivity by hypothetical 15,848 EUR/employee – holding the labor force allocation constant in its 1995 values – the productivity decline in professional services, ceteris paribus, reduced the growth potential of overall labor productivity by 13%; i.e., 1,981 EUR/employee *(within effect).* In addition, the fact that parts of the labor force were reallocated from sectors with positive average productivity growth toward a sector with declining productivity, negatively affected overall productivity growth *(interaction effect).*

Table 1: Decomposition of labor productivity growth in the German business economy 1995-2017

labor productivity [EUR]	NACE M	rest of the bus. economy	**sum**
between-industry effect	4,553	-2,603	**1,951**
within-industry effect	-1,981	15,848	**13,866**
interaction effect	-1,688	-0,737	**-2,425**
sum	**0,884**	**12,509**	**13,392**

Notes: 2015 constant prices. Rest of the business economy = NACE 1-digit industries from B to N excluding M.

A productivity decline in an important supply industry can also restrain productivity growth in the rest of the economy if the supplying firms deliver less output or output of lower quality for the same unit price. In fact, professional services, together with transportation, are the second most important industries after manufacturing with respect to the provision of intermediate goods and services to other industries. In 2016, professional services provided 10% of all intermediate goods and services from domestic production used in the German economy against 27% provided by manufacturing (Table C.3 in the appendix). In absolute terms, the largest share of professional service production outside of business services goes to manufacturing, finance, real estate, and trade, which combined contributed one half to total domestic value added creation in 2019. Hence, the productivity decline in the professional services industry since the 1990s may have dampened aggregate productivity growth, as professional services provide fundamental services for a wide range of industries.

In sum, we find that professional services experienced a significant and continuous deterioration of labor productivity over a long time span. It can be considered the worst performing sector in the German business economy, whose productivity loss has had a measurable negative effect on productivity growth in the entire economy. Furthermore, the sectors' crucial role as a supplier of intermediates in the economy might have further negative effects on aggregate productivity growth, even though these effects are difficult to quantify.

3. Empirical strategy

This study assesses various factors that may explain the decline of productivity, starting with explanations that we summarize as *composition* effects (section 3.1). We then examine the role of the market environment, as the decline in productivity might be driven by changes in *competition* (section 3.2).

The analysis uses official German data at different levels of aggregation with a focus on the firm, industry, and sector levels. The firm-level data stems from the annual survey of service firms conducted by the Federal Statistical Office (*AfiD-Panel Dienstleistungsunternehmen*, doi: 10.21242/47415.2018.00.01.1.1.0), available for 2003 to 2017, which contains between 29,000 and 65,000 observations per year in professional services.[3] The advantage of these data is that it is a representative sample of all German professional service firms. The data contain detailed information on various firm characteristics, including value added, spending for intermediates, investment, turnover, and employees. Data at the industry (NACE 2-digit) and sector level (NACE 1-digit) is taken from the national accounts, which are based on the same firm-level data and have been projected to the national level by the Federal Statistical Office.

3.1. Composition effects

A key question of the analysis concerns the composition of the firm population in terms of firm size. Between 2004 and 2017, the number of firms in professional services increased by 56% (Destatis, 2006, 2019). Most of these new entrants were micro and small-sized firms (see the Appendix, Table C.1). It is an established fact that firms are, generally, more productive, the larger they are (Medrano-Adán et al., 2019; Moral-Benito, 2018). It is argued that the firm entry and growing number of micro and small firms might be a driver of the productivity decline (Flegler and Krämer, 2021). Therefore, we examine whether changes in the size composition of the industry account for the decline in aggregate labor productivity. In other words, we test whether the small- and micro-sized firms are at the heart of the productivity problem in professional services.

To this end, we follow De Loecker et al. (2020) and decompose productivity growth by firm size into a *within-size-effect* that measures the contribution of each size class' internal productivity changes, a *between-size-effect* that accounts for labor force reallocation between firms of different size, and an *interaction effect* that measures the joint impact of both. We

[3] Note that professional services (NACE M) did not exist as a proper NACE category before 2008. At that time, professional service firms were instead scattered across other categories or were not part of the industry classification at all. In fact, one of the main reasons for the ISIC/NACE revision in 2008 was the recognition of the rising importance and diversity of service firms, which up to that point were insufficiently identifiable in NACE. We use Dierks et al. (2019) to identify professional service firms before 2008.

distinguish between micro-sized firms *(micro)* and small to large firms *(sml)*. The formula is given by

$$\Delta LP = \underbrace{\Delta s^{micro} LP^{micro}_{t_0} + \Delta s^{sml} LP^{sml}_{t_0}}_{\text{between effect}} + \underbrace{\Delta LP^{micro} s^{micro}_{t_0} + \Delta LP^{sml} s^{sml}_{t_0}}_{\text{within effect}} + \underbrace{\Delta LP^{micro} \Delta s^{micro} + \Delta LP^{sml} \Delta s^{sml}}_{\text{interaction effect}} \tag{2}$$

with $s^i_t = (L^i_t / L_t)$ denoting size class' i's labor share in the whole economy at time t, Δs^i is defined as $\Delta s^i = s^i_{t_1} - s^i_{t_0}$ and ΔLP^i as $\Delta LP^i = LP^i_{t_1} - LP^i_{t_0}$. Due to the NACE revision in 2008, we consider the periods 2004 to 2007 and 2008 to 2017 separately. A negative between-size effect would indicate that the disproportional increase of micro-sized firms negatively contributes to productivity growth through labor force reallocation from high-productive to low productive firms.

The second composition effect concerns changes in the workforce. Within the observation period, the share of part-time workers in Germany nearly doubled from 16% in 1995 to 29% in 2017 (Destatis, 2021a). Detailed data for professional services is available from 2008 onwards. There, part-time work increased from 15% in 2008 to 24% in 2017 (Destatis, 2021b). Using descriptive analysis, we test whether the sharp increase in employment observed in professional services is explained by the growing importance of part-time work. If so, the numbers for labor productivity – which are based on the number of employees – would hardly be comparable over time and the decrease in productivity would reflect changes in the composition of the work force instead of declining competitiveness.

A third potential explanation focuses on changes in the value-added chain. The vertical integration of production has declined throughout the economy over the past decades. This is illustrated, among others, by the fact that the average expenditure for intermediates per employee in the German business economy has risen by 46% between 1995 and 2017; in some sectors, such as finance and IT, it has risen by up to 300% (see the Appendix, Figure D.2). If the use of intermediates has grown faster than gross output over time, labor productivity – defined as the ratio of value added, i.e. gross output minus intermediates, to employees – must, *ceteris paribus*, decrease. Using descriptive analysis, we evaluate whether the slow growth in value added is due to an increased usage of intermediate goods and services as well as whether labor productivity would follow a similar trend if it was calculated with the gross production value instead of value added. Comparing both measures reveals to what extent changes in the composition of value added are responsible for the decline in productivity.

3.2. Changes in competition

The conventional view in the economic literature is that competition and productivity are positively linked, i.e. an increase in competitive pressure reduces managerial slack, fosters innovation, and reallocates resources from less productive firms to more productive firms (Backus, 2020b; Grullon et al., 2019; Hsieh and Rossi-Hansberg, 2019). If the relationship also holds in the inverse case, a decrease in competitive pressure would affect aggregate productivity in a negative way by facilitating managerial slack, reducing the need for innovation, and allowing unproductive firms to stay in the market. The second part of the analysis examines how competition has changed over time and whether these changes might have been the driving force for the observed decline in productivity.

3.2.1. Market structure

Markets for professional services differ to some degree from markets in other industries, since parts of the offered services can be considered credence goods. This means that even after experiencing the product, the buyer cannot fully ascertain its quality and, in most cases, firms provide both the diagnosis and the treatment (Emons, 1996). The result are customer-tailored solutions and markets that are characterized by a high degree of price and quality intransparency (Dulleck and Kerschbamer, 2006; Mimra et al., 2016). For example, customers of legal services have difficulties in judging the quality of a legal advice or the necessary steps for taking their cases to court. In that sense, it is often difficult for the customer to evaluate which parts of the performed service are really necessary, but also whether relevant treatments are not performed. Furthermore, many of these markets are highly localized, often with little international competition due to language barriers and specific national rules. Finally, in many countries, market entrance in some of the professions is not as straightforward as in others. In Germany, persons wishing to work as a lawyer, architect, certified public accountant, tax counselor, or veterinarian must register with the national bar associations and chambers before entering the market.

