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Part II Determinants of Demand for ICT

Introduction

The information and communication technologies (ICT) development that allowed Internet-based communication is often referred to as the fourth technological revolution. Just like steam and electricity, the diffusion of those 'general-purpose technologies' in all sectors of activity modifies not only the products, but also the organization of production and the way of life. Nevertheless, their 'added value is based on the manipulation and diffusion of ideas', which attribute radically different characteristics and properties. ICT and the Internet can be thought of in the context of network economy as they are characterized by constant fixed costs and small/negligible marginal costs; the wide use of these technologies impacts on markets' structure. Varian (2000) analyzed the relation between technology and market structure and concluded that the value creation process must be reconsidered. Indeed, the diffusion of ICT and network technologies changes the sharing of profits along the value chain, redesigns the physical firm's borders, as well as the way firms compete in the market. Brynjolfsson and Hitt (2000) give examples of those transformations and show how technical and organizational changes made possible by ICT cause vertical integration and/or redefinition of capabilities within companies. Many of these aspects are considered using the quantitative approaches collected in this volume.

Organization of the book

The chapters in this book consist of a selection of contributions submitted to the 98th International Conference of the Applied Econometric Association, entitled "Internet Uses and Impacts: Quantitative Analysis," organized in Marseille on 5–6 November 2009. Their aim

is to explore and deploy tools and methodology in order to measure phenomena embracing the different nature of ICT impacts. These approaches are grouped together in three parts. Part I makes an international comparison of ICT diffusion and impact on productivity at macro level. Part II examines determinants of household demand and adoption for ICT at micro level. Part III examines the supply side at micro level and highlight the impact of ICT on organization of production and products. The Parts II and III also emphasize the international comparison by using samples, collected in several geographical areas.

Part I: ICT and productivity

Data and methodology

At the macro level, standard growth accounting framework, as well as a technical inefficiency measurement based on a stochastic frontier, are used to compare and explain the gap between US and EU total factor productivity (TFP) growth. ICT is one of the possible answers explored across the first chapters. Vincenzi, in Chapter 1, proposes a measure of the impact of ICT on TFP and technical progress (looking at information technology, complementary capital and the transatlantic productivity divergence). Here, he re-examines the gap in productivity between the USA and Europe using US, French and Belgian data regarding investments in ICT. The notion of organizational capital is introduced into the production function estimated for three countries and 30 sectors of activity between 1993 and 2005. In Chapter 2, Dimelis and Papaioannou seek to find factors explaining how ICT is correlated with labor productivity growth, but not so clearly with the TFP growth. Using a selection of 17 countries providing data on ICT capital from 1990–2005, they analyze possible ICT effects in reducing aggregate technical inefficiency, paying particular attention to the ubiquity (the professional along with the private use) of ICT generating further externalities. Thus, ICT diffusion among firms and households seems to be a determinant for the competitiveness of nations. In order to have a clear picture of what is going on in Europe, therefore, in Chapter 3 Vicente and López present measures of diffusion of ICT and their usage in European households, comparing several ICT measurements obtained at regional level. Regional statistics on the information society provided by Eurostat are analyzed, applying principal components and cluster techniques to 216 regions belonging to 30 European countries.

Summary of main results

ICT had a significant impact on labor productivity growth in the USA and EU and accounts, in part, for the faster productivity growth witnessed in the USA during the late 1990s. However, its impact on technical progress and TFP growth has not been so clearly demonstrated. The fact that there are high levels of US investment in ICT, as well as, most significantly, the ability of industries and firms to derive greater output boosts from their investment explain how some of the divergence in TFP can be attributed to ICT. Theory suggests that TFP growth should be negatively correlated with contemporaneous investments in ICT capital because firms are diverting resources to install the new capital, whereas it should be positively associated with lagged investments in ICT capital. In Chapter 1, Vincenzi establishes that while the United States started to invest in ICT and in complementary capital in the late 1980s and continued throughout the 1990s, evidence has been found that France and Belgium delayed their wave of ICT investments until the late 1990. In addition, Vincenzi suggests a different conceptualization of 'complementary capital', suggesting that constrained supplies of skilled labor are a determining factor in the impact of ICT investment on productivity. In particular, he finds that complementary investments are necessary to fully exploit these technologies.

