

# The Effect of Innovation on Productivity in Services: Evidence from Germany

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## ABSTRACT

Innovation has already been in the past an important driver for change, performance and competitive advantage. Due to the constantly changing and more complex environment through instant flow of information, it gets increasingly more important nowadays. While the manufacturing sectors applied innovation in various ways, the structural transformation entails innovation to services. However, the corresponding amount of research is scarce and its implications for organizational change and company's productivity. Hence, this research study aims to investigate the effect of innovation on productivity in service firms in Germany. The results suggest that innovation and productivity are negatively related.

## Keywords

Innovation, strategic management of innovation, productivity, service industries, Germany.

## INTRODUCTION

Innovation as "the successful exploitation of new ideas" (Beacham, 2006, p. 3) has its origin in the early human desire for knowledge and advancement. While the steam engine and the industrial steelmaking triggered the revolution in the 18th and 19th centuries, personal computers and the internet are recent developments. Despite their radically new characteristics, the productivity gains of those inventions have been utilized compared to 20 years ago. New breakthrough innovations such as AI start causing little gains in the initial phase, whilst rising in later ones.

In addition to curiosity and the desire for change, innovation has been widely perceived as key element of competition and efficiency in markets. Thus, the strategic management of innovation denotes a critical imperative for a firm's successful differentiation in the marketplace. It represents a significant component of the overall corporate strategy (Hamel, 2000). It does not only support firms in gaining competitive advantage, but it also enables them to exploit changing market opportunities and customer demands creating value and growth in the long-run.

Despite this optimism, the relationship between innovation and productivity remains unclear. Previous studies investigated the manufacturing sector facilitated through easily accessible and measurable data. The last quarter of the 20th century, however, witnessed a development of advanced economies that increasingly moved towards services (McKee, 2008). This growing economic importance is also illustrated by the increase of the total employment share by 21 percentage points in the European Union making the services to the most important industries.

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Although institutions such as Eurostat started gathering data from service firms and made it available, the empirical findings concerning the impact of innovation on the service sector are still limited. This, particularly, applies to the link between innovation and productivity so that it remains unclear if services experience a similarly positive relationship between innovation and productivity as the manufacturing sector. The purpose of this study is to fill this gap by examining the following research question: *To what extent does innovation effect the productivity of service firms?*

While innovative, non-innovative, technological and non-technological innovations were used to explain the effect of innovation, the metric of sales per employee was applied as a proxy for productivity. The empirical results of the statistical analysis suggest that innovation is negatively associated with productivity. Consequently, firms engaging in innovation experience a slowdown of productivity.

## INNOVATION

Innovation has begun to occupy a pivotal role in research and practice. The increasing prominence of this topics has evoked a plethora of models, frameworks, classification and definitions of innovation. In the early stages, innovation was defined as company's development of ideas and practices perceived to be new (Damanpour, 1991). In contrast, recent studies emphasize the positive impact of innovation such as the value added to company's stakeholders (du Plessis, 2007). Despite the large amount of research evoking high differences, a consensus can clearly be identified indicating that novelty is a central concept of innovation, supporting firms in strengthening their competitive position.

When narrowing down the definitions to specific types of innovation, a similar manifold characteristic exists. Nevertheless, the definition of Schumpeter and Opie (1934) received much approval summarized in the following areas: product innovation, process innovation, marketing innovation and organizational innovation. The first two types are linked to the concept of technological innovations, while the latter types describe recent developments as non-technological innovations. Those developments can be mainly explained by the movement to tacit knowledge and intangible resources.

Hence, the impacts of innovation can range from effects on sales and market share, to changes in productivity and efficiency while firms often try to increase demand or reduce costs through innovation to improve their overall performance (OECD & Communities, 2005). Thus, the increasing usage of innovation as performance indicator makes it an important element of firm's business strategy. Innovation enables firms to not only defend their current position but also seek out for new competitive advantages.

The previously derived point can clearly be identified as the research area of strategic management of innovation

focusing on the use of strategic management techniques and measures. Apart from its purpose to enhance the positive impact on firm's growth and performance, its role got more important in recent years due to the more complex and dynamic environment, characterized by an instant and constant flow of information.