To remedy some of these aforementioned issues, the German legislature decided to regulate output prices for certain professional services. These comprise legal services, architectural and engineering activities, tax counseling, and veterinary activities. For these professions, the legislature publishes detailed fee schedules consisting of two-part tariffs with a lumpsum fee for specific treatments and a variable fee depending on the value of litigation or construction.

Since the 2000s, the European Commission pushes for intensifying competition in professional services; for instance, as part of the EU Internal Market Directive in 2006 and with several infringement procedures against Germany for alleged violation of EU competition rules (EC, 2015, 2018a,b,c). The consequences are an increasing number of exemptions from the price regulation (e.g., extralegal activities, allowance for side agreements with time-based rates and lump-sum payments) and the suspension of the fee schedule for architects and engineers following a ruling by the European Court of Justice in 2019.

In sum, competition may be hampered in parts of German professional services by the fact that several of the services can be characterized as credence goods, by the fact that markets are highly localized, and because of barriers to entry. Although European policy aimed at fostering competition in services, it is unclear how successful these policies were.

However, while regulation is important for a number of business services, this does not mean that all German business services are regulated. The regulated industries account for about 40% of turnover, half of the employees, as well as half of total value added that is created in this sector. Quite a number of industries, namely advertising, management and consultancy activities, accounting activities, as well as research and development activities, are unregulated meaning that prices are set freely.

3.2.2. Estimation of markups

To measure changes in competition, we analyze the evolution of firm-level markups. Markups are defined as the margin between output price and marginal costs of production (Hall, 1988; De Loecker, 2011b). When competition is fierce, firms usually set output prices close to marginal costs plus some margin for covering fixed costs. Decreasing competitive pressure allows firms to increase the output price beyond that level and to generate additional profit margins. In a recent publication, De Loecker et al. (2020) show that markups in the US have increased by 40% between 1980 and 2016, arguing that the rise in markups translates an increase in market power and reduced pressure from competitors. Studies for Germany show more nuanced results: Ganglmair et al. (2020) find that markups only moderately increased between 2007 and 2015 and exhibit a rather unstable trend in the service sector. Their measure of services comprises not only business services but also transport (NACE category H), accommodation and food (category I), information and communication (category J) as well as real estate (category L). Furthermore, their dataset is biased toward large firms, and, thus, is not fully representative of the German professional service industries, which is dominated by micro-sized firms (see the Appendix, Table C.1).

We estimate markups in the professional service industries applying the approach developed by De Loecker and Warzynski (2012) and De Loecker et al. (2020) with industry-specific production functions at the 2-digit-level (see, e.g., Ganglmair et al., 2020; De Loecker et al., 2020; Andrews et al., 2019; De Loecker et al., 2016, for further applications). Assuming a Leontief production function in intermediate goods and services M_{it} and two other inputs, capital K_{it} and labor L_{it}, an estimate for firm-level markups is given by

$$\hat{\mu}_{it} = (\frac{1}{\hat{\mu}^l_{it}} + \frac{p_M M_{it} e^{\hat{\epsilon}_{it}}}{S_{it}})^{-1} \tag{3}$$

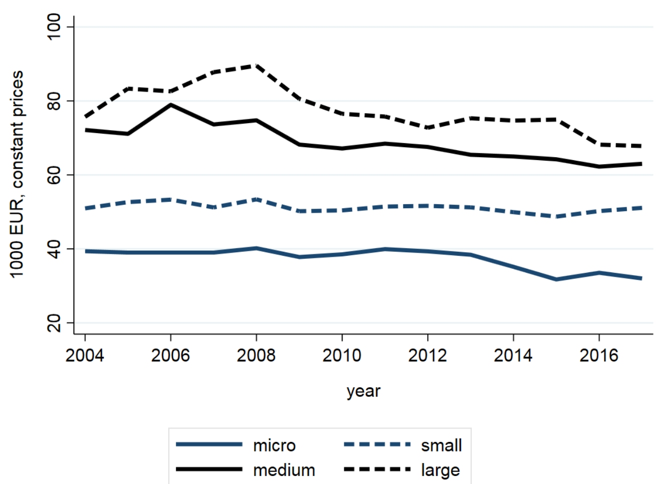
with $(p_M M_{it})/S_{it}$ denoting the firm's expenditure share for intermediate goods and services in the gross production value, $\hat{\epsilon}_{it}$ is an estimate for the output measurement error, and $\hat{\mu}^l_{it}$ stems from the second term in the Leontief production function. It is defined as the output elasticity for labor times payroll over gross production value and corresponds to an estimate for the markup over marginal costs in a gross production values function with the two inputs labor and capital. We provide further details and an intuition for the estimation routine in the Appendix, Section B.

4. Results

4.1. Composition effects

The vast majority of new entrants in the market since the 2000s comprise micro and small-sized firms: Their number increased by more than a quarter of a million between 2004 and 2017 (see Table C.1 in the Appendix). In addition, we find that average productivity decreases with firm size: micro firms in professional services are significantly less productive than small firms, which in turn are less productive than medium-sized companies etc. (Figure 2). The strong growth in the number of small and micro firms together with their subdued labor productivity might make a case for these firms driving down the aggregated sectoral productivity. Therefore, we analyze whether changes in the average firm size could explain the negative trend in aggregate productivity growth by decomposing productivity growth according to equation (2).

Figure 2: Average (median) labor productivity by firm size



Source: German microdata of official statistics. AFiD-Panel Strukturerhebung im Dienstleistungsbereich, doi:10.21242/ 47415.2007.00.01.1.1.0, 10.21242/47415.2017.00.01.1.1.0, own calculations.

Table 2 summarizes the results. The last row shows that labor productivity fell between

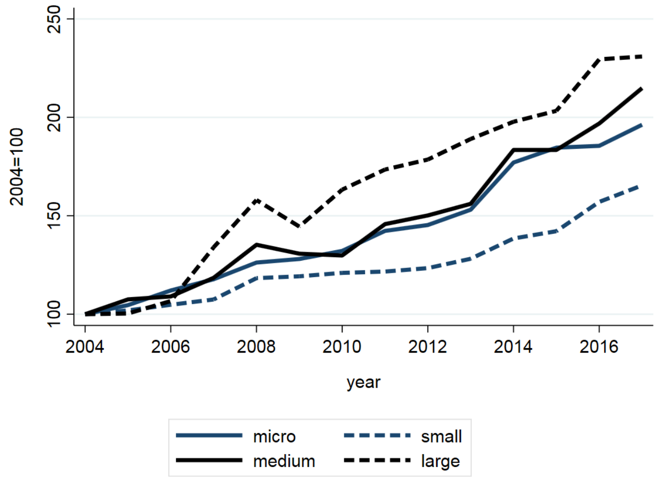
2004 and 2017 in total by 2,373 EUR per person employed. However, the between-size effect is positive, i.e., the changes in composition of the firm population between 2004 and 2017 had a *positive* impact on labor productivity growth. The reason is that the number of firms in the different size categories increased at the same pace (see Figure 3) and that the increase of the larger firms was accompanied by a relatively larger increase in persons employed in large firms. Therefore, the share of persons employed in micro firms actually *decreased* over the years despite the massive entry of micro firms, and the labor force reallocation positively impacted productivity growth. The results hold true if we join micro and small firms within one category (see Table C.2 in the Appendix). Hence, the decomposition analysis reveals that the massive entry of micro-sized firms did not cause the decline in aggregate productivity.

Table 2: Decomposition of labor productivity growth by firm size 2004-2017

	2004 to 2017		
labor productivity in EUR	micro firms	small to large firms	**sum**
between-size effect	-1,511	2,135	**623**
within-size effect	-1,627	-1,429	**-3,056**
interaction effect	130	-71	**59**
sum	**-3,008**	**635**	**-2,373**

Notes: 2015 constant prices. German microdata of official statistics AFiD-Panel Strukturerhebung im Dienstleistungsbereich, doi:10.21242/47415.2007.00.01.1.1.0, 10.21242/47415.2017.00.01.1.1.0, own calculations.