In Chapter 2, Dimelis and Papaioannou use a method that allows them to quantify the ICT impact in the reduction ofcross-country inefficiencies. They show that, on average, ICT contributed by more than 5 percent to the increase in technical efficiency across countries and over time. The efficiency estimates indicate that the most efficient countries are Belgium and the Netherlands, followed by the USA. However, it seems that several south European countries are less efficient and have not yet reached the efficiency levels of the most developed OECD countries. Finally, there is evidence to suggest that ICT acts as an enabler of productivity growth, including its TFP component – thus, economic growth and competitiveness. Appropriate indicators and measures of such phenomena are needed in order to support and inform policymaking. Vicente and López, in Chapter 3, analyze the range of Eurostat ICT indicators and conclude that the leaders in ICT adoption are Nordic territories, together with some British regions. In contrast, Eastern and Southern European countries lag behind. Furthermore, five ICT clusters are indentified across Europe, with 15 low-performing regions and 68 high-performing territories. In order to identify factors underlying the regions and countries gap, to the matter is studied at micro level. Data describing characteristics and behaviors of individuals and households,

as well as firms and the business sector, are, respectively, mobilized in the two following parts.

Part II: Determinant of demand for ICT

Data and methodology

Because ICTs 'are reformulating the equation of aggregate productivity' (Faucheux et al., 2010), the measurement of their effects and the identification of spillover factors matter. A first approach consists in indentifying factors enhancing or hampering speed and spread of adoption and usage of ICT among people and households. A second range of studies aims to describe the demand function and measure the advantages of consumption and usage of Internet. Thus, in Chapter 4, Kouado considers the Côte d'Ivoire, and in Chapter 5, Walid Hadhri, Mohamed Ayadi and Adel Ben Youssef *consider* France, aim*ing* to identify characteristics of users and non-users. *With regard to the Côte d'Ivoire*, data come from a survey conducted on behalf of the Telecommunications Agency of Côte d'Ivoire (ATCI) by the Ivorian Centre for Economic and Social Research (CIRES) with 1,500 households drawn under a two-stage sample selection with stratification. Hadhri et al. use different souces of statistics provided by French National Statistics (INSEE), the French postal and electronic communications regulatory authority (ARCEP) and l'Institut de l'Audiovisuel et des Télécommunications en Europe (IDATE). *Both chapters* base their estimates on the distinction between access and intensity of utilization. Kouakou estimates a simple logit model in order to discern factors behind the decision to adopt the Internet*;* then he considers the frequency of usage after having access to the network.

Frequency of use of the web, wherever it occurs, is estimated using the ordered logit model. Hadhri et al. estimate the decision of the Internet adoption using a simple probit model in which the dependant variable is the probability of deciding to adopt Internet. Second, Internet use estimation is based on the time that the individual spends online. The dependant variable represents the number of hours per week that individuals spend connected to the Internet. The two-step Heckman's method deployed allows differentiation between Internet adoption and access to frequency patterns and ability to solve the selection problem. In Chapter 6, Bayrak proposes also to measure benefits for the consumer. He focuses on consumers with home networks and highlights the different demand characteristics and welfare attainments of consumers who connect to the Internet through wireless networks from those who connect through other (wired) types of networks; the incremental consumer surplus from using wireless networks is measured. For

highly time-intensive goods, the true cost of consumption includes the opportunity cost of time, in addition to very small market expenditures. Using the variation in time use and wage data is likely to give more accurate estimates of elasticities and welfare than using market price and consumption data. The data consist of a sample of 4,865 respondents who report to have some type of home network and are online at least monthly. This sample is selected from North American Consumer Technographics data from Forrester Research. Finally, a fourth demand function is estimated in order to measure the willingness of consumers to pay for a new service. In Chapter 7, Durand analyses the adoption of a service of electronic signature and digital identification card aimed at securing online transactions by Luxembourg inhabitants. He uses a survey conducted with 1,509 individuals from 16 to 74 years old.

