Information Economics and Policy 25 (2013) 190–203

Contents lists available at SciVerse ScienceDirect

Information Economics and Policy

journal homepage: www.elsevier.com/locate/iep

More bits – more bucks? Measuring the impact of broadband internet on firm performance

Irene Bertschek [a,*], Daniel Cerquera [b], Gordon J. Klein [c]

[a] ZEW Mannheim, ICT Research Group, P.O. Box 103443, D–68034 Mannheim, Germany
[b] ZEW Mannheim, ICT Research Group, Germany
[c] Heinrich-Heine-University of Düsseldorf, Düsseldorf Institute for Competition Economics (DICE), Germany

ARTICLE INFO

Article history:
Available online 5 December 2012

JEL classification:
D22
L23
O31

Keywords:
Labour productivity
Product and process innovation
Broadband Internet

ABSTRACT

The paper provides empirical evidence for the causal impact of broadband Internet on firms' labour productivity and realised process and product innovations. The analysis refers to the early phase of DSL expansion in Germany from 2001 to 2003, when roughly 60% of the German firms already used broadband Internet. Identification relies on instrumental variable estimation taking advantage of information on the availability of DSL broadband at the postal code level. The results show that broadband Internet has no impact on firms' labour productivity, whereas it exhibits a positive and significant impact on their innovation activity.

1. Introduction

Numerous empirical studies at different levels of aggregation demonstrate the important role of information and communication technologies (ICTs) for economic performance.[1] As general purpose technologies (Bresnahan and Trajtenberg, 1995), ICT enable firms to reshape their business processes and to improve their products and services (e.g. Brynjolfsson and Saunders, 2010). Firms' innovation activity in turn increases labour productivity, thereby entailing growth and competitiveness.

In order to reap the potential benefits of ICT, policy makers and industry representatives denote the availability of an efficient broadband internet infrastructure as being essential. Broadband internet is defined as Internet access provided at a certain high level of speed. The particular definitions are heterogeneous and cover a wide range of actual speed.[2] However, in many regions across the US and in European countries internet access is not available at any speed that can be defined as broadband. Fostering the availability of such infrastructures has therefore been declared a policy objective of European countries and of the US.[3]

Even though the benefits of broadband internet seem to be undisputed among policy makers, empirical evidence on the benefits is inconclusive. A causal, positive effect of telecommunication infrastructure on economic performance has already been presented in the literature (Röller and Waverman, 2001). There are some studies (Koutroumpis,

* Corresponding author.
E-mail addresses: bertschek@zew.de (I. Bertschek), cerquera@zew.de (D. Cerquera), klein@dice.hhu.de (G.J. Klein).

[1] See for instance the recent comprehensive study by Van Reenen et al. (2010) as well as Draca et al. (2007), Van Ark et al. (2008) and Jorgenson et al. (2008).

[2] For instance, the OECD defines the lower bound of broadband internet as Internet access with speeds above 256 kbits per second. However, in their analysis (OECD, 2009) they also distinguish between different speeds that are by far more rapid.

[3] For example, the Federal Communications Commission (2010) has published a detailed broadband strategy, the European Commission (2010) defines broadband deployment as one goal in its Europe 2020 strategy and the German Federal Ministry of Economics and Technology (Bundesministerium fnr Wirtschaft und Technologie, 2009) announced broadband deployment as a policy objective, too.

0167-6245/$ - see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.infoecopol.2012.11.002

2009; Czernich et al., 2011) showing positive effects of broadband internet on economic growth at the aggregate level. By contrast, empirical evidence on the causal impact of broadband on firm performance is still lacking.

