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Identifying and quantifying the indirect benefits of broadband networks for e-government and e-business: A bottom-up approach

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ABSTRACT

Recent developments of broadband infrastructure deployment and service development have shown the variety of applications it can entail, thereby affecting many, if not all, sectors of the economy and society. Despite an increasing growth of broadband networks combined with a rising number of studies calculating in great detail the direct costs and benefits of these deployments, less attention has been paid to the indirect effects resulting from those emerging applications. As these effects have proven to contribute to economic growth, this paper argues that that they should be taken into account when evaluating a cost-benefit analysis and proposes a model for conceptualization, measurement and quantification. It studies these indirect benefits in the area of e-government (related in particular to savings on travel and waiting time by introducing an e-counter) and e-business (related to reducing traffic jams by allowing employees to work at home). In a bottom up manner, the paper quantifies the indirect benefits in these two sectors by studying two cities: Ghent (Belgium) and Eindhoven (the Netherlands). By quantifying these benefits per actor, the paper shows that the indirect benefits would provide large business and local authorities additional incentives to stimulate investment in broadband networks. The model and results of the paper could be used by decision-makers to improve the business case for new investments in fibre networks and allows evaluating existing and future investment cases.

1. Introduction and motivation

Conventionally, investment in broadband access networks has been evaluated using the narrow focus of cost-benefit analyses (CBAs), which indicate that investments needed to upgrade current networks are huge and can hardly be covered by customers' incremental monthly subscription fees (Casier & Verbrugge, et al., 2008; Corning, 2009), but which insufficiently identify indirect effects generated by e-services emerging in sectors outside of telecom. Based on the Bresnahan and Trajtenberg (1995); however, it has been shown that broadband infrastructure can act as an enabler supporting an endless variety of applications using the Internet as a platform (OECD, 2008). As such, broadband access

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networks are pervasive technologies affecting different sectors of the economy in providing opportunities for growth of new e-services in a complementary manner. If these complementarities are taken into account, CBAs have to focus in great detail on the conceptualization, measurement and quantification of indirect effects (OECD, 2009b). In investigating a number of sectors, the OECD (2009a) concluded that the cost savings in just four sectors of the economy (particularly transport, health, electricity and education) would justify the construction of a nationwide FTTH network. In focusing on the government and business sector, the paper is aimed at providing a clear identification, categorisation and quantification of indirect benefits.

In the paper we argue that indirect effects of broadband infrastructure should be taken into account in the evaluation of broadband deployment projects as these effects are responsible for economic growth and thus necessary to account for the full impact of broadband deployment and uptake. Since Aschauer (1989), that there may be substantial discrepancies between the results of conventional CBAs and the ultimate effects of such investments on welfare, research in the public choice tradition has increasingly focused on the existence and the quantification of indirect effects. In a static Arrow–Debreu economy, the Pareto optimality criterion indicates whether or not there are welfare improvements generated from indirect effects. In a dynamic Schumpeterian world, in which general purpose technologies provide necessary inputs into different application sectors (such as health, education and energy), policy has a function in providing incentives to provide broadband infrastructure and to foster the adoption of new e-services. Furthermore, the "Guide to Cost Benefit Analysis of Investment Projects" (European Union – Regional Policy, 2008) stresses the need for incorporating the socio-economic benefits in the project objective and evaluation, but acknowledges the difficulties in predicting and quantifying all impacts of the project.[1]

Literature has just started to provide conceptual frameworks to examine these indirect benefits. In the discussion on the "real" benefits of broadband infrastructure for economic growth (Katz, 2010; Kenny & Kenny, 2011), rarely any agreement has been reached with respect to common methodologies and appropriate data sources to measure and evaluate these benefits. Although there have been a few studies focusing on the value of these indirect benefits, they have not been consistent and frequently not transparent in describing their methodologies. It is furthermore not always clear if the baseline for comparison is a low-speed connection (e.g. dial-up), broadband (e.g. ADSL) or no internet connection at all. The study performed by Columbia Telecommunications Corporation (2009) for example, claims to calculate additional social effects of FTTH on top of traditional broadband, but the meta-study by Hayes (2011) doubts this. Other studies (e.g. New Zealand Institute, 2007) take, apart from sector-specific effects, also increased economic growth and innovation into account, which increases the monetary value of the effects, but on the other hand increases the risk of double-counting.

Having identified the clear need for the identification and quantification of these effects, as well as the discrepancy in previous evaluation studies, this paper investigates the indirect benefits using a bottom-up approach by concentrating on two specific sectors where most indirect benefits can be expected in the near future (Hayes, 2011): e-business and e-government. This bottom-up approach allows to more clearly link the monetary results to the individual effects (Damart & Roy, 2009), while top-down methods only evaluate the overall effect using aggregated macro-economic data. Even if a bottom-up approach is sensitive to input assumptions, it provides more detailed results compared to top-down approaches (Casier et al., 2009; Lannoo et al., 2008). Furthermore, since no macro-economic data comparing ante- and post-deployment situations are needed, our model allows forecasting the value of the effects whereas top-down models only allow for evaluating ex-post of deployment.

The model uses data from two cities: Ghent (Belgium) and Eindhoven (Netherlands), chosen based on comparability regarding number of inhabitants and information-intensive enterprises, size, presence of university, etc (Stad Gent, 2012; Eindhoven Buurtmonitor, 2012). Combining this comparability with the main diversity between the two cities (a well-established FTTH network in Eindhoven versus traditional xDSL and cable networks in Ghent), allows investigating the possible impact of a fibre network in terms of indirect effects.

After this motivational introduction paragraph, Section 2 explains the identification and categorisation process and applies it on both e-government and e-business. The quantification model is detailed in Section 3, followed by a short comparison to previous studies. Section 4 describes the main results for Ghent and Eindhoven, which are benchmarked in Section 5, and linked to regulations and investment decisions in Section 6. Finally, Section 7 concludes the paper and provides some recommendations for future work.

2. Identification and categorisation of indirect benefits for e-government and e-business

As described above, this paper will focus on the bottom-up modelling of the indirect effects of two sectors: e-government and e-business, because these sectors conceal the most important effects for the near future (Hayes, 2011). Electronic Government utilises the ICT environment in an integrated manner to offer public services to all, at any moment of the day. Using e-government will improve the quality and speed of those services and enhance the support of the government policy and the democratic process (Andersen & Henriksen, 2006; Layne & Lee, 2001; Lee, 2010). e-business on the other hand is typically defined as the application of ICT for the support of all kinds of business activities (Chaffey, 2007).

[1] It should be noted though that the context and historical developments strongly affect these effects. Recent work (e.g. Triplett, 1999; Gordon, 2000) suggests that ICTs do not always lead to productive uses by people. For more details, we refer to Section 5.3.