The estimation of demand function and the elaboration of the models to capture the modalities of diffusion of ICT do not offer an exhaustive picture of uses and associated transformations. In particular, social networks play a new and crucial role in the process of innovation. To fully understand the social and economic changes, one needs to consider also new forms of social interactions based on Internet communities (for a complete overview of the economic characteristic of social network, see Gensollen, 2007). Quantitative analysis, proposed by Gaudeul, Peroni, and Mathieu in Chapter 8, explores the role of reciprocal attention in Internet communications. Properties of blogging networks are derived from a model where bloggers devote attention to others, produce content for others and exchange attention for content within their network of relations; as Gaudeul et al. put it: 'in a network, an agent that offers little content compared to others will need to compensate for this by devoting more attention to others in order to maintain her place in the network. Conversely, an agent that offers a lot of content compared to others will devote less attention to others.' The aim of the analysis is to demonstrate, first, that bloggers who display higher levels of content production and general blogging activity have more readers and, second, that bloggers with relatively more friends than readers produce less content than other bloggers. The predictions from the model are tested with a novel dataset from LiveJournal, a major blogging community. The database contains a number of measures of activity and involvement in social relations from data gathered on the activity of 2,767 bloggers drawn randomly from LiveJournal.

Summary of main results

The measurement of ICT effects and the identification of spillover factors give a better understanding of factors behind the spread of

the service in the population. Age, location, type of employment, education and social capital are important factors in the decision to adopt the Internet network, in the Côte d'Ivoire as well as in France. Moreover, for France, findings confirm the fact that a higher education level, computer and Internet skills and lifestyle have a positive effect on Internet adoption. Those with higher levels of income and younger people are more willing to use Internet. Lifestyle, which indicates ICT and electronic tool use, positively correlate with Internet use. Indeed, using an ICT or electronic tool, such as a mobile phone, laptop, DVD player or digital camera influences positively the probability of adoption of the Internet. Finally, high-income people were more able to adopt Internet, but they spend less time online than low-income ones. This relies on time opportunity cost. Evaluating consumer surplus shows that French time opportunity cost is three times more important than connection cost. French households have found the Internet to be a valuable addition to their welfare levels. In 2005, the French consumer surplus ranged between $1,240 and $3,126, depending on the methodology applied (between $2,107 and $2,651 with the two-stage estimation method). Following Bayrak's estimation for USA, the consumer surplus from the Internet is around $7,000. With the most conservative estimate, consumers with wireless networks are found to be realizing, on average, $824 more consumer surplus from the use of the Internet, compared to wired network owners. Finally, measuring utility throughout non-monetary variables, blogger's activity has been found to be related to the size of that blogger's relational network and to the level of aggregate reciprocation within that network. Bloggers who do not adhere to reciprocity norms are found to have fewer readers than their activity might otherwise have predicted. Posting activity and intensity of interaction are positive determinants of network size; departures from aggregate reciprocity can be accounted for by content production; failure to reciprocate attention is sanctioned with a lower popularity than other measures of activity might normally warrant. These results suggest that bloggers who produce more content devote less attention to others. Furthermore, bloggers sanction deviations from the norm of reciprocity, which occur when a blogger does not return friendship as expected.

Beyond blogs, social networks, peer-to-peer and file sharing, new tools generate new individual behavior, redesigning business models. Thus, the last part of the book focuses on a piece of work analyzing Internet impact on specific businesses and markets.

