Adoption of Cloud Computing in Emerging Countries: The Role of the Absorptive Capacity

Adel Ben Youssef
(University of Nice Sophia-Antipolis, GREDEG-CNRS)

Walid Hadhri
(ISG Tunis, University of Tunis)

Téja Maherzi
(University of Nice Sophia-Antipolis, GREDEG-CNRS)

Abstract

This paper aims at developing a theoretical framework that explains the decision of cloud computing (CC) adoption in Emergent Countries. It emphasizes the specific role of the technological absorptive capacity especially when the firm is seeking innovation by adopting CC. The absorptive capacity considered in this work is close to the work of Todorova and Durisin (2007) who proposed a framework linking both the contributions of Cohen and Levinthal (1989) and Zahra and Georges (2002). To test our theoretical claims, we estimated two models predicting the probability of adopting CC and adopting CC for innovative aims with (1) competitive pressure and external environment, (2) Technology perceived impacts, and (3) technological absorptive capacity of the firm. We use control variables such as size, sector of activity and seniority in order to control the general purposes of our claims. We use a bivariate probit model in order to understand the determinants of the decision of adoption and an ordered probit with sample selection in order to understand the determinant of adoption of CC for innovative aims. Based on a face-to-face questionnaire administered to a random sample of 350 Tunisian firms, and using a Heckman selection method. Our empirical findings confirm our theoretical claims and show that technology perception is key factor for CC adoption (for general purposes) and that the absorptive capacity is fundamental when the adoption of CC is for innovation goals. We found also that competition pressure is an important explanatory factor: the more competitors that adopt this technology, the more likely the firm adopt it.

Key words: Innovation, Information and Communication Technologies, Cloud Computing, Heckman selection method, Probit Model, Technology Adoption, Tunisia, IPRs, Absorptive Capacity.

JEL Classification: L21, O31, O33

1. Introduction

One of the most important differences between Developed Countries (DC) firms and Emerging Countries (EC) firms (on average) is their ability to innovate and to invest in acquisition of new technologies. Several constraints may affect the ability of ECs to innovate and adopt new technologies including lack of available human capital, lack of financial resources, and a weak science and technology system. However, the adoption of disruptive technologies by EC firms can be faster than earlier adoption by DC firms since catching-up and leapfrogging tactics can be exploited. EC firms seek opportunities to modernize their business and to improve their performance at lower cost.

Cloud Computing (CC) is a novel paradigm in computing and could be seen as a disruptive technology[1] leading to paradigmatic changes both inside and outside the firm (Sultan, 2013). CC is defined as "*a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can rapidly provisioned and released with minimal management effort or service providers' interaction*" (Li et al., 2011). CC is associated with an increase in the use of new software, applications, and solutions and helps firms with increased implementation of innovations at a price that is relative to their real use. For example, CC allows new sales management processes, new marketing channels, access to new geographic markets, and increases collaboration with external partners.

From an analytical perspective, discussing the adoption of CC as a new technology in the context of ECs needs to consider at least two distinct strands in the literature.

The first of these strands explores the determinants of adoption of CC in ECs. There is a fairly large literature shows how classical determinants such as characteristics of the firm (firm' size, firm seniority), the environment of the firm (competitive pressure) are correlated with the CC adoption decision (Alsanea and Wainwright, 2014; Gupta et al. 2013). At the same time, other contributions explain that factors such as bandwidth, mobility, the fear of losing control, security, privacy, data protection, lack of CC business brokers, and unawareness may lower the rate of adoption (Gréczy et al. 2014; Oliveira et al., 2014). This literature does not make differences in the purposes of adoption of CC and have weakly examined the specific role of the absorptive capacity of the firm. In fact, most of this literature has examined the decision adoption of CC without considering the disruptive nature of the technology and the potential radical changes that will hugely impact the internal organization of the firm.

In fact, the adoption and use of CC tends to differ from previous adoption of information technologies (IT) especially in the context of EC. According to Tiers et al. (2013), CC is inducing four complementary disruptions in the firm: technical disruption, market disruption, human disruption, and security disruption, and is inducing an important change in firm behavior. The adoption decision needs to take

[1]A disruptive technology is a combination of existing technologies or news that can be used in innovative ways to change technological services or product paradigms (Ganguly et al., 2010).

account of all these disruptions, and may be negatively evaluated in the context of ECs.

