

The importance of broadband Internet for businesses' innovative success

The efficient use of modern ICT solutions requires a high-performance broadband infrastructure. The European Commission (EU 2020 strategy) and the German government (broadband strategy) have therefore called for a massive expansion of broadband Internet access. This study by the Centre for European Economic Research (ZEW) shows that broadband Internet is a significant driving force for innovation in German companies. In the early phase of DSL expansion (from 2001 to 2003), firms using broadband Internet access were able to increase the probability of realizing product and process innovations by 25 percentage points on average. Broadband Internet has been a catalyst for innovation particularly in the service sector.

Information and communication technologies (ICT) play a key role in productivity and growth. ICT benefits enterprises in all industries, especially when it comes to product and process innovations. ICT applications can help business processes run more smoothly and make a key contribution to innovations or improvements in products and services. A high-performance broadband infrastructure is essential for any company seeking to efficiently utilize the potential of the latest ICT solutions.

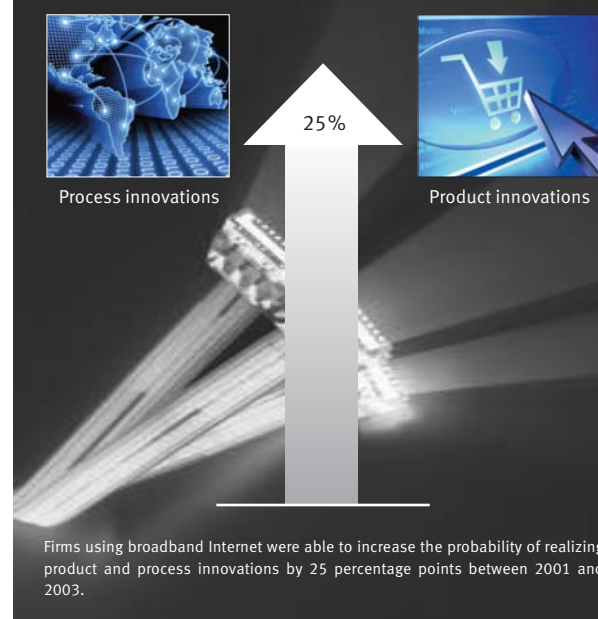
Global networking allows products and services to be offered not just in the domestic market but also far beyond the borders of the home country. Networking also facilitates knowledge transfer and allows tasks to be distributed in ways that were not feasible until a few years ago. Many studies have confirmed the positive effect of ICT on economic growth in general. However, so far little empirical research has been conducted into the effects of broadband Internet on innovation activities in companies. In this study, ZEW investigates the significance of broadband Internet for innovation in companies. The study looks at an early phase of DSL expansion in Germany (from 2001 to 2003).¹ While transmission rates of 50 Mbit/s or more are available in many regions today, the first DSL lines offered a maximum download speed of 768 kbit/s. In this early diffusion stage, the parameters "broadband usage at the company level" and "broadband availability by postal code" varied sufficiently to enable differences to be identified between companies that had broadband and those that did not.

In contrast to empirical analyses which are limited to pointing out correlations, this study uses econometric methods which

make it possible to identify causal effects of broadband use on a company's success. The results show that broadband Internet significantly stimulated the implementation of product and process innovations in the early phase of DSL expansion between 2001 and 2003.

Companies which had broadband Internet access showed an increased tendency to innovate compared to the case of not having broadband Internet. The findings highlight the contribution that broadband Internet has made to the competitiveness of German companies.