Part III: New organizational business frontier

Data and methodology

Going back to the behavioral attitude seen throughout Internet worlds, in Chapter 9 Poort and Rutten analyze the impact of file sharing on business models in the music industry, providing a comprehensive overview. The production of recorded music, as well as that of films and games, is characterized by relatively high fixed costs and low marginal costs. As a result of digitization, the costs of reproduction and distribution of content have decreased dramatically, as well as the possibilities for copyright holders to control this process. The fact that file sharing gives free access to content is just one of the various reasons to engage in this activity, while interactions between file sharing and buying can be either positive, neutral or negative. A lot of source of information has been mobilized in order to draw a detailed picture of facts and trends. The study reviews relevant literature and draws on a range of secondary – particularly statistical – sources, as well as interviews of active uploaders and downloaders and a survey of a representative group of 1,500 Internet users, conducted by research agency Synovate in the Netherlands. Analyzing characteristics of and trends in the film, games and music industries and their respective markets related to file sharing highlights developments in the business models of the sectors and offers hints for identifying the possible implications of file sharing for consumer behavior in other markets in which this content is sold (and also the short- and longer-terms implications of these changes). As it can be seen throughout the analysis of the music industry, ICT impacts business models through the modification of consumption behaviors. It also impacts directly the internal and external organization of firms by allowing multiple shifting of the frontier of their activities. Indeed, to manage their activities effectively, firms choose to resort increasingly to outsourcing and/or offshoring of activities, both for the manufacture of products and for the inputs included in the production process. Moreover, technological changes favor the compatibility and tradability of many services across the world. In Chapter 10, Martin attempts to modelize the choice of whether to buy in ICT services and characterizes Luxembourgish firms which outsource some of their IT functions. A primary consideration, as firms are trying to minimizing costs, rests on the relative costs of producing in-house or purchasing services on the market. Second, the firm has to choose between sourcing from a foreign subsidiary or an independent outside firm. The dataset comes from the Luxembourg part of the 'ICT Usage and e-Commerce in Enterprises' survey (2007). Models tend to analyze the two contrasting effects that could

be expected: either the firm's investment in ICT can reduce the cost of outsourcing and, thus, can favor it; or conversely, if the firm has skilled workers, the cost of managing in-house ICT services will be lower.

For Japan, Idota, Ogawa, Bunno, and Tsuji propose, in Chapter 11, to analyze the choice of outsourcing and/or offshoring implementing a bivariate probit. In order to improve performance and efficiency in all aspects of business activities, SMEs need to increasingly rely on ICT as a basis for organizational restructuring. The chapter is based on data collected from field surveys, a mail survey and in-depth interviews in two of Japan's most prominent SME clusters, located in Higashi-Osaka city in Osaka prefecture, and Ohta ward in the Tokyo metropolitan area. In 2004, questionnaires were sent to more than 6,000 SMEs in the two clusters, yielding nearly 1,200 responses mail surveys of selected high-ICT-adopting SMEs. In order to identify factors that promote ICT use among Japanese SMEs, an index of ICT usage using an analytic hierarchy process (AHP) is calculated. Ordinary least squares (OLS), logit and probit regression are implemented in order to predict ICT use and identify factors that promote ICT use, based on survey responses. For Catalan firms, Ben Youssef, Merino and Walid Hadhri propose to modelize, in Chapter 12, the intra-firm diffusion process, combining the well-established models of technological diffusion with an organizational and networking complementarities view and epidemic evolutionary approaches. Three econometric models are then tested. The first one is an ordered probit model estimating the probability of ICT adoption by firms. Second, a general model is built in order to explain intra-firm diffusion of ICT according to some specific tools, as well as to different business uses of these digital technologies. The database comes from a survey conducted in 2003 by the Catalan government of 2,038 enterprises. Thus, in order to promote ICT use and impact, better understanding of adoption of ICT by firms and their internal diffusion, as well as their link with innovation capacity, is needed in order to help their promotion. The generalized diffusion of ICTs, including their convergence with the Internet network and capabilities, increases the value of innovations and R&D investments of firms; furthermore, competitive pressure on the market of products in turn imposes more reactive organizational forms. In Chapter 13, Ben Aoun and Dubrocard highlight the complexity of this relationship between ICT and innovation at firm level, using an original sample of Luxembourgish firms.

Summary of main results

Chapter 9 establishes that music is steadily acquiring the characteristics of a public good, while live concerts constitute an ever-growing source of income for industry. Thus, new artists are gaining access to

novel and accessible channels through which to market their wares, such as MySpace and YouTube, responding to the democratization of talent development. In order to survive, the industry must redesign its business model and is increasingly focusing on sponsorship contracts, 360-degree contracts and merchandising. These new value creation drivers include such initiatives as alliances between the mobile phone and music industries. At the same time one can see that file sharing impacts on the rest of the economy through spin-off revenues.