The second literature strand points to the special role of the technological absorptive capacity in matter of IT adoption. Absorptive capacity (ACAP) consists of the capabilities to recognize the value of new knowledge, to assimilate it, and to apply it to commercial ends. The concept of ACAP was largely applied to the case of innovation (Tsai, 2001; Meeus et al., 2001) and in matter of IT (Boynton et Zmud, 1994; Ja-Shen Chen et al., 2004; Harrington et Guimaraes, 2005). While a plethoric literature have showed how the absorptive capacity is key for the adoption process of IT, few papers have looked at how the adoption of CC depends from previous technological absorptive capacity and how is affecting firms' innovation activity,[2] although there is evidence that CC is increasing innovation in EC firms which are more likely to innovate and to adopt new innovations at lower cost.

Understanding the link between the adoption of CC and the internal organization of the firm is crucial in the context of ECs. Uncoordinated adoption of IT and organizational practices by EC firms due to structural weaknesses related to their management and governance, can lead to lack of complementarities between IT and organizational practices, and an overall weak effect on firm performance. In some cases this anarchistic adoption process may lead to internal "disorganization" and a decrease in the firm's structural competitiveness (Knights and Vudurbakis, 2005). Thus the adoption and use of CC tends to differ from previous adoption of information technologies (IT). To our knowledge, few academic works proposed an analytical framework discussing the adoption of CC in the context of ECs and have examined the specific role of absorptive capacity in the process of adoption of CC especially when the firms seeks the innovation.

This paper aims at tackling this specific issue and developing a theoretical framework that explains the decision of CC adoption in ECs. It emphasizes the specific role of the technological absorptive capacity especially when the firm is seeking innovation by adopting CC. The absorptive capacity considered in this work is close to the work of Todorova and Durisin (2007) who proposed a framework linking both the contributions of Cohen and Levinthal (1989) and Zahra and Georges (2002).

Based on a face-to-face questionnaire administered to a random sample of 350 Tunisian firms we test our theoretical claims. We estimated two models predicting the probability of adopting CC for general purposes (especially for increasing the competitiveness of the firm) and adopting CC for innovative aims with (1) competitive pressure and external environment, (2) technology perceived impacts, and (3) technological absorptive capacity of the firm. We use control variables such as size, sector of activity and seniority in order to control the general purposes of our claims. We use a bivariate probit model in order to understand the determinants of the decision of adoption and an ordered probit with sample selection in order to understand the determinant of adoption of CC for innovative aims.

The rest of the paper is structured as follows. Section 2 proposes an analytical framework and discusses our main hypotheses. Section 3 presents the sample and the

[2]E.g,, Xu (2012) shows that CC can facilitate cloud manufacturing and could change the boundaries between certain economic sectors.

econometric models. Section 4 discusses the econometric results and presents the limitations of the work and section 5 concludes.

2. Adoption of CC in Emergent Countries: the specific role of the technological absorptive capacity of the firm

This section reviews the arguments for adopting CC and focuses especially on the innovation motive in the context of ECs, proposes our main hypotheses and present our general model. Our analytical work relies to the Technology-Organization-Environment (TOE) Framework and extends it by considering the absorptive capacity of the firm as the main component of the internal organization. In fact, within the TOE theoretical framework several studies have been explored how the CC was adopted[3]. According to Backer (2011), there are three groups of factors affecting the adoption of technological innovations: Technological factors (perceived characteristics of the technological innovation), Organizational (internal firm's characteristics) and Environmental (characteristics of firm's external environment) ones. We advocated that these three components vary strongly from the context of DCs to the context of ECs.

2.1. Environment: competition pressure, Internet connection and CC adoption

Adoption of new technologies is very sensitive to the milieu of interactions of the firm and its external environment. The decision of adoption a new technology is encouraged by environmental pressure (DiMaggio and Powell, 1983). As the numbers of adopters increases the non-adopters will find more incentives to do the same (Tolbert and Zucker, 1983).

The external environment of the firm includes various physical characteristics such as public utilities provision, the local labor market, the Internet connection, and the actors in the value chain (competitors, sub-contractors, clients, customers, etc.). ECs differ strongly from DCs in matter of the external environment. At least one needs to consider two main factors. From the one hand, the physical characteristics such as Internet connection, public utilities…are of less quality and availability. From the other hand, it is generally well accepted to consider that the ECs markets are less competitive (i.e.) their intensity of competition is weaker. These differences have an impact of the decision of adoption of CC.