### **Innovation in the Service Industry**

Particularly, the amount of information is a key feature of the service industry triggered by the structural transformation. Since this movement from a technology-based economy established by industrial manufacturing to a service society with knowledge as a key resource requires an alteration of the innovation process. Moreover, the specific characteristics of services such as heterogeneity, intangibility and perishability make innovation more complicated compared to innovation in industrial sectors. In addition, the close interaction between the service provider and the customer complicates this classification. Consequently, instead of a clear distinction between various innovations, a continuous process with series of incremental changes takes place.

It has revealed that innovation plays an important role for companies to advance, compete and successfully differentiate themselves in the market. Thus, innovation is a key driver for productivity and market growth. Despite its importance of productivity, limited empirical research about this area exists (Gummeson, 2014). Nevertheless, it appears as if service productivity has not improved in the past, in contrast to the manufacturing industry. This might also be the reason for the unclear statement about the link between innovation and productivity. To fill this gap, the research study aims to apply this link to the service sector in Germany. Thus, the following research question can be derived: *To what extent does innovation effect the productivity of service firms?*

Due to the limited amount of research on innovation in the service sector, the author first investigates if service firms tend to innovate or not before delving deeper into specific types of innovations. As the literature has shown that firms innovate to achieve a higher level of efficiency and higher amount of sales while simultaneously reducing their costs, the first hypothesis is defined as follows (OECD & Communities, 2005):

*H1: Innovative firms in the service industry have a positive correlation with productivity*

In contrast, other researchers proved that some firms do not innovate due to external factors such as low and/or high uncertain market demand and low degree of competition. On the other hand, the required financial and human resources are missing, and no government grants/subsidies are obtained. To estimate the link between non-innovators and productivity, the next hypothesis is formulated as follows:

*H2: Non-innovative firms in the service industry have a negative correlation with productivity*

Due to the characteristics of the service sector, innovations in product and process cannot be separated accurately. Instead the distinction between technological and non-technological innovations is more valuable (Mansury & Love, 2008). The aim of demand increase and cost reduction result in the third hypothesis:

*H3: Product and/or process innovations have a positive*

*effect on the productivity of service firms*

Moreover, it appears that resources tend to be more intangible, whereas, particularly, knowledge and learning are more important. Derived from the finding with the high intangibility, and importance of human capital in services, the next hypothesis examines the effect of organization and marketing innovation:

*H4: Organization and/or marketing innovations have a positive effect on the productivity of service firms*

Despite the popular distinction between technological and non-technological innovations, past research studies have also shown that companies do not strictly follow only one innovation strategy. The likelihood of introducing another innovation type is higher, when one type is already in place so that the joint relationship to productivity is of high interest. Thus, the following hypothesis assumes a higher level of productivity due to the joint and simultaneous adoption of innovation strategies:

*H5: Product and/or process innovations and organization and/or marketing innovations combined have a positive effect on the productivity level of service firms*

### **METHODOLOGY**

To investigate the effect of innovation on the productivity of service firms, data from the Community Innovation Survey (CIS) 2016 gathered in Germany has been used. The CIS is a harmonized survey about business innovation activities in firms conducted every two years by the National Statistical Offices and administrated by Eurostat. It consists of cross-sectional data broken down by country, the type of innovators, economic activities and, size classes. The reference period of innovation activities is 2014-2016, whereas the reference year for expenditures, employments and sales figures is 2016. Furthermore, the random sample is stratified by firm size and 2-digit industries and regions in Germany (Eurostat, 2019).

In the past, Germany has heavily expanded its tertiary sector through structural change and now encompasses the highest number of service firms adopting innovations. The investigated services in Germany are classified according to NACE Rev. 2 which covers the following service sectors: wholesale trade, transportation and storage, information and communication, financial and insurance activities, and other business activities and other services.

### **Empirical Model**

To analyze the relationship between productivity and innovation, a modified version of the widely used structural model established by Crépon, Duguet and Mairesse (1998), known as the CDM model, has been estimated. This model is comprised of three equations; while the first two equation define and use R&D as innovation indicator, the third one called productivity equation links productivity and innovation outputs (Crépon, Duguet & Mairesse, 1998). This equation is also known as the Cobb-Douglas production function and will be used as a foundation estimated by ordinary least squares, with robust correlation matrix. Since all five models did not meet the regression assumptions, the natural logarithm transformation has been applied.