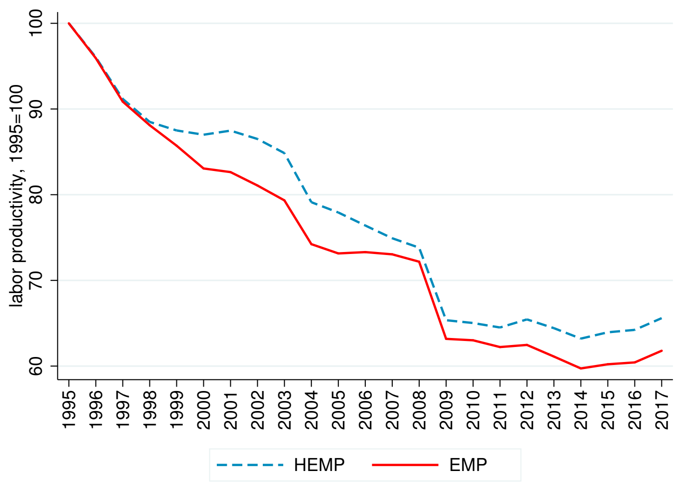
Figure 3: Growth in the number of firms by firm size between 2004 and 2017



Source: German microdata of official statistics. AFiD-Panel Strukturerhebung im Dienstleistungsbereich, doi:10.21242/ 47415.2007.00.01.1.1.0, 10.21242/47415.2017.00.01.1.1.0, own calculations.

Another potential cause for the measured productivity decline might be the growing importance of part-time work, which changes the composition of the workforce. In order to verify the relevance of this explanation, we contrast productivity growth based on the total number of hours worked with productivity growth based on the number of employees. Figure 4 shows that labor productivity based on hours worked performed slightly better between 1998 and 2008, but continues to deteriorate as well. The gap between both productivity measures widens toward the end of the observation period cumulating in a difference of 5 percentage points in 2017. However, against a total decline of 37 percentage points between 1995 and 2017 this difference remains small. Hence, we conclude that the composition of the workforce in professional services, i.e., the growth in part-time work only explains a minor part of the downward trend in labor productivity.

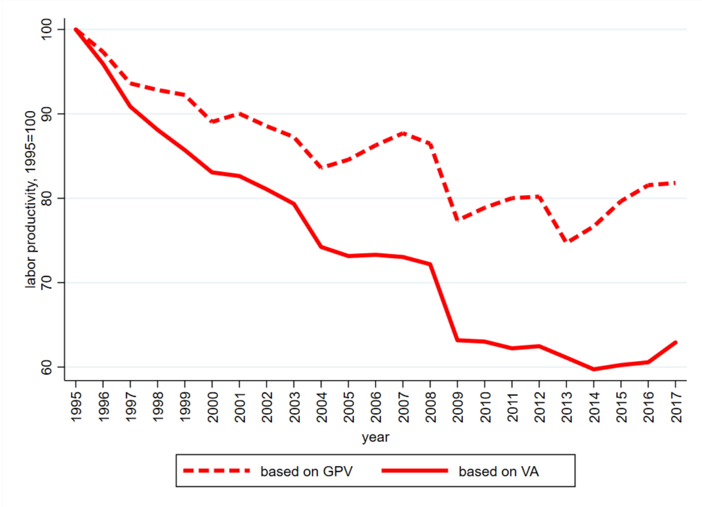
Figure 4: Labor productivity based on hours worked vs. number of employees



Source: Destatis (2020): national accounts, domestic product 2019

Finally, we analyze whether changes in the vertical integration of production plays a role in the decrease of productivity. Figure 5 compares the evolution of productivity based on value added with productivity based on the gross production value for the period 1995 to 2017. Both time series follow a similar trend until 2013, but the decline is less pronounced with gross production value (-18%) than with value added (-39%) and the gap between them widens over time. In other words, the increasing use of intermediate goods has not been accompanied by a more parsimonious use of employees, leading to productivity losses that increased throughout the observation period. Therefore, vertical disintegration within firms plays a substantial role in the productivity decline, accounting for about half of the productivity loss between 1995 and 2017.

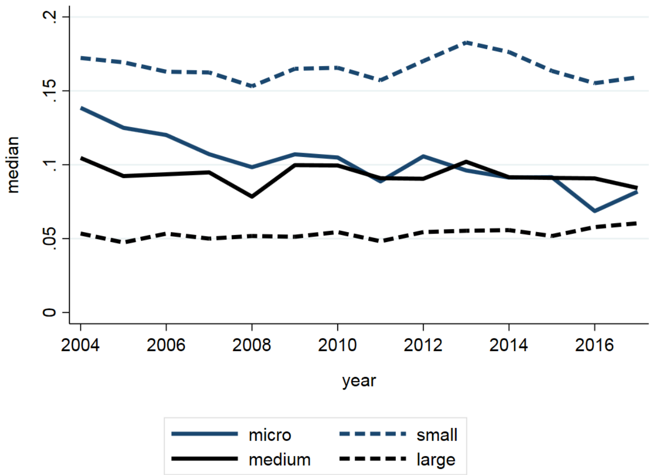
Figure 5: Labor productivity based on value added vs. gross production value



Source: Destatis (2020): national accounts, domestic product 2019

Using sectoral input-output data provided by the Federal Statistical Office allows us to shed more light on the nature of the intermediate goods and services consumed by professional services firms. In addition to the high internal interdependence, the most important inputs in business services come from the IT sector, e.g., in the form of software, IT system administration, and web-related programming services (Table C.4 in the Appendix). In the R&D sector, inputs from the manufacturing industry also play a major role, and expenses for licenses and usage fees from various media outlets are particularly important in the field of advertising and marketing. Among all sections of professional services, we observe proportionally high expenses for rents. Yet, the share of rents in total intermediate expenditure decreased between 2004 and 2017 in all size classes (Figure 6). Hence, although important in absolute terms, rents and leasing costs do not drive the increased expenditure of intermediate goods and services. Unfortunately, the microdata do not allow us to disentangle the expenditures for intermediate goods and services any further, thus we cannot analyze their evolution over time in more detail.

Figure 6: Rents and leasing costs in total expenditure for intermediate goods and services



Source: German microdata of official statistics. AFiD-Panel Strukturerhebung im Dienstleistungsbereich, doi:10.21242/ 47415.2007.00.01.1.1.0, 10.21242/47415.2017.00.01.1.1.0, own calculations.

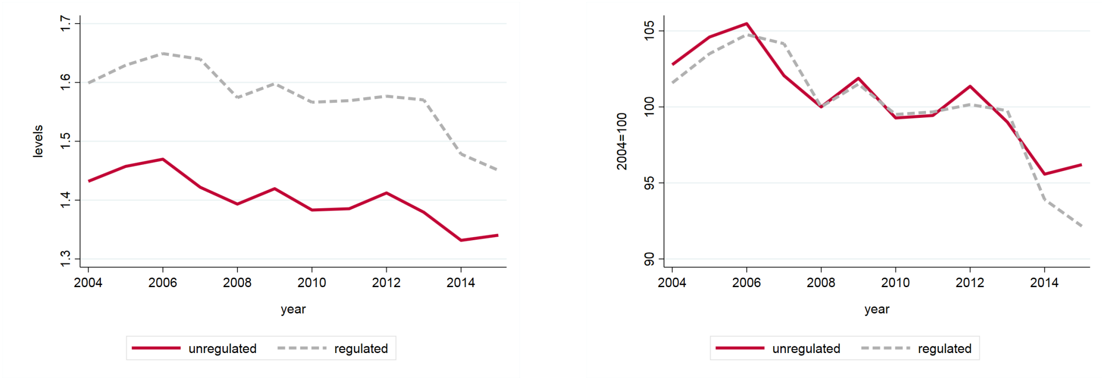
4.2. Competition and market structure

A little less than half of the productivity decline is still unexplained. Therefore, we also address the question whether declining competitive pressure could have reduced incentives to eliminate slack in production or could have allowed unproductive firms to stay in the market. To measure competitive pressure, we analyze the evolution of average markups over marginal costs as an indicator for the firms' market power. We removed the top and bottom 1% of the observations to avoid having results that might be driven by outliers.[4]

We find that the markups in the regulated industries, such as legal and accounting services or architecture and engineering activities, are, on average, higher than in the unregulated industries (Figure 7a). However, they follow the same trend over time: markups in the regulated and unregulated industries fell by an average of 6% between 2004 and 2014 (Figure 7b). Zooming more closely into the industries, we see that markups declined in all industries through 2015 with the exception of management and consulting services, where they remained fairly stable, as well as architecture and engineering activities, where they increased over time (Figure D.5b in the Appendix). The decreasing pattern seems to be consistent across firm size. If we weigh the mean by the gross production value, the picture does not change much (Figure D.6 in the Appendix).