Tiers et al. (2012) propose a framework for CC adoption. They consider that the adoption decision depends strongly on the external environment especially users and competitors. Therefore, competitive pressure is considered to be positively correlated to adoption of CC (Lumsden and Gutierrez, 2013; Tiers et al., 2013; Low et al., 2011, Mohamed et al., 2009). More generally, Pan and Jang (2008) suggest that pressure from business partners is a main determinant of the adoption and use of IT.

Most ECs are characterized by inefficiency and coordination problems. CC can contribute to resolving this problem and can improve the entire economic system. Low

[3] Alternative theories can also used as explanative frameworks for CC adoption such as Technological Acceptance Model (TAM) or the Theory of Diffusion of Innovation (DOI) (Zhu et al. 2006).

et al. (2011) highlight the advantages of CC adoption in the context of ECs pointing out that it improves the speed of business communications, resolves coordination problems among the firms, improves communication with customers and access to market information. CC allows the sharing of common applications and hardware. It can facilitate the creation of new products and services, and increase the efficiency of networks (productive system), create more added value, and allow the sharing of common inputs. CC can foster the "interactive learning" (Lundvall, 1985; Meeus et al. 2001) and contribute to solving coordination problems in ECs.

In relation to the firm's physical environment most of the literature agrees that the main problem preventing the adoption of CC in the context of ECs is Internet bandwidth and telecommunication infrastructure. CC is an attractive service if and only if the speed of Internet guarantees effective use. ECs are not a homogenous group. In many ECs the Internet connection and Internet services are very close to DCs' standards. While in other ECs the Internet connection is of less quality.

2.2. Technology: perception of CC and its adoption

The perception of the technology is widely supposed as one key driver of the adoption of new innovations and technologies. Several papers have showed that perceived advantages and disadvantages of CC might substantially differ between ECs and DCs. This is mainly due to the profiles of the managers and to the differences in the competition pressure between ECs and DCs.

CC is associated with several economic advantages which are discussed extensively in the literature. Firstly, CC allows firms to customize their IT services to their specific needs, and thus to cut costs. Most academic studies discuss the conditions under which the cost-cutting argument can be considered the main driver of adoption. Secondly, CC improves the firm's IT capacity. IT provides greater capacity without investment in more computing infrastructure, memory, and storage capacity (no need for dedicated servers). The firm will have a modifiable storage space with the request. Firms benefit from flexible and quasi-infinite storage space. In addition, they obtain certain fast elasticity based on the technical capabilities (processing speed of data) of the remote hosts used for CC. Firms have no need to acquire more computers "very last thing" and renew thus less their parks data processing. Thirdly, CC provides a service at lower cost based on pay per use consumption, which optimizes the firm's management costs, while related spending on CC becomes an operating expense. The price of the service is calculated based on the firm's effective consumption similar to gas or electricity consumption. The firm to some extent buys the possibility of using data-processing power on demand. Pooling hardware resources optimizes the costs compared to having these services delivered. Fourthly, firms can obtain access to various applications such as customer relationship management packages, without having to acquire the corresponding licenses. The firm can explore new technological possibilities such as e-commerce in order to improve its efficiency and innovativeness at a reasonable cost.

There is a large and important literature which stresses that despite their importance the perceived advantages are not sufficient to explain the adoption of CC in the context of ECs (Gupta et al., 2013; Lian et al., 2014; Morgan et Conboy, 2013; Lin et al., 2012; Low et al., 2011; Lumsden and Gutierrez, 2013, Oliviera et al., 2014). This work stresses that the perceived disadvantages can limit the adoption and use of this disruptive technology.

Several perceived disadvantages are shown to limit the adoption of CC such as the fear of losing control, security, privacy, data protection, performance and uptime, lack of cloud business brokers, and unawareness. In ECs adoption of CC may be perceived as risky in relation to security and interfacing with internal and external systems (interoperability), ownership of content, and other, legal requirements, (Raval, 2010). Numerous international studies suggest that security is a major concern for organizations and entrepreneurs deciding to adopt CC. "Outsourcing" the storage of the all the firm's data potentially exposes the firm to several security problems. Concern over interoperability can also deter the move to CC. Firms need to keep open options related to the future of their IT systems, and might be wary of lock-in effects from adoption of CC. This does not apply to private CC, which allows the firm to customize its services, and uses in line with existing technological options. Finally, there are legal issues associated with CC (Bradshaw et al., 2011). These include limited liability of providers, conditions for ending an arrangement, and changes made by the provider. Many firms do not have the required skills and are not able to evaluate these legal issues sufficiently, preferring to keep their information system as it is. Following these developments we propose to test four hypotheses

2.3. Organization: Absorptive capacity of the firm and CC adoption

Compared to DC firms, EC firms generally have lower ability to innovate due to financial constraints and a less highly performing innovation system. They may see these disruptive technologies as an opportunity to catch up in innovation, and to increase their innovation performance. Firms' innovation capacity is measured by their technology absorptive capacity.