As the output per employee is a common measure for productivity, the sales per employee in year 2016 has been

used to examine the impacts of innovation on productivity. The average labor productivity of the German service sector is €13.37 million, whereas the manufacturing sector accounts for €0.589 million based on the CIS 2016 results. Furthermore, the innovation output is measured as suggested by the literature based on product, process, marketing and organizational innovation (OECD & Communities, 2005). For instance, the product innovations are measured in terms of turnover generated by newly launched products. To account for external factors, number of employees and number of firms have been used as control variables.

## RESULTS

The table below illustrates the overall descriptive statistics for each variable without the natural logarithm transformation. Likewise, it indicates that the dataset encompasses 26 service sectors. While Wholesale Trade is the largest sector with 24,043 firms, the smallest sector - Air Transport - consists of only 129 firms. However, the latter does not have the lowest number of employees, instead Water Transport employs the least number of workers. Furthermore, the highest labor productivity was the Legal and Accounting Activities sector, while Wholesale Trade displays the lowest level despite its volume.

When comparing innovative and non-innovative firms in terms of absolute turnover in 2016, it is revealed that the share of innovative firms ( $M = 85.00$ ,  $SD = 179.12$ ) has a higher average turnover measured in billions of EUR than the share of non-innovative firms ( $M = 12.86$ ,  $SD = 37.80$ ). Although some firms do not innovate, it seems that their average turnover ( $M = 12.86$ ,  $SD = 37.80$ ) is higher than those carrying out non-technological activities ( $M = 10.54$ ,  $SD = 26.58$ ).

Table 1

*Descriptive statistics – Distribution of non-transformed variables*

	N	Min	Max	Mean	SD
(1) Number of firms in sector	26	129	24,043	4221	5372
(2) Number of employees in sector	26	28,903	1,326,869	306,607	318,539
(3) Sales per employee	26	0.71	31.82	13.37	8.53
(4) Innovative enterprise	26	5.28	741.06	85.00	179.12
(5) Non-innovative enterprise	26	0.24	195.91	12.86	37.80
(6) Product and/or process innovative enterprise	26	1.00	105.41	14.92	26.71
(7) Organization and/or marketing innovative enterprise	26	0.42	137.20	10.54	26.58

Furthermore, the correlation indicates that innovative enterprise and product and/or process innovative enterprise are measured similarly. This also applies to the transformed variable of non-innovative enterprise and organization and/or marketing innovative enterprise.

## Regression Analysis

When estimating all five regression models, it reveals that they all explain between 67.0% and 70.2% of the variance and have a significant p-value. Thus, each estimated model indicates a link between innovation and productivity. However, the results of the first hypothesis show that instead of a positive link between innovative firms and productivity, a negative relationship exists. A similar negative pattern can be noticed when investigating the second hypothesis. In this case, there is enough evidence to support the hypothesis that the increase of turnover of non-innovative firms leads to a decrease in labor productivity. For model 3, a positive link between product and/or process innovation and productivity was estimated which turned out to be negative. Furthermore, organization and/or marketing innovative firms are also negatively related to labor productivity. For the last hypothesis, technological and non-technological innovations

were used as predictors. Instead of confirming the assumed joint significance, it appears that those variables only significantly contribute to the model individually. Hence, the variable product and process innovation does not show a link between labor productivity, whereas organization and marketing innovation is negatively related to productivity.

## DISCUSSION

Although the results of this research have shown a negative link between innovation and productivity and not a positive one as assumed, valuable insights are provided. Brynjolfsson and Hitt (2003) argue that the productivity increase is slow and might be, therefore, only noticed in the long-run. Thus, the examined sample might experience the “productivity paradox” describing the dramatic shrinkage of the American service sector in the 1990s. Due to deregulation and foreign direct investments, the service sector had a higher degree of competition which, in turn, led to inefficiency. In the past, the service sector, was often described as residual, dependent on the manufacturing industry, technologically backward.

Although both innovative and non-innovative firms have a negative link to productivity, it is stronger for innovators as those activities involve high level of uncertainty, risk and investments. Particularly, the latter is for small firms challenging due to the limited access to financial and human resources (Mansury & Love, 2008).