[4] We also had to discard observations after 2015 since a new sample design in 2016 makes observations hardly comparable over time. The problem is mostly resolved when using population weights, which were used in the labor productivity graphs (Figures 2 and 3) as well as Tables 2, C.1 and C.2. Unfortunately, it is not possible to use population weights in the markup estimation routine.

Figure 7: Unweighted mean markups in professional services between 2004 and 2015



(a) levels

(b) growth since 2004

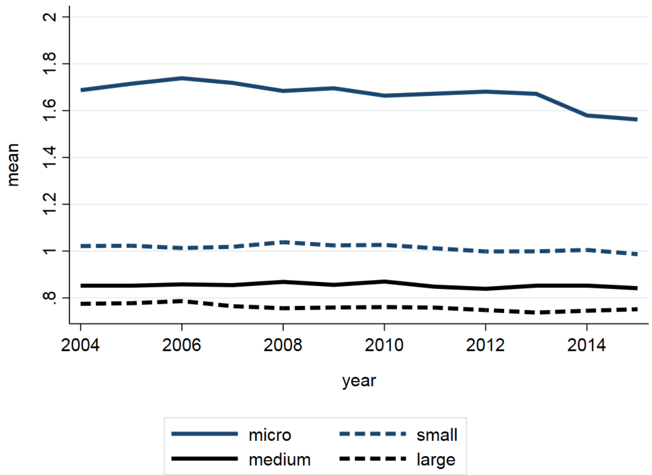
Source: German microdata of official statistics. AFiD-Panel Strukturerhebung im Dienstleistungsbereich, doi:10.21242/ 47415.2007.00.01.1.1.0, 10.21242/47415.2017.00.01.1.1.0, own calculations.

However, plotting the markup by firm size reveals another interesting aspect (Figure 8). We find that micro firms have the highest markups, which is in line with the results of Ganglmair et al. (2020). The latter suggest that smaller firms are less exposed to competitive pressure as their business focus is narrower *(niche firms)*. As in their study, the observation of a gap between small and large firms is strikingly consistent across industries in our analysis (see Figure D.7 in the Appendix). This makes us draw a different conclusion. The labor share in micro firms could be downwardly biased if owners working in the firm do not or only incompletely report their own wages.[5]

In sum, we find evidence for a decline in price margins over marginal costs within all size classes. Taken together with the observed substantial entry into the market since 1995, these factors largely indicate that competitive pressure in professional services has increased since the 2000s. This is at odds with the significant fall in labor productivity within all size classes and suggests that changes in competitive pressure are unlikely to explain the observed decline in labor productivity.

[5]While this phenomenon could, in principle, occur among firms of all size classes, the distorting effect on labor share will be particularly pronounced for micro firms. First, because their wages are relatively more important in the total payroll due to a smaller workforce and, second, because micro-business owners are more likely to work in the firms. A downward bias in the labor share causes an upward bias in the markup estimate as can be see from equation (7) in the Appendix. Self-employment is relatively wide-spread in professional services, particularly in the context of micro firms with up to 10 employees, which would explain the gap between micro firms and firms of other size classes in our results.

Figure 8: Average (mean) markups in professional services 2004 to 2015 by size classes



Source: German microdata of official statistics. AFiD-Panel Strukturerhebung im Dienstleistungsbereich, doi:10.21242/ 47415.2007.00.01.1.1.0, 10.21242/47415.2017.00.01.1.1.0, own calculations.

5. Discussion and outlook

5.1. Hampered substitution

The previous analysis reveals that the decline in aggregate labor productivity can be partly explained by the increased usage of intermediate goods and services. When considering sales per employee, the decrease in productivity is only half as strong as the decrease in value added per employee. This is a puzzling result because, in the long-run, the substitution of in-house production by intermediates should be followed by one of two possible adjustment strategies: Either firms lay off parts of the workforce that are no longer needed or firms increase sales, using the freed workforce productively in other parts of production that remain in-house.[6] Of course, if sales growth is sufficiently strong, the total workforce can also grow despite an intensified use of intermediates. This has been the case for several decades in the German automobile industry and in information & communication services. It remains an open question for future research why firms in professional services, on average, have evidently increased employment so much and simultaneously raised their consumption of intermediate goods and services despite a modest development in sales.

[6] Of course, it does not need to be the identical workforce. Some of the employees no longer needed might lose their jobs, e.g. because they lack the necessarily qualification, while firms simultaneously hire new employees to cope with the growing sales.

5.2. Increasing complexity, bureaucracy

Besides highlighting the relevance of intermediates in explaining the decrease in value added per employee, section 4.1 also reveals that total sales per employee have been declining for a long time. This decline amounts to 18% between 1995 and 2017 (see section 4.1, Figure 5). In fact, professional services as well as administrative and support services are the only sectors apart from real estate that experienced negative sales by employee growth over that period (Figure D.8). Since we deflated sales and purged them of any price effect, it means that physical output per employee has decreased.

A decreasing average output by employee is difficult to conceive of for many of the respective professions, such as lawyers, engineers, and auditors. Certainly, work in some fields might have become more complex, in particular in RnD, where some researchers argue that ideas are becoming harder to find (Bloom et al., 2020). However, the physical productivity of the employees will not have decreased, i.e., there is no reason to believe that an engineer in the year 2020 is less capable than in the year 1995. It is more probable that the increased complexity of the work creates additional workload that either slows down the production process (e.g., stricter environmental and safety regulations complicate the planning process of bridges or buildings) or requires additional staff (IT system administrator, social media officer, funding administrator). It is important to note that the increased complexity not only relates to possibly increased government regulations, but also includes the consequences of digitization (e.g., IT department, software) and the Internet age (e.g., website, social media). Another source of complexity could be changed demand patterns, i.e. higher customer expectations (Flegler and Krämer, 2021).

The increased complexity of the work is not just confined to professional services, of course, but it could be more relevant in knowledge-intensive services than in manufacturing or low-skilled services. Output by employee in manufacturing will, to a much greater extent, be driven by the capital used, i.e., by technological innovations. Ancillary services and regulation might be of less relevance in construction, gastronomy, or cleaning. It remains an open question, though, why other knowledge-intensive services such as finance, real estate, or communication and information, should have been less affected or whether they better managed to cope with the growing complexity.

5.3. Past excess returns

The second part of the analysis focuses on the state of competition in the markets, as weakened competition could be another source for aggregate productivity decline. However, the results indicate a tendency for increasing rather than decreasing competition. Although this finding contrasts with our initial expectation regarding the cause of the productivity decline, it is an inherently interesting result. It might be seen as evidence that past EU policies have succeeded in fostering competition in these particular markets following the EU Service Directive in 2006. However, this raises the question why productivity has not increased due to more intense competition. A possible explanation could be that competition was so severely restricted in the past that firms were able to generate massive excess returns. If these were large enough, firms could have achieved high volumes of value added and subsequently high values of labor productivity. If markups then decrease over time due to fiercer competition, value added per worker would also decline. Hence, one interpretation would be that the decreasing labor productivity is actually the result of fiercer competition. However, there is little empirical evidence for this. If the argument was true, we would expect markups levels to have been much higher in professional services than in other industries in the past. We find no such evidence, at least not for the period for which microdata is available. Figure 8 in section 4.2 shows that average markups have not been abnormally high in the past, and were generally below 1.1 for most of the firms, except for micro firms.[7]

5.4. The role of prices

Finally, we return on the price deflation routines used to compute deflated monetary values in order to make them comparable over time. Unless physical inputs and outputs are available, it is standard to analyze productivity using deflated values. In production function estimations, the mismeasurement of prices can lead to biased output elasticities and, thus, to wrong productivity estimates. Klette and Griliches (1996), Foster et al. (2008), Katayama et al. (2009), De Loecker (2011a), Collard-Wexler and Loecker (2016), Grieco et al. (2016), and De Loecker et al. (2016) provide a detailed discussion on this issue for production function estimations. Yet, we will show that labor productivity is also affected by the chosen price deflator and we will explore the role of price corrections in the assessment of labor productivity growth in more detail.