This paper provides empirical evidence on the causal impact of broadband Internet on firm performance using a sample of German manufacturing and services firms. Firm performance is measured in terms of labour productivity and realised product and process innovation. The data base stems from a business survey and was collected by the Centre of European Economic Research in the years 2002 and 2004 (ZEW ICT Survey). This data contains detailed information on the economic characteristics, performance and ICT use of the sampled firms for the years 2001 and 2003, including the use of broadband internet. Given that broadband usage might be influenced by firms' economic performance (i.e. reverse causality), an instrumental variable approach is used to control for potential endogeneity of broadband usage at the firm level. We use DSL availability at the postal code level as instrumental variable for firms' broadband usage. The focus on the early phase of DSL expansion in Germany (from 2001 to 2003) allows us to exploit differences in the rate of broadband usage across German firms.[4]

The paper provides two main results. First, even though the econometric analysis shows a positive correlation between labour productivity and the use of broadband internet, this effect is not robust when controlling for endogeneity and different sources of variation. Using an instrumental variable approach, we show that the impact of broadband internet on firms' labour productivity is highly heterogeneous among German firms and not statistically different from zero. Second, the impact of broadband internet on firms' innovation activity is positive, significant and robust with respect to different specifications. This suggests that broadband internet enabled firms to reorganise and reshape their business processes and to improve their products or services. This innovation activity induced by broadband usage may have been translated into productivity gains in later periods, as suggested by the vast empirical evidence on the productivity effects of innovation.

2. Background discussion

In their seminal paper, Röller and Waverman (2001) show that investment in telecommunication infrastructure has causal positive and significant effects on economic growth. In order to identify causal effects and to take account of endogeneity they estimate a structural multi-equation model. Their data base comprises a time period of 20 years and 21 OECD countries. The results suggest that the positive effect resulting from investment in telecommunication infrastructure is stronger as soon as a critical level of telecommunication penetration is reached.

Previous work shows evidence for the economic impact of telecommunication investment on growth for developing versus developed countries (Hardy, 1980), for the US (Cronin et al., 1991) and for manufacturing versus services sectors (Greenstein and Spiller, 1995). Subsequent studies support the results found by Röller and Waverman (2001) for OECD countries (Datta and Agarwal, 2004) and for Chinese regions (Shiu and Lam, 2008).

A recent study by Czernich et al. (2011) provides empirical evidence for the growth effects of broadband infrastructure at the aggregate level.[5] The authors use a panel data base of OECD countries comprising the years 1996–2007. They apply a technology diffusion model explaining the availability of broadband internet. They thereby take account of the fact that investment in infrastructure takes place in prospering regions or countries first, i.e. the investment decision itself depends on the economic potential of a region or country and is thus endogenous. The results show an increase in GDP per capita growth by 0.9–1.5 percentage points per year.

Further studies support the important role of broadband internet for the economy, for example Duggal et al. (2007) and Koutroumpis (2009).[6] Gillett et al. (2006) consider different measures of economic performance. They analyse the impact of broadband internet availability in the US on employment, wages and the number of IT-intensive firms.

Forman et al. (2011) take a regional perspective and analyse the hypothesis that internet lowers the cost for economic engagement also in geographically isolated regions. Thus, internet should have effects on the performance of firms and employees also in regions whose performance was comparably low before the diffusion of the internet. The authors do not look at broadband internet but at business investment in advanced internet technologies.[7] They find that although advanced Internet widely diffused in the US from 1995 to 2000, the economic benefits in terms of wage growth were concentrated in a few well-performing counties only.

Clearly, our study is also related to the wide literature on the role of ICT for firm performance. This literature has shown that ICT has positive and significant effects on firm performance usually measured by labour productivity (see for example the surveys by Kretschmer (2012), Prieger and Heil (2010), Draca et al. (2007), Hagen et al. (2005, 2007), and UNCTAD (2007)).

Polder et al. (2010) take a firm-level perspective to analyse the role of ICT and R&D for innovation success and productivity of Dutch firms. They find that the use of broadband internet is particularly important for services firms where broadband is positively related to product and process innovation as well as to organisational innovation. By contrast, in the manufacturing sector, broadband is

[4] Due to the rapid diffusion of broadband internet, subsequent surveys do not provide this variation, because DSL diffusion had reached almost 100%. DSL was the dominant broadband technology during that period such that the focus is on this technology.

[5] In their study, internet access with at least 256 kbit/s is defined as broadband independent on whether it is DSL, fibre or any other kind of connection.

[6] See also the survey by Holt and Jamison (2009).

[7] As advanced internet technologies Forman et al. (2011, p. 562) consider ERP, customer service, education, extranet, publications, purchasing, technical support.