



ICT and economic growth – Comparing developing, emerging and developed countries

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ABSTRACT

This paper analyzes the impact of information and communication technologies (ICT) on economic growth in developing, emerging and developed countries. The main question is whether the gains from investments in ICT differ between developing, emerging and developed countries. The analysis is based on a high-quality sample of 59 countries for the period 1995–2010. Various panel data regressions confirm the previously reported positive relationship between ICT capital and GDP growth. For the combined sample of all 59 countries, the estimated output elasticity of ICT is larger than the ICT factor compensation share suggesting excess returns to ICT capital. The regressions for the subsamples of developing, emerging and developed countries do not reveal statistically significant differences in the output elasticity of ICT between these three groups of countries. Thus, the results indicate that developing and emerging countries are not gaining more from investments in ICT than developed economies, calling into question the argument that these countries are ‘leapfrogging’ through ICT.

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1. Introduction

Productivity growth lays the foundation for improvements in the standard of living.² Investments in information and communication technologies (ICT) are seen as a key driver of productivity growth. This relationship has been extensively studied in developed countries at the firm, industry and country level with the majority of studies showing the productivity effect of ICT to be positive and economically significant.³ Recent literature reviews by Cardona et al. (2013), Draca, Sadun, and Van Reenen (2007), and Van Reenen, Bloom, Draca, Kretschmer, and Sadun (2010) list a comprehensive set of studies applying different methodologies. To date, there has been only rather weak and ambiguous empirical evidence on the contribution of ICT investments to economic growth for emerging and, in particular, developing countries. Despite the rather ambiguous empirical evidence, the World Bank (2012) takes an optimistic view stating that “information and communication technologies (ICTs) have great promise to reduce poverty, increase productivity, boost economic growth (...).” The weak and ambiguous empirical evidence on the impact of ICT in developing countries may largely

be driven by the lack of high-quality micro- and macro-level data sets on ICT for these countries.

A priori, there may be valid reasons why the impact of ICT on growth in developing and emerging countries is different than in developed countries. On the one hand, developing and emerging countries might be lacking absorptive capacities such as an appropriate level of human capital or other complementarity factors such as R&D expenditures⁴ and therefore gain less than developed countries from investments in ICT. On the other hand, ICT could enable developing and emerging countries to ‘leapfrog’ traditional methods of increasing productivity as mentioned by Steinmueller (2001). The additional productivity gains could be triggered by “ICT-related spillovers or network effects”⁵ as ICT may lower transaction costs and speed up the process of knowledge creation.⁶ These network effects may be more pronounced “when many firms in a region or industry are using similar levels or types of ICT.”⁷

This paper contributes to the literature in several ways. Section 2 reviews the current empirical literature on the impact of ICT on economic growth, focusing on differences in methodologies, data sources and sample periods. Section 3 describes the unique features of the data set used for the empirical work. The Confer-

¹ For information on further projects by the author see www.zew.de/staff_tni as well as the ZEW annual report on www.zew.de/en.

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² See e.g. Timmer, Inklaar, O’Mahony, and Van Ark (2010), p. 18.

³ Cardona, Kretschmer, and Strobel (2013), p. 109.

⁴ Keller (2004), p. 774.

⁵ Stiroh (2002), p. 43.

⁶ Pilat (2004), pp. 57–58.

⁷ Draca et al. (2007), p. 106.

ence Board Total Economy Database ([The Conference Board, 2014a](#)), the main source, contains annual data for GDP, ICT and non-ICT capital services as well as labor services to control for changes in human capital. In contrast to previous studies, the empirical work is based on these capital and labor services which are a more appropriate measure than stock variables. The sample for the empirical analysis consists of 59 developing, emerging and developed countries between the years of 1995 and 2010 and thus covers more countries and years than previous studies were able to. This rich, high-quality data set allows for a clarification of the previous empirical results. Based on this data, Section 4 presents the results, including a comparison of the estimated coefficients for the output elasticity of ICT for the pooled sample and the three subgroups of countries.

The results for the full sample of countries confirm the positive contribution of ICT to economic growth with an output elasticity of about 10%, exceeding the factor compensation share by a considerable amount.⁸ The estimates with subsamples for the three country groups only reveal small differences between developing, emerging and developed countries. Thus, the results indicate that developing and emerging countries are not gaining more from investments in ICT than developed economies, calling into question the ‘leapfrogging’ through ICT argument discussed above.

2. Related literature

The macro-level empirical work on the relationship between ICT and economic growth is mostly based on growth accounting as well as econometric studies. Several growth accounting studies reveal economically significant contributions of ICT capital to economic growth after the mid-1990s in developed economies. These studies by [Jorgenson and Stiroh \(2000\)](#) and [Oliner and Sichel \(2000, 2002\)](#) focused on the productivity effects of ICT in the US because ‘European statistics offices’ published industry data on ICT assets lag behind the US.⁹ The work by [Inklaar, O’Mahony, and Timmer \(2005\)](#) compared the ICT contribution of the US and the EU4 consisting of France, Germany, the Netherlands and the United Kingdom, showing higher contributions for the US than the EU4 during the period 1979–2000. With the release of the EU KLEMS database ([O’Mahony & Timmer, 2009](#)), cross-country studies like [Inklaar, Timmer, and Van Ark \(2008\)](#), [Van Ark, O’Mahony, and Timmer \(2008\)](#), and [Strauss and Samkharadze \(2011\)](#) as well as [Timmer, Inklaar, O’Mahony, and Van Ark \(2011\)](#) appeared, showing substantial sectoral and cross-country heterogeneity with respect to the contribution of ICT to labor productivity growth in developed countries.