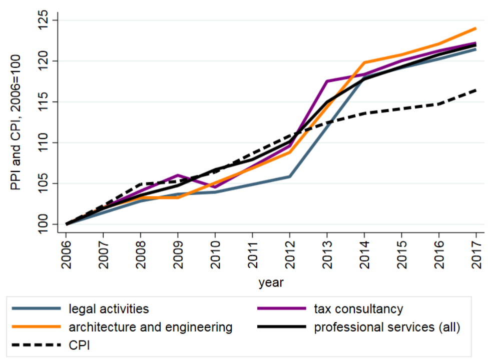
The present analysis either directly used the deflated values at the industry level, as published by the Federal Statistical Office, or it deflates nominal values (e.g., in the micro data) with the official price indices at the two-digit industry level. The latter are also published by the Federal Statistical Office.

The collection of prices to calculate the price indices in professional services is notoriously difficult due to the market characteristics discussed in Section 3.2.1. Detailed price indices per 4-digit industry are publicly available only for a subgroup of industries within professional services. Information for activities of head offices (NACE division 70.1), bookkeeping (divisions 69202 and 69204), RnD (division 72), other activities (division 74), and veterinary activities (division 75) are missing. Furthermore, the time series only start in 2003 and 2006. By contrast, aggregate data for professional services are available from 1991 onwards.

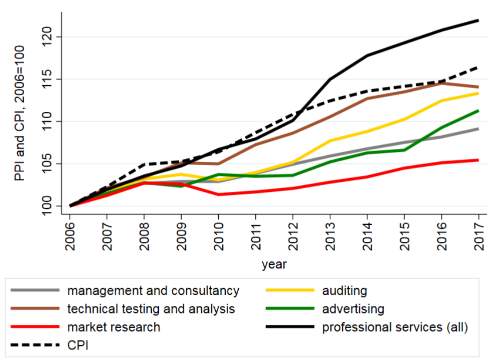
[7] We give an intuition for the high markups of micro-sized firms in section 4.2.

Figure 9 plots the evolution of the published price indices against the inflation rate and the deflator time series for value added. The jump of the price indices in the regulated industries (legal services, tax accounting, architecture and engineering activities) between 2012 and 2014 stems from an adjustment of the fee schedule with an average increase of 10 to 20%.[8] The figures reveal two key insights. First, it becomes clear that output prices in professional services – as published by the Federal Statistical Office – increased more slowly than the inflation rate up to 2012. This suggests that real income in these industries declined over the years. The adjustment of the fee schedule in 2013 resolved this issue for the regulated industries, whose price erosion was overcompensated by the reform. Second, the deflator time series for value added (black line) develops close to the producer price indices of the regulated industries (Figure 9a), but much stronger than the price indices of unregulated industries (Figure 9b). This could indicate that the official price indices for value added rely to a larger extent on the easily available prices for the regulated sectors, despite the fact that these sectors account for only 40% of the total turnover, half of the employees, as well as half of total value added (see section 3.2.1).

Figure 9: Producer price indices in professional services



(a) regulated industries



(b) unregulated industries

Source: Destatis (2020)

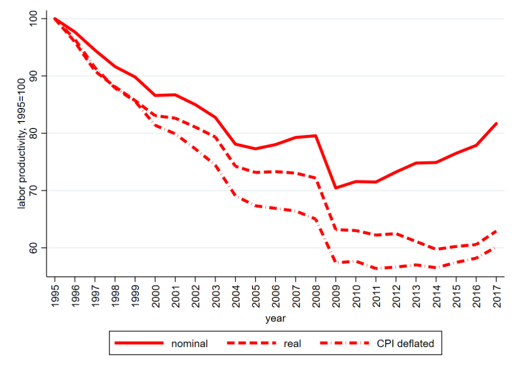
To further examine this, Figure 10 compares nominal and real labor productivity growth. For convenience, we report both the officially deflated values and CPI-adjusted values to approximate real values. Figure 10a reveals that all measures of labor productivity show a similar trend until 2009, after which nominal labor productivity starts to significantly recover. A first and important finding is, thus, that labor productivity in professional services has fallen for ten continuous years, regardless of whether nominal or real value added is used. Hence, price indices and price corrections cannot be the cause for the decline in productivity

[8]Prices for the lumpsum fees had not been adjusted since 2004 (legal services), 2009 (architecture and engineering), and 1998 (tax consulting).

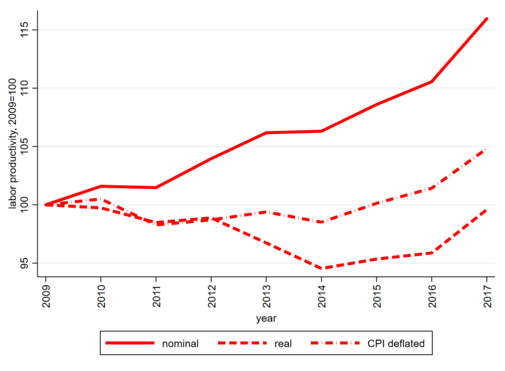
in this period.

Second, there is a strong divergence in developments after 2009 (Figure 10b). This divergence is clearly more pronounced if labor productivity is calculated using officially published real value added than when deflating nominal value added with the CPI. Together with the observed close proximity between value added deflators and the PPI of the regulated industries, this raises the question of whether the officially published price corrections for value added are too large. In other words, the negative labor productivity growth after 2009, based on real value added, might be exaggerated to a certain extent.

Figure 10: Labor productivity growth in professional services, different deflator



(a) 1995-2017



(b) 2009-2017

Source: Destatis (2020): national accounts, domestic product 2019

6. Conclusion

We provide first evidence on the dramatic decline in labor productivity of up to forty percent since the 1990s for German professional services, which includes, among others, architecture and engineering services, marketing research, and tax and legal consulting. The firms in this industry work today with an efficiency that is more than a third lower than in the mid-1990s. Thus, the negative growth in labor productivity in this industry, which is also observed in several other Western European economies, contributes to the general analysis of why overall productivity growth has slowed since the 1980s – an issue that is a source of increasing concern for politicians and academics.

Half of the surprising decline in productivity among professional services is explained by changes in the firms' vertical integration and the growing usage of intermediate goods and services, while the increase in part-time employment is responsible for a further minor part of the decline. However, the underlying causes of this development remain unclear. It is likely that it is increasingly challenging for these firms to provide their services; for example, due to more red tape, increased regulatory requirements, for instance environmental requirements for engineering services, or increased customer requirements in consulting. Furthermore, fixed costs could also be increasing, which might be only inadequately covered by the price index for intermediate goods.

Interestingly, larger companies, where the effect of the growing usage of intermediate goods may also have a greater impact, face similar productivity losses as small and micro firms. Thus, there is no evidence supporting the expectation that small and micro firms that are the primary drivers of the productivity decline in this industry. Additionally, the assumption that the productivity loss is a consequence of reduced competition in this industry could not be confirmed. Rather, our analysis indicates a tendency for intensified competition. The latter finding might also explain why labor productivity in professional services stabilized since 2014. Although this study provides some explanations for the productivity decline, our analysis remains incomplete with respect to the underlying causes of this decline. To this end, additional research is needed.

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Appendix A Definition of business services

In this appendix, we briefly describe which economic activities are summarized under business services and why the study focuses on professional services. Business services, or *MtN*, is used by Statistical Offices for the sum of two NACE sections: professional, scientific, and technical activities (section M) – we use the shorted name professional services– as well as administrative and support activities (section N), which we call administrative services. They comprise a variety of professions; including, for instance, lawyers, consultancy, advertiser, leasing activities, and travel agencies (see Table A.1).

Table A.1: NACE classification of business services

div.	section M	div.	section N
69	legal and accounting activities	77	rental and leasing activities
70	management consultancy activities	78	employment activities
71	architectural and engineering activities	79	travel agency, tour operator and others
72	scientific research and development	80	security and investigation activities
73	advertising and market research	81	services to buildings and landscape
74	other professional, scientific and technical activities	82	office administrative, office support, and other business support activities
75	veterinary activities		

Source: Eurostat (2008)

The productivity decline does not confine to professional services, but is more broadly found among all business services (*MtN*, see Figure D.4). However, administrative services (NACE N) contain employment placement and temporary employment agencies (division N78). This may bias the labor productivity measures, because the tremendous growth in temporary agency work over the last decades is not related to internal employment in this division since temporary agency workers usually work in other industries. In order to avoid such bias, we focus on professional services (NACE M) in our analysis.

