

Chapter 101

The Economics of Cloud Computing

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ABSTRACT

This chapter examines the economic impact of the diffusion of a new technology as cloud computing. This will allow firms to rent computing power and storage from service providers, and to pay on demand, with a profound impact on the cost structure of all the industries, turning some of the fixed costs in marginal costs of production. Such a change will have a substantial impact on the incentives to create new business, and through this, on: investments and macroeconomic growth, job creation in all industries and job reallocation in the ICT sector, and public finance accounts, through the direct impact on the public sector spending and the indirect one on the tax revenues. In this study, the author investigates the consequences of the diffusion of cloud computing on market structures and competition and tries to disentangle the above mentioned aspects with a particular focus on a simulation run for the European economy.

INTRODUCTION

Cloud computing is a general purpose technology of the IT field which became widely available in the late 2000s. Vaquero *et al.* (2009) define it as “a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized Service Level Agreements.”

The diffusion of this new technology appears to follow the pattern of older general purpose innovations. In the course of modern history, the introduction of new technologies has often created initial resistance (think of modern assembly lines), initial diffidence (think of early mobile phones), visionary ideas (think of Bill Gates' claims of bringing a PC in every house), a slow adoption at the beginning (even for electricity),¹ with a mix of clear general benefits and specific costs (think of new energy sources), and finally a process of rapid and generalized adoption. Researchers often talk of a technology adoption lifecycle model: the first group of agents to use a new technology is called

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“innovators” (and they overcome technological or institutional or coordination barriers to the adoption of the new technology), followed by the “early adopters” (that are typically forward looking), the majority (that simply follows a process of rent maximization) and the “laggards” (that are relatively myopic). This leads to repeated processes of gradual and sometimes slow diffusion of new technologies, even when their net benefits for the society are large and generalized. With the new general purpose technology of the ICT field, cloud computing, the path of adoption is likely to be similar, though different national policies in support of its adoption may induce variable speed of diffusion in different countries.²

Cloud computing is an Internet-based technology through which information is stored in servers and provided as a service and on-demand to clients. The impact of its diffusion may be quite relevant, as it happened for the diffusion of telecommunications infrastructures in the 70s and 80s (for a related econometric study on their economic impact see Röller and Waverman, 2001) or the introduction of the Internet in the 90s (for an interesting study on this technological revolution see Varian *et al.*, 2002) and, in general, for the diffusion of computers in the last three decades. In an important article, Jorgenson (2001) has shown how substantial has been the contribution of the adoption of the computer for the accumulation of capital and for the growth process of the US since the 80s.³

Through cloud computing, firms will be able to rent computing power (both hardware and software in their latest versions) and storage from a service provider, and to pay on demand, as they already do for other inputs as energy and electricity. This will have a profound impact on the cost structure of all the industries using hardware and software, and therefore it will have crucial consequences on:

- Business creation and macroeconomic performance;

- Job creation in all industries and job reallocation in the ICT sector;
- Public finance accounts, through the direct impact on the public sector spending and the indirect one on the tax revenues.

In this study we try to disentangle these three aspects of the impact of cloud computing with reference to the European economy in the next few years. The first aspect is in line with our earlier results derived in Etro (2009,a) on the basis of recent research on endogenous market structures in macroeconomic models by Etro and Colciago (2010) and more recently Colciago and Rossi (2011): the diffusion of the new technology may create a few hundred thousand new European SMEs with a substantial impact on employment and a reduction of the unemployment rate of a few decimal points. Moreover, the net impact on employment derives from a high ratio between new jobs in all sectors and lost jobs in traditional ICT employment: the problem of reallocation of labor (within IT departments or between these and other IT-related sectors) may be quite limited. Finally, our simulation suggests that the corresponding impact on the deficit/GDP ratio should be around 0.1% in the pessimistic scenario and 0.2% in the optimistic one. Therefore, the introduction of a cost reducing technology as cloud computing, can have a small but not negligible impact on public finances, even if it creates a marginal reduction of the costs of the public sector. This happens because public finances benefit on one side from the direct reduction in costs, and on the other side from the additional tax revenue derived from the boost of the economic activity and the creation of new private business and jobs.

The paper is organized as follows. Section I reviews multiple aspects of the new technology. Section II is about its macroeconomic impact with a special emphasis on the labor market. Section III examines the social costs and benefits of the process of job creation and destruction associated

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