In the past decade, a number of macro-level econometric studies on ICT and productivity in developed countries have been carried out. [Stiroh \(2002\)](#) surprisingly finds a negative output elasticity of ICT capital in his pooled OLS and IV regressions based on US manufacturing industries data for the years 1984–1999. With an updated data set and more detailed industry breakdown, [Stiroh \(2005\)](#) reports positive coefficients of ICT capital in the production function regressions. Based on dynamic panel data estimations, [O’Mahony and Vecchi \(2005\)](#) as well as [Dimelis and Papaioannou \(2011\)](#) show that there is a significant positive effect of ICT capital on output growth for both the UK and the US. [Dahl, Kongsted, and Srensen \(2011\)](#) confirm these findings for eight European countries using EU KLEMS data ([O’Mahony & Timmer, 2009](#)).

Another strand of the literature focuses solely on communication technologies (CT). [Roller and Waverman \(2001\)](#) find a causal

relationship between wireline telecommunications and GDP for 21 OECD countries. [Czernich, Falck, Kretschmer, and Woessmann \(2011\)](#) support the finding of [Roller and Waverman \(2001\)](#) on the importance of communication technologies. Based on a panel of 20 OECD countries, they provide empirical evidence that an increase in the level of broadband penetration leads to an increase in GDP growth rates. A recent literature survey conducted by [Bertschek, Briglauer, Hüschelrath, Kauf, and Niebel \(2015\)](#) confirms the positive relationship between broadband internet and economic growth. More comprehensive reviews of the empirical literature on general ICT with a focus on developed countries are found in [Biagi \(2013\)](#), [Cardona et al. \(2013\)](#), [Draca et al. \(2007\)](#), and [Van Reenen et al. \(2010\)](#). Furthermore, [Indjikian and Siegel \(2005\)](#) provide an overview of the quantitative and qualitative research on the relationship between ICT and economic performance in both developed and developing countries.

A priori, it is not clear whether the impact of ICT on economic growth in emerging and developing countries is larger than in developed countries. [Steinmueller \(2001\)](#), p. 194 points out that ‘ICTs have the potential to support the development strategy of ‘leapfrogging’, i.e. bypassing some of the processes of accumulation of human capabilities and fixed investment in order to narrow the gaps in productivity and output that separate industrialized and developing countries.’ If the ‘leapfrogging’ hypothesis holds, the output elasticities of ICT in developing and emerging countries should be significantly larger than those in developed countries. Whether this strategy is successful crucially depends on the absorptive capacities (“the ability and effort of workers and managers to apply new technology”¹⁰) of the emerging and developing countries (see e.g. [Keller, 1996](#); [Keller, 2004 & Henry et al., Henry, Kneller, & Milner, 2009](#)). A report by the [United Nations \(2011\)](#), pp. 71–78 lists a variety of examples illustrating why ICT may have a strong(er) impact on economic performance in emerging and developing countries. First of all, investments in ICT may decrease the administrative burden on firms through the introduction of e-government applications. Furthermore, ICT can be used for training and advisory services. It also enhances access to relevant information. As a tool to save travel time and to reduce transaction costs, mobile money services are particularly important to micro- and small enterprises. None of these ICT services and applications are specific to emerging and developing countries. But in these countries, ICT often provides services that were previously not available in either the digital or non-digital economy.

The empirical macro-level literature on ICT and growth in developing and emerging countries examines differing country groups and time periods, which limits the comparability and generalizability of the results. [Dewan and Kraemer \(2000\)](#) find a positive effect of the ICT capital stock on GDP growth in developed countries, whereas the ICT coefficient for developing countries is insignificant. The authors explain this finding through potentially missing ‘IT-enhancing complementarity factors’ like human capital. The estimation is performed with a panel of 36 countries (14 developing and 22 developed countries) for the years 1985–1993. As this period represents just the beginning of the rapid diffusion of ICT in developed countries, it was probably too early to see any (economically) significant effects in developing countries. [Pohjola \(2002\)](#), with data on 42 countries within the period 1985–1999, does not find any significant relationship between ICT and economic growth in either the full sample or any of the country subgroups. These results are possibly driven by the fact that the ICT input variable is measured as the share of nominal ICT investment in GDP, which does not incorporate any quality improvements of ICT over time. [Papaioannou and Dimelis \(2007\)](#)

⁸ This difference is smaller in the IV regressions.

⁹ [Draca et al. \(2007\)](#), p. 112.

¹⁰ [Kneller \(2005\)](#).

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