Appendix B Markup Estimation

B.1 Calculation of the price margins over marginal costs

We closely follow De Loecker et al. (2020) and use firm-level production data to estimate markups, i.e. price margins over marginal costs. The strategy was initially proposed by De Loecker (2011b) and De Loecker and Warzynski (2012) and, unlike previous approaches, does not require any assumptions on a specific demand system. This is particularly useful for estimating markups in professional services, as markets in this industry are highly intransparent and other factors than prices (e.g., reputation) play an important role for determining consumer choices.

We assume that firms decide on the optimal size of their labor force in a cost minimization problem, which can be expressed by the following Lagrangian function

$$\mathcal{L}(K_{it}, L_{it}, M_{it}, \lambda_{it}) = r_t K_{it} + w_{it} L_{it} + p_M M_{it} + \lambda_{it}(Q_{it} - Q(\cdot)), \tag{4}$$

where r_t denote the user costs of capital varying with year t, K_{it} is firm i's capital stock, L_{it} is the number of employees who each receive an average firm-level wage w_{it}, $p_M M_{it}$ denotes the expenditure for intermediate goods and services, and Q_{it} is the output that the firm produces per year. If $Q(\cdot)$ is continuous and twice differentiable, the first order condition with respect to labor is given by

$$\frac{\delta \mathcal{L}_{it}}{\delta L_{it}} = w_{it} - \lambda_{it} \frac{\delta Q}{\delta L_{it}} = 0, \tag{5}$$

where λ_{it} are the marginal costs of production at a given level of output. Furthermore, the formal definition of the output elasticity of labor is given by

$$\theta^l_{it} \equiv \frac{\delta Q(\cdot)}{\delta L_{it}} \frac{L_{it}}{Q_{it}}. \tag{6}$$

Using equations (5) and (6), we can calculate firm-specific markups μ^l_{it}, i.e. the price margin over marginal costs, as

$$\mu^l_{it} = \theta^l_{it} \frac{P_{it} Q_{it}}{w L_{it}}. \tag{7}$$

Since the true output is usually not observed in the data, we correct the markup formula for the log measurement error ϵ_{it} and obtain the following estimate for the firm-level markup

$$\hat{\mu}^l_{it} = \hat{\theta}^l_{it} \frac{P_{it} Q_{it}}{w L_{it} e^{\hat{\epsilon_{it}}}}. \tag{8}$$

B.2 Production function estimation

The calculation of the markups requires an estimate of the output measurement error and of the output elasticity of labor. We assume a production function with three inputs, capital K_{it}, labor L_{it}, and intermediate goods and services M_{it}, used to produce the gross production value $S_{it} = P_{it}Q_{it}$. The observed output can differ from the true output by some measurement error ϵ_{it} and production depends on unobservable total factor productivity Ω_{it}. Both labor and intermediate goods and services are flexible, static inputs that can be adjusted within one year with negligible adjustment costs. Ackerberg et al. (2015), Levinsohn and Petrin (2003), and Doraszelski and Jaumandreu (2013) have stressed that output elasticities are difficult to identify in the presence of more than one flexible input. Therefore, we follow De Loecker et al. (2020), De Loecker and Scott (2016) and Ganglmair et al. (2020) by assuming a Leontief production function given by

$$S_{it} = min[\theta_{it}^{M} M_{it}, f(K_{it}, L_{it}, \Omega_{it})]e^{\epsilon_{it}} \tag{9}$$

that is estimated separately within each NACE 2-digit industry. The true functional form of $f(\cdot)$ is approximated by a translog function with

$$s_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_{ll} l_{it}^2 + \beta_{kk} k_{it}^2 + \beta_{kl} l_{it} k_{it} + \omega_{it} + \tau_r + \eta_b + \epsilon_{it} \tag{10}$$

where lower-case letters denote logs, τ_r are fixed effects, and η_b controls for the firm's legal form. We apply the control function approach of Ackerberg et al. (2015), which was initially proposed by Olley and Pakes (1996) to estimate the output elasticity of labor. The identification strategy exploits the fact that current shocks to productivity will immediately affect firms' demand of a fully flexible, static input, but not those of dynamic inputs, which react more slowly to productivity shocks, given the adjustment costs. The inverted input demand function of a static, flexible input can then be used to express productivity in terms of observables. We use the input demand for intermediate goods and services to express productivity as

$$\omega_{it} = h(m_{it}, l_{it}, k_{it}) \tag{11}$$

and replace productivity in equation (10) with equation (11). Furthermore, we assume that productivity follows a first-order Markov process with

$$\omega_{it} = g(\omega_{it-1}) + v_{it}. \tag{12}$$

The production function is estimated in a two-step GMM procedure, where the output elasticities are identified from the moment conditions $\mathbb{E}[l_{it-1}, k_{it} | v_{it}] = 0$. Applying the approach of Ackerberg et al., we consider the possibility that total factor productivity correlates with input choice, a well-known simultaneity problem which otherwise leads to biased estimates of the output elasticities (Mundlak and Hoch, 1965; Levinsohn and Petrin, 2003; Olley and Pakes, 1996; Wooldridge, 2009). The control function approach has been widely applied to determine total factor productivity in various industries and to obtain unbiased estimates for the output elasticities (e.g., De Loecker et al., 2020; Peters et al., 2017; De Loecker et al., 2016; Collard-Wexler and De Loecker, 2015; Doraszelski and Jaumandreu, 2013; Parrotta et al., 2014; De Loecker, 2011a; Aw et al., 2011). Finally, De Loecker et al. (2020) and De Loecker and Scott (2016) stress that the estimate for the markup in equation (8) is incomplete under a Leontief production technology. In this case, $\lambda_{it} = \lambda^l_{it} + \lambda^m_{it}$ holds, since both conditions of the Leontief function have to be met simultaneously, which requires taking the first-order condition of equation (4) for both parts of $Q(\cdot)$. The price margin over marginal costs is then defined as

$$\mu_{it} = \frac{P_{it}}{\lambda^l_{it} + \lambda^m_{it}} = (\frac{1}{\mu^l_{it}} + \frac{\lambda^m_{it}}{P_{it}})^{-1}. \tag{13}$$

The second component λ^m_{it} of the marginal costs can be derived from the first-order condition with respect to the intermediate input and is equal to p_M/θ^M_{it}. The output elasticity for the intermediate input is easily computed from rearranging $Q_{it} = \theta^M_{it} M_{it}$. Inserting both in the equation above yields

$$\mu_{it} = (\frac{1}{\mu^l_{it}} + \frac{p_M}{\frac{Q_{it}}{M_{it}} P_{it}})^{-1}. \tag{14}$$

Using the definition of the gross production value $S_{it} = P_{it}Q_{it}$ and correcting for the output measurement error, we obtain the final markup estimate

$$\hat{\mu}_{it} = (\frac{1}{\hat{\mu}^l_{it}} + \frac{p_M M_{it} e^{\hat{\epsilon}_{it}}}{S_{it}})^{-1}. \tag{15}$$

Appendix C Tables

Table C.1: Number of firms in 2004, 2008 and 2017

	micro		small		medium		large	
	%	N	%	N	%	N	%	N
2004	88.4%	226,669	10.5%	26,830	0.9%	2,373	0.2%	427
2008	89.3%	297,797	9.5%	31,599	1.0%	3,367	0.2%	684
2017	90.2%	462,890	8.6%	44,178	1.0%	5,347	0.2%	999

Source: German microdata of official statistics AFiD-Panel Strukturerhebung im Dienstleistungsbereich, doi:10.21242/47415.2007.00.01.1.1.0, 10.21242/47415.2017.00.01.1.1.0, own calculations.

Table C.2: Decomposition of labor productivity growth by firm size 2004-2017

	2004 to 2017		
labor productivity in EUR	micro/ small firms	medium/ large firms	**sum**
between-industry effect	-2,844	4,048	**1,204**
within-industry effect	-2,013	-1,485	**-3,497**
interaction effect	157	-236	**-80**
sum	**-4,700**	**2,327**	**-2,373**

Notes: 2015 constant prices. German microdata of official statistics AFiD-Panel Strukturerhebung im Dienstleistungsbereich, doi:10.21242/ 47415.2007.00.01.1.1.0, 10.21242/47415.2017.00.01.1.1.0, own calculations.