Furthermore, the characteristics of services might also explain the unexpected results of the study since a diversity between the sectors cannot only be identified, but also within the sectors different trends exist. When continuing this line of thought, the heterogeneity in the types of innovation makes the estimation more difficult. In addition to the structural change, a clear movement from manufacturer-centric innovative approach to user-centered innovation process can be identified. Consequently, the increase in the heterogeneity of customer requests causes a slowdown.

When applying the line of reasoning of the “productivity paradox” to the micro-level, a similar phenomenon exists called the disruptive effect. This effect arises after introducing a new product to the manufacturing plant which disrupts the production and leads to short-term reduction in productivity (Freel & Robson, 2004). Deriving from the present research results, it appears that this effect can also be observed for services. Since new product or process innovations might require alteration of staff qualifications, training needs evolve resulting in productivity slowdown.

Although past studies, particularly, emphasized the positive association of non-technological innovation with productivity and its importance for achieving competitive advantage, this study on the German service sectors reveals a pessimistic view. This might be due to various regulations in terms of customer protection. Passing new regulations can also require the implementation of new work structures or new knowledge management systems which involves in a long-term adaption and learning process.

Another interesting finding is shown by the combined effect of technological and non-technological innovations. Whereas both types of innovation indicated a negative significant impact on innovation individually, technological innovation does not demonstrate a connection with

productivity as non-technological innovation does in the joint model.

## CONCLUSION

This study has investigated the association between the innovation and productivity of the service sectors in Germany, in the form of the discrepancies between innovative and non-innovative firms, technological and non-technological firms and labor productivity. The interest and the importance of innovation has constantly increased over the past years. By being innovative, firm, particularly, try to improve their performance, gain competitive advantage and exploit changing market opportunities. Although business leaders share an overall optimistic view about the impact of innovation, the link between productivity and innovation still remains unclear in the service sector due to the scarce amount of research.

The empirical results based on services in Germany suggest a link between innovation and productivity which, however, results in a productivity slowdown. On the other hand, the assumption that non-innovators have a negative relationship with productivity was confirmed. It was also found that technological and non-technological innovations cause a decline in labor productivity, while their combined effect seems to be different. Thus, the analysis supports the assumption that organization and marketing innovation play a decisive role for services, while product and process innovations are less important. In conclusion, this paper has contributed to the body of literature on innovation in services by discovering that innovation has negative and significant effects on productivity.

The study likewise indicates important managerial and societal implications. On the one hand, managers should be aware that due to the characteristics of services, attempts to measure innovation and productivity might not be accurate or possibly misleading. Hence, they should be careful in drawing conclusions about changes in efficiency, technological improvements, and the industry competitiveness. Nevertheless, innovation illustrates an important contribution to a firm's success. Although a productivity slowdown might exist, it is still recommendable that firms innovate and make innovation an integral component of firm's strategy. As in long-run, the likelihood of succeeding and gaining sustainable competitive advantage is high. On the other hand, policy makers should extend the existing programs of the manufacturing sector to services to incentivize firms to innovate. Those programs cannot only maximize the social returns, but they also trigger knowledge sharing and spillovers through innovation collaborations.

The lack of publicly available data regarding innovation limited the scope of this study to the German service sector. Thus, the small sample size reduced the robustness of the statistical analysis. Apart from restricted number of variables, the natural logarithmic transformation has to be applied to satisfy the regression assumptions. Furthermore, the characteristics of the CIS questionnaire might trigger subjectivity leading to biases from respondents. Future research could use micro-data so that the sample size would increase. Due to the history of the divided Germany, it might be interesting to investigate the differences in German regions. The observation of dynamics over time would help to derive future patterns in terms of innovation and the

addressed productivity paradox.

Despite the cautious interpretation of the results, the study highlighted the importance of innovation for service firms. Ambiguous characteristics and difficulties in measurement should not deter firms from continuously innovating. In contrast, the embracement of such experiences is decisive to learn and exploit future productivity opportunities which might trigger new breakthroughs such as AI.

## ROLE OF THE STUDENT

Laura Kraus was an undergraduate student supervised by the PhD candidate Jandre Jansen van Rensburg. The topic was proposed and developed by the student individually. The design of the research, the quantitative analysis, the processing of the results, the formulation of the conclusion and the academic writing were completed by the student.

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