Cohen and Levinthal (1989, 1990) introduced the absorptive capacity to label the capabilities of the firm to innovate and, thus, to be dynamic. Absorptive capacity consists of the capabilities to recognize the value of new knowledge, to assimilate it, and to apply it to commercial ends. An important debate occurred since the seminal work of Cohen and Levinthal (1989) in order to refine the concept and the initial model (Zahra and Georges, 2002; Todorova and Durisin, 2007; Lane, Koka and Pathak, 2006; Lane and Lubatkin, 1998 among others).

In this work we would like to emphasize four important dimensions of the absorptive capacity of the firm that may behave differently in ECs and DCs namely: the appropriability regimes and their impacts on the process of acquisition of new technologies; the managers skills and their role in recognizing the value of the technology; the ability of the firm to assimilate, transform and exploit the new innovations, and the coordination of tasks between employees. Our work relies strongly to the model of Todorova and Durisin (2007) which conciliate and extends the original works of Cohen and Levinthal (1989) and Zahra and Georges (2002).

The first factor is linked to appropriability regimes. Appropriability regime was mentioned by Cohen and Levinthal (1989) and Zahra and Georges (2002) as one of the key aspects for the absorptive capacity. However, the authors do not agree where to locate the effect of the appropriability regime in their models. In this work we rely to the model of Todorova and Durisin (2007) who proposed that the appropriability regimes are prior and after the absorptive capacity. The adoption of new technology or knowledge is contingent to the approriability regime. At the same time the ability to obtain competitive advantages and innovation from a new technologies is also contingent to the appropriability regime.

In fact, one important difference between ECs and DCs concerns the Intellectual Property Rights (IPRs). ECs markets are characterized by low efficacy of IPRs and ease replication. Firms fail to appropriate the return of their innovation. Cohen and Levinthal (1990) have found that the effect of appropriability regime on absorptive capacity is negative. Absorptive capacity increases with weak regime and competitive spillovers. We advocate that CC may offer a solution to them in order to innovate and to protect better their innovation. Most of the CC providers are hosting their servers in countries where there is strong respect of IPRs. By hosting their data and innovation in CC they may be better protected and better protect their innovations. This implies that investing in CC and building an ACAP is positively linked to IPRs.

The second factor concerns the recognition of the value of the new technology (knowledge). More often firms fail to identify new technological knowledge and to absorb new technologies because they are hampered by their embedded knowledge base, rigid capabilities, and path-dependent managerial cognition (Gavetti and Levinthal, 2000; Langlois and Steinmuller, 2000; Trispas and Gavetti, 2000). Christensen and Bower (1996) have showed that the main problem comes from the inability of managers in properly assessing the value of new knowledge when it is not relevant for the current demands of key customers. Managers' problems of assessing the value of new technologies are very important. They are more often assessing it based on solely the criteria of its current implications for current customers and less about its potential future uses.

The managers play a prominent role in the process of recognition of the value of the new technology (ICT). They are considered to be the principal actors in the success of ICT adoption and implementation in EC firms. The manager's profile (education level, age, style of command, ICT knowledge and skills, etc.) has a major impact on the adoption process (Amabile and Gadille, 2003; Low et al., 2011).As the complexity of the technologies increases, the support of the senior executives (Managers) is essential to effect organizational change based on visible commitment. Top management support helps to overcome any internal resistance to change (Lumsden and Gutierrez, 2013). The differences in the profile of managers, their education, ICT skills use can play an important role in the process of adoption of new technologies especially CC.