Table C.3: Consumption of professional services in the German economy in 2016

NACE	industry	share in total domestic intermediates production	share of NACE M in total intermediates consumed by this industry	industry's consumption share in all intermediates produced by NACE M
A	agriculture, forest and fishing	0.02	0.05	0.01
B	mining and quarrying	0.01	0.08	0.00
C	manufacturing	0.27	0.06	0.24
D	energy	0.03	0.04	0.01
E	water, waste and remediation	0.02	0.16	0.02
F	construction	0.05	0.03	0.02
G	trade, repair of vehicles	0.09	0.08	0.07
H	transportation and storage	0.10	0.03	0.02
I	accommodation and food	0.00	0.02	0.00
J	information and communication	0.07	0.06	0.03
K	finance and insurance	0.07	0.17	0.03
L	real estate	0.07	0.15	0.07
M	professional services	0.10	0.45	0.31
N	admin. and support services	0.08	0.19	0.07
O	public administration	0.02	0.06	0.02
P	education	0.01	0.01	0.00
Q	health and social care	0.01	0.04	0.01
R	arts and entertainment	0.01	0.07	0.01
S	other	0.01	0.03	0.00

Source: Destatis (2020).

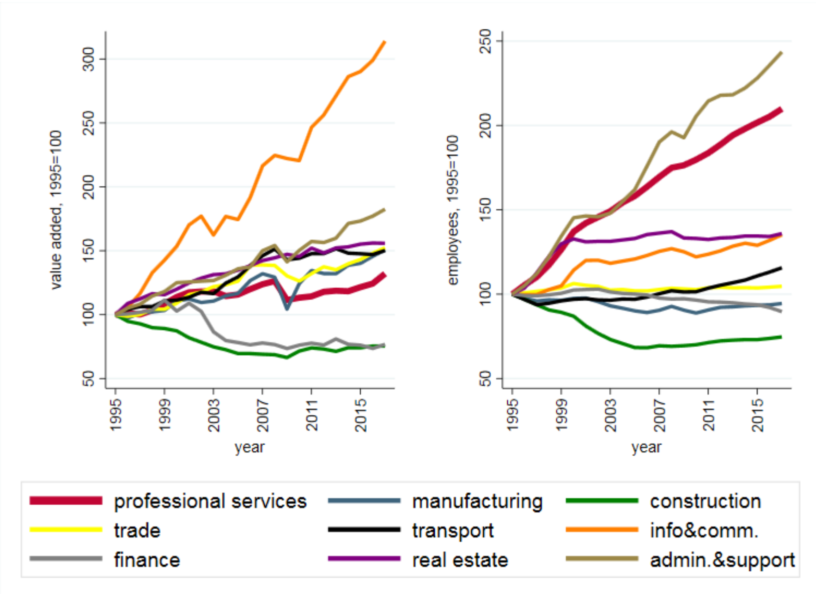
Table C.4: Sectoral input composition within professional services in 2016

NACE input	legal, management, consulting, and accounting	architecture, engineering, technical analysis	RnD	advertising and market research	veterinary and other activities	**NACE M**
A	0.00	0.00	0.00	0.00	0.00	**0.00**
B	0.00	0.00	0.00	0.00	0.00	**0.00**
C	0.02	0.02	0.14	0.04	0.06	**0.04**
D	0.01	0.01	0.03	0.01	0.02	**0.01**
E	0.00	0.00	0.01	0.00	0.01	**0.01**
F	0.03	0.02	0.03	0.03	0.05	**0.03**
G	0.02	0.03	0.08	0.04	0.07	**0.04**
H	0.02	0.01	0.09	0.02	0.04	**0.03**
I	0.00	0.00	0.00	0.00	0.00	**0.00**
J	0.07	0.09	0.12	0.49	0.14	**0.12**
K	0.03	0.04	0.05	0.03	0.05	**0.04**
L	0.10	0.15	0.05	0.09	0.08	**0.10**
M	0.61	0.48	0.15	0.13	0.33	**0.45**
N	0.05	0.07	0.10	0.05	0.07	**0.06**
O	0.04	0.05	0.02	0.05	0.05	**0.04**
P	0.00	0.00	0.09	0.00	0.01	**0.01**
Q	0.00	0.00	0.01	0.00	0.01	**0.00**
R	0.01	0.01	0.01	0.01	0.01	**0.01**
S	0.00	0.00	0.00	0.00	0.00	**0.00**
sum	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Source: Destatis (2020).

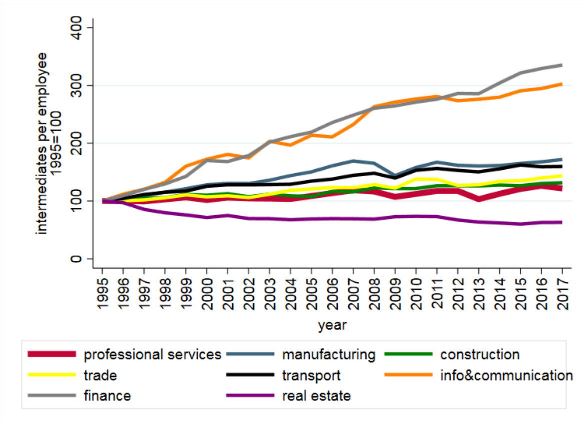
Appendix D Figures

Figure D.1: Employment and value added growth in German industries since 1995



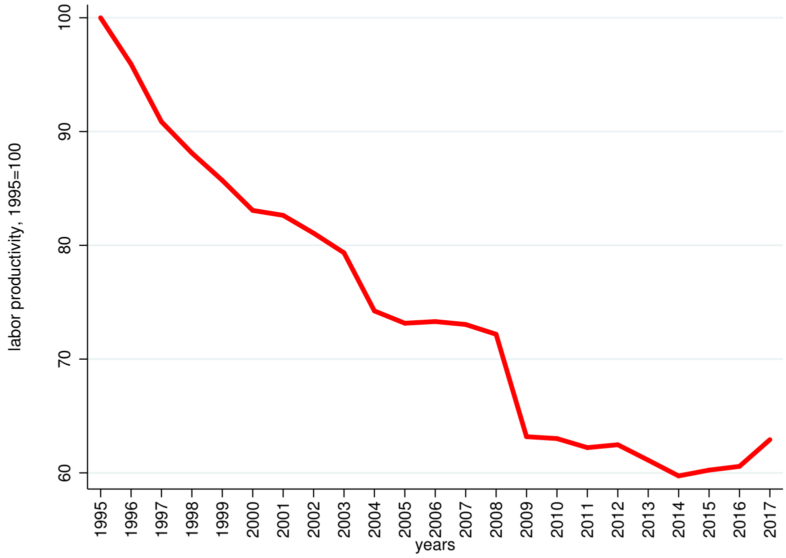
Source: Destatis (2020): national accounts, domestic product 2019

Figure D.2: Average expenditure for intermediate goods and services per employee



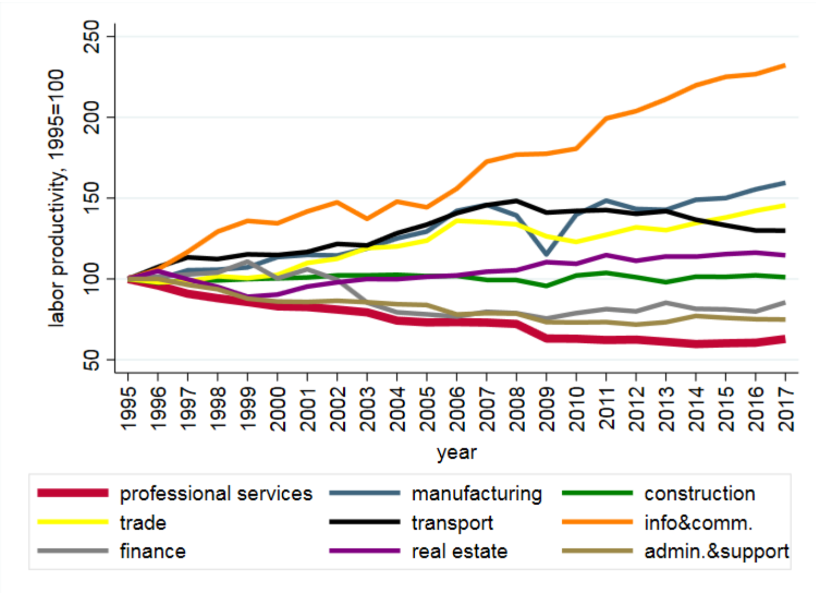
Source: Destatis (2020): national accounts, domestic product 2019