From the point of view of intra- and inter-firm reorganizations, Chapter 10 establishes that, for Luxembourg, firms' resources positively influence the probability of choosing the option of outsourcing and offshoring ICT activities. Concerning ICT investment, after the control of its potential endogeneity, one can observe that firms with the highest specific ICT needs choose to find these services from external suppliers or firms located abroad, especially when their ICT competencies measured by the presence of ICT/IT specialists is low. Conversely, other firms that have high ICT needs but that are associated with the employment of IT specialists don't seem to resort to external services providers. Finally, it appears that high trust in data transfer favors the choice of outsourcing ICT services. These results find echoes in Japanese studies (see Chapter 11), showing that information security is a major concern for large firms that want subcontractors to use the firms' ICT systems, with associated costs for complying with ICT demands. Finally, the lack of human resources to handle ICT and concern about security and privacy of data related to customers and business transactions are the main factors hampering ICT adoption. Moreover, the latest study emphasizes that the best way to promote ICT use among SMEs is to encourage top management to better understand, value and proactively pursue ICT. Once management adopts a positive perception of ICT, they can determine the exact ways in which they will implement ICT to meet their specific goals. Therefore, in Chapter 12, Ben Youssef et al. show that boosting ICT diffusion depth inside the firms does not depend only of the top management state of mind and willingness. Their results confirm the well-established literature. Thus, the main conclusion is that inter-firms ICT diffusion (i.e., investment in digital equipment) and depth of ICT adoption (i.e., spread of efficient digital uses) have different determinants, although they share some common traits based on the existence of complementary effects between digital technologies, innovation, organizational structure and workers' skills within a firm. Linking ICT adoption to innovation ability in Luxembourgish firms, it can be established that the probability of being innovative increases significantly with the size of firm, regardless of the type of innovation. This link between size and innovation ability is concave. R&D ratio expressed as R&D expenses over

turnover has also a positive impact on probability of innovation (for every type other than marketing innovation). The most frequently significant variable representing ICT is the number of automatic links. Indeed, it is the only ICT variable with a positive impact for technological innovations; the percentage of highly qualified employees also contributes significantly and positively to explaining the probability of innovation for a product. Finally, on the one hand, ICTs constitute an aggregate of major innovations which, in turn, accelerate the process of innovation through new applications and new processes. As ICTs favor innovation, they improve all inputs' productivity. On the other hand, the innovation process accelerates and modifies the way to implement ICT in a process of co-invention, which renders the ICT more effective. Therefore, ICTs are closely related to the firms' ability to innovate, that is to say to introduce new products and services, new processes and new applications. In addition, sharing and knowledge transfer, as well as the development of real-time networks, foster scientific and technological innovation and make new practices and organizational arrangements possible. For example, e-management, e-business or e-commerce are themselves organizational innovation, and enhance firms' performance. Indeed, data at firm level evidence the impact of intangible organizational investments and innovation of products and services related to computers. These are necessary to make organizational structures coherent with technological capabilities.

References

ARCEP (Autorité de Régulation des Communications Electroniques et des Postes) (2005) 'Rapport d'activité de l'Autorité de Régulation des Communications Electroniques et Postales 2005'.

Brynjolfsson, E. and L.M. Hitt (2000) 'Beyond Computation: Information Technology, Organizational Transformation and Business Performance', *Journal of Economic Perspectives*, Vol. 14, No. 4, pp. 23–48.

Brousseau, E. and N. Curien (2007) *Internet and Digital Economics: Principles, Methods and Applications*, Cambridge: Cambridge University Press.

Faucheux, S., C. Hue and I. Nicolaï (2010) 'TIC et développement', Brussels: De Boeck.

Gensollen, M. (2007) 'Échanger: Comment le numérique modifie en profondeur les conditions de socialisation de l'échange', mimeo, available at http://www.gensollen.net/Gensollen_echanger_2007_05_enligne.pdf

IDATE (INSTITUT de l'AUDOVISUEL et des TELECOMMUNICATIONS en EUROPE) (2005) 'Use-IT: qui consomme quoi en 2015?'

REGULATION (EC) No 1006/2009 of the European Parliament and of the council official journal of the European Union.

Regulation (EC) No 808/2004 concerning Community statistics on the information society.

Varian, H.R. (2000) 'Market Structure in the Network Age', in E. Brynjolfsson and B. Kahin (eds), *Understanding the Digital Economy*, Cambridge, MA: MIT Press.

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