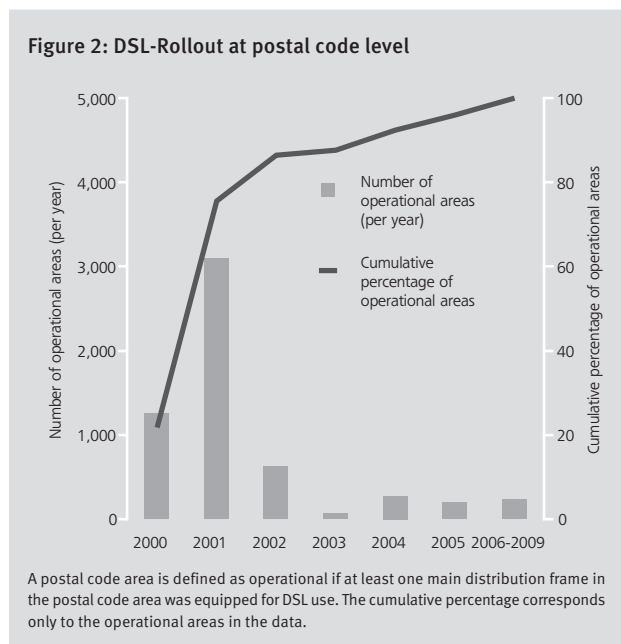
Figure 1: Broadband Internet triggers innovation



¹ The DSL network was first implemented in a few cities in mid-1999 and began to be expanded on a large scale in 2000.

Comprehensive data basis with more than 4,500 companies throughout Germany

The analyses are based on a broad data basis. Firstly, the investigation used data on DSL availability provided by Deutsche Telekom. Secondly, the 2002 and 2004 waves of the ICT survey conducted by ZEW were used. Each time the survey covered some 4,500 German companies in manufacturing in-



dustry and selected service sectors that had five or more employees. The data contains detailed information on the use of various ICT applications, the type of Internet access and the number of employees and their qualification structure.

The analysis included the following variables:

Broadband

- ▶ Broadband usage in the company in 2002, where broadband means DSL or a leased line²
- ▶ DSL availability by postal code

Performance variables

- ▶ Implementation of product and process innovations in the period 2001 to 2003 (yes/no)

ICT intensity

- ▶ Proportion of employees who work mainly on a computer

As Fig. 2 shows, the DSL broadband network was expanded rapidly between 2000 and 2002. By the end of 2002, DSL was operational in 86.5 percent of postal code areas, i.e., at least

one main distribution frame in the postal code area was equipped for DSL use. The benefit of using the 2002 and 2004 waves of the ICT survey is that they relate to a period that follows on from the initial phase of DSL expansion. During this period there was still great variation between companies in respect of the availability and use of broadband. If a later period is considered, DSL coverage has already progressed so far that it becomes hard to find businesses located in postal code areas in which DSL is unavailable. The measure for DSL availability used below is the number of days on which DSL was available in the respective postal code area up to the cut-off date December 31, 2001. The descriptive statistics for company data (see Table 1) show that a total of 61 percent of the companies surveyed used broadband in 2002. On average, companies with broadband Internet access have higher revenues and more employees than companies without broadband (not shown). They also have a higher ICT intensity. In companies that have broadband, an average of 59 percent of employees work on a computer. In companies without broadband this figure is 41 percent.

Regarding labor productivity, there is not that much difference between companies with or without broadband Internet. Companies that have broadband Internet generate on average eleven percent more revenue per employee than companies without broadband Internet. The differences are more

Table 1: Descriptive statistic

	All	Firms without Broadband	Firms with Broadband
Percentage of employees, working mainly on a computer	0,52 (0,34)	0,41 (0,33)	0,59 (0,33)
Broadband use	0,61 (0,49)		
Labor productivity 2003 (Sales in Mill. EUR per employee)	0,20 (0,30)	0,18 (0,22)	0,20 (0,27)
Percentage of firms with realized product innovations in the years 2001 – 2003	0,63 (0,48)	0,55 (0,50)	0,71 (0,46)
Percentage of firms with realized process innovations in the years 2001 – 2003	0,74 (0,44)	0,66 (0,47)	0,80 (0,40)
Percentage of highly qualified employees	0,21 (0,25)	0,15 (0,22)	0,25 (0,27)

Broadband use = DSL or leased line 2002. Databases is the ZEW ICT-Survey 2002 and 2004. Averages and standard deviations (in brackets).

² No distinction was made between different broadband technologies. Different analyses indicate that DSL and leased lines do not have different effects on the performance indicators in question.

marked when it comes to process and product innovations. Among broadband users, the proportion of companies which have implemented a process innovation is 21 percent higher than among non-broadband users. The descriptive analysis shows which company characteristics may be associated with broadband usage and with the success of the company. The extent to which these factors are statistically significant is examined using econometric analyses.