Figure D.3: Labor productivity growth in German professional services since 1995



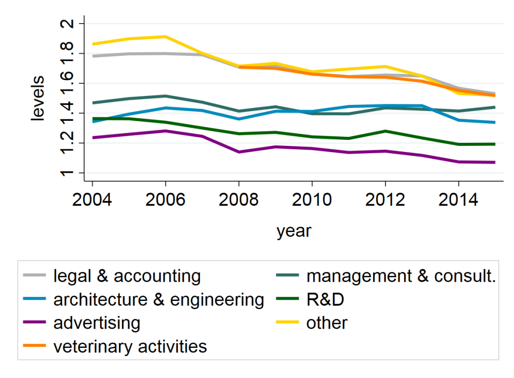
Source: Destatis (2020): national accounts, domestic product 2019

Figure D.4: Labor productivity growth in the German business economy since 1995

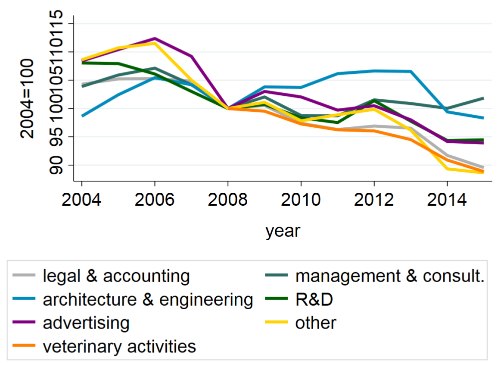


Source: Destatis (2020): national accounts, domestic product 2019

Figure D.5: Average (mean) markups in professional services by 2-digit industry between 2004 and 2015



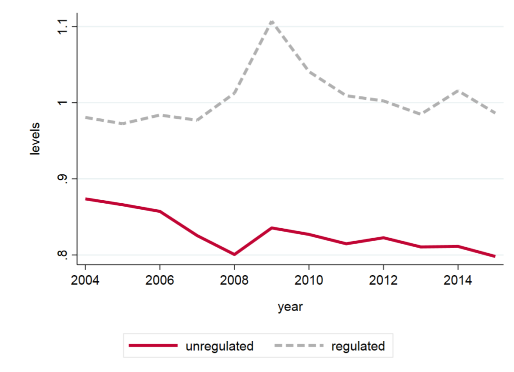
(a) levels



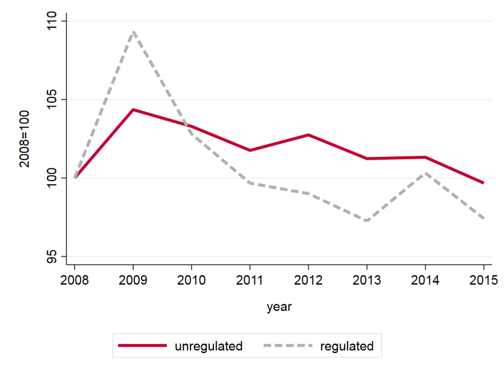
(b) growth since 2004

Source: German microdata of official statistics. AFiD-Panel Strukturerhebung im Dienstleistungsbereich, doi:10.21242/ 47415.2007.00.01.1.1.0, 10.21242/47415.2017.00.01.1.1.0, own calculations.

Figure D.6: Weighted mean markups in professional services between 2004 and 2015



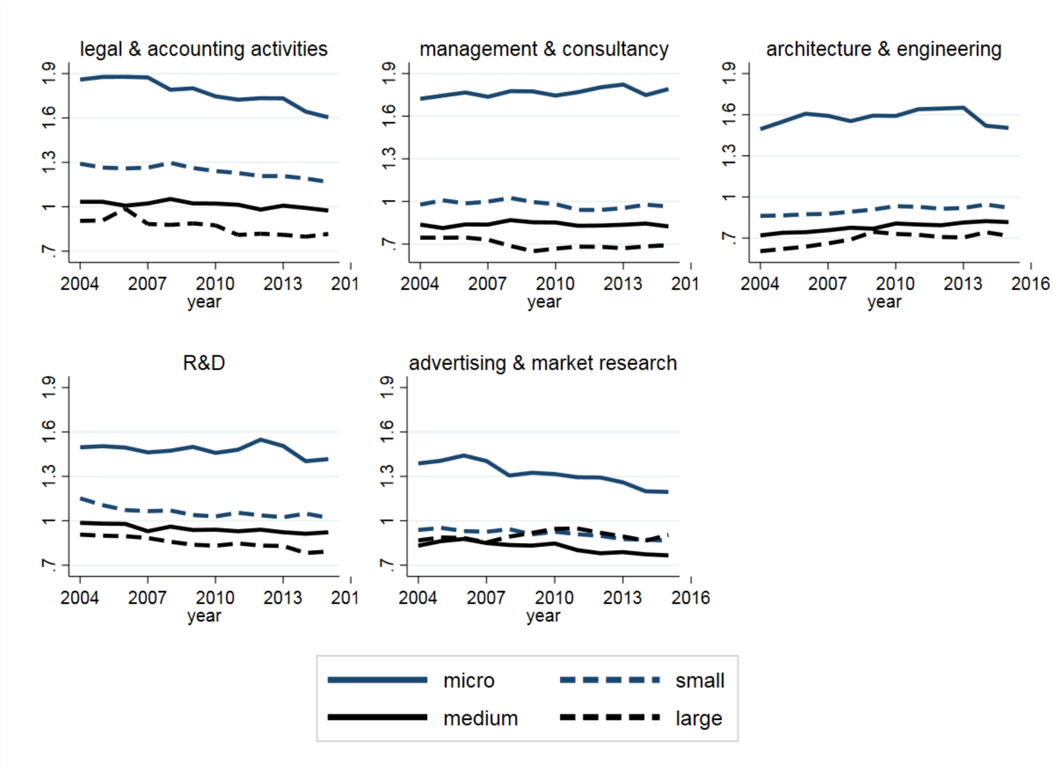
(a) levels



(b) growth since 2004

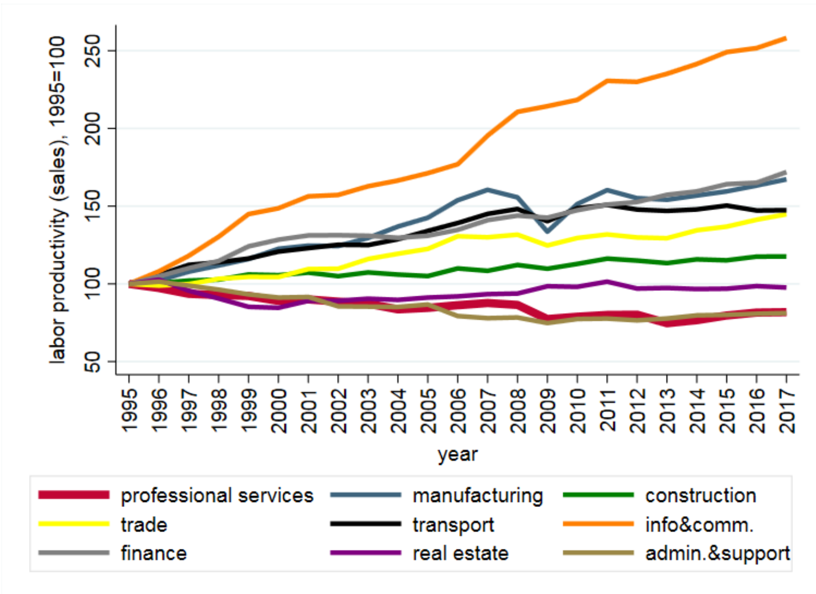
Source: German microdata of official statistics. AFiD-Panel Strukturerhebung im Dienstleistungsbereich, doi:10.21242/ 47415.2007.00.01.1.1.0, 10.21242/47415.2017.00.01.1.1.0, own calculations.

Figure D.7: Markups in professional services by industry and size between 2004 and 2015



Source: German microdata of official statistics. AFiD-Panel Strukturerhebung im Dienstleistungsbereich, doi:10.21242/ 47415.2007.00.01.1.1.0, 10.21242/47415.2017.00.01.1.1.0, own calculations.

Figure D.8: Labor productivity growth based on sales in the German economy since 1995



Source: Destatis (2020): national accounts, domestic product 2019