Analysis of innovation activities

The analysis is focused on two measures of innovation in order to investigate the significance of broadband Internet for the implementation of innovations. The process innovation variable measures whether a company introduced new or noticeably improved processes between 2001 and 2003. Similarly, the product innovation variable measures whether a company brought new or noticeably improved products or services onto the market between 2001 and 2003.³

Hence both variables are qualitative and take the value “one” if an innovation was realized or the value “zero” if this is not the case. Thus the results relate to a period of three years. Innovative success occurred if at least one process or product innovation was realized between 2001 and 2003. The analysis applies estimation methods that take into account the fact that the innovation variables are binary. On the other hand, the fact that a company’s broadband usage may depend on its innovation activities and that it is precisely the companies that use broadband that are in any case more innovative (reverse causality) is considered in the analysis.

What effect does broadband Internet have on innovative success?

The empirical analysis looks at the realization of process and product innovations as a measure of a company’s success. Econometric estimations are performed in order to be able to say what factors are statistically significant for explaining this measure of success.

Broadband Internet promotes innovation

The results of the analysis (see Table 2) show that broadband Internet significantly stimulated the implementation of product

and process innovations in the early phase of DSL expansion from 2001 to 2003. Companies that used broadband Internet were on average 25 percentage points more likely to implement a process innovation. Compared to the case of not having broadband Internet access, companies which had broadband Internet access showed a markedly increased tendency to innovate. For the product innovations as well (see Table 2), positive and significant effects of broadband usage can be seen in most of the estimates. These effects are roughly of the same order of magnitude as those for the process innovations, although they have a lower significance level. Using broadband Internet also increased the likelihood of bringing new or noticeably improved products and services onto the market by 25 percentage points on average. Thus broadband Internet has a positive impact on product and process innovations in businesses in all sectors. These effects are particularly pronounced in the service sector. Business processes can be re-designed. Via an Internet-based customer relationship management system, for example, new services can be offered to accompany products. In this way, customers become more involved in internal production processes and companies can react more quickly to changes in demand.

Conclusion

The study shows that broadband Internet is a significant driving force for innovation. Broadband usage in companies stimulates the realization of process and product innovations. It therefore makes a significant contribution to companies’ competitiveness. This analysis looks at a relatively early stage of DSL expansion. This has the crucial advantage that differences between companies with and without broadband Internet can be clearly identified. The analysis methods also allow cause and effect relationships to be specified more precisely.

In the current debate on higher broadband speeds and the expansion of the broadband infrastructure, the question arises as to whether such improvements will result in positive effects similar to those seen with the introduction of DSL. At any rate, new applications and services with higher bandwidth requirements are creating a need for the further systematic expansion of the broadband infrastructure. The fragmentation of value chains and, associated with that, a more distributed organizational structure in companies along with continually increasing employee mobility – to give just a few examples – call for high-performance Internet connections. Cloud computing (Internet-based computing where shared resources are provided

³ The definitions of product and process innovations are based on the definitions set out by Eurostat and the OECD in the Oslo Manual.

Table 2: Innovations 2001-2003

	Processes	Products
Broadband use ¹	+	+
Employees	0	+
Investment	+	0
Past product innovations	+	+
Percentage of employees, working mainly on a computer	0	0
Percentage of highly qualified employees	0	+
Observations	982	978

“Plus” indicates a positive and significant coefficient, “Minus” a negative and significant coefficient and “Zero” a statistically insignificant coefficient.

1. Broadband use = DSL or leased line 2002 (ZEW ICT-Survey). Two equations with broadband use and process or product innovations are estimated simultaneously. DSL availability is used as an exclusion restriction in the broadband use equation. Explanatory variables use a one period lag. Industry, export and location (Eastern vs. Western Germany) dummies as well as the GDP per capita at a county level are included in all estimations.

on demand) requires high bandwidths for fast access, both for efficient processes and for handling orders. It seems reasonable to assume that the move to higher bandwidths will give a further boost to innovation activities in businesses, but this remains to be seen.

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The detailed project report is available at:
<http://www.zew.de/breitbandstudie2010>



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