The third dimension is the ability of the firm assimilates and exploits the new technology. The implementation of new ICTs requires dedicated workers able to solve the problems and pass on their knowledge to other employees. This is particularly true in the context of EC firms. To some extent, technological absorptive capacity is associated with the technology readiness of the firm, and can explain CC adoption. It reflects the firm's readiness for CC adoption (Lumsden and Gutierrez, 2013). CC adoption implies that the firm has accumulated skills and experience in previous generations of ICT. Starting from this one can consider the intensity use of ICT as a good proxy of the ability of the firm to transform, assimilate and exploit CC. Although the firm may be convinced about the potential value of the innovation, lack of implementation know-how can be a barrier to its adoption. Knowledge that either facilitates implementation or reveals implementation difficulties potentially could affect the adoption decision (Greve, 2011).

The last dimension is the ability of the firm to transform the power relationships and internal organization. In fact, CC adoption can induce important organizational changes within the firm including changes to workers' roles, interaction patterns, and power relations. These changes may disrupt routines, and may require expert advice and support (Tiers et al., 2013). Redesign of the information system means that several peripheral activities can be outsourced or re-designated. At the same time, new applications may give access to new distribution channels (e.g. the implementation of e-commerce). According to Raza et al., (2015) the main reason for the slow growth of CC is the lack of consensus among the IT workforce. Based on the result of a survey of IT workers at various organizational levels and in different countries, Raza et al. (2015) show that fear of losing one's job has played a huge role in the slow adoption of CC. This also may explain the difference in the rates of adoption between small and medium sized enterprises (SMEs) and large corporations. It might also explain the difference in adoption of CC by DC and EC firms. Ben Youssef et al., (2014) suggest that the complementarity between ICT and NOP adoption is strengthened as the technology evolves. Adoption and usage of the latest technologies are pushed by prior adoption of NOP. Starting from this assumption, the adoption of CC requires adoption of NOP to support the organizational change.

The next section discusses the empirical investigation strategy and describes the econometric model.

2.5. The Model

This conceptual model summarizes our general theoretical claims about the CC adoption in the context of ECs. The theoretical model we have developed is probably contingent on several factors. We check the effects of three important variables, because potentially they limit the generality of our claims.

The first variable control is firm size, which is often considered as resource strength. The size of the firm is supposed to play an important role in the process of adoption of new technologies. This is well known under the rank effect. The more the firm is big the more it is able to absorb and adopt new technologies. The size of the firm is linked to its financial resources, human resources, and ability to solve problems and to take risks. Starting from these considerations, CC adoption is supposed to be linked to the size of the firm. However, we need to take into account the dual effects of firm size because while big firms have more resources in order to innovate and adopt new technologies, they are generally characterized by bureaucratically decision making process and rigid rules and routines. The second variable is seniority. One needs to mention that seniority is also supposed as a good indicator of the resources of the firm. The more the firm survives the more it accumulates experience and resources to face changes and to adopt new technologies and to engage in innovative activities. Seniority is supposed to have positive impacts on the adoption of new technologies. The third variable is sector of the activity. Adoption of IT is contingent to the sector of activity. Many researchers have pointed the differences in the adoption and use of IT between sectors. Several industries are under continuous pressure to adopt new IT. For example, for Knowledge Intensive Sectors (KIS) firms it is more important to keep up to date than for firms in other sectors, since the former's core competencies are linked to innovation.

3. Research study

3.1. The Tunisian Context

Tunisia is a small, open country located in the North of Africa and close to Europe. It is considered as an Emergent Country since the per capita GDP (parity of purchasing power is around USD 11,380 (in 2014 – international dollars)[4]. The penetration of ICT can be considered important since most firms are well equipped with technology. In 2011,74.7% of Tunisian firms had a broadband connection, 78.9% of firms regularly used the Internet, and 83.5% regularly use computers in their daily jobs (INS, 2012). Several studies show that in the early stages, adoption of ICT was relied mainly on social considerations and mimetic behavior (Bellon et al., 2006; Ben Youssef et al., 2012). While the adoption by firms of first and second generations of ICT was rapid, previous experience of technology or the perceived advantages can slow adoption. Tunisia is an excellent object of study for the adoption of a new disruptive ICT such as CC, and allows investigation of the link between the adoption of the technology and absorptive capacity of the firm.

3.2. Sample and Data description

The survey aimed at charting the state of CC adoption by Tunisian firms. A private firm in Tunisia under our guidance conducted the survey. Before its implementation, we checked the questionnaire in order to ensure its consistency. Each survey contained a cover letter explaining the purpose of the study. For each firm, the participants were assured that their answers would be treated with confidentiality. All respondents were from top management staff.

The data was gathered from a face-to-face questionnaire administered in 2014 to a representative random sample of 350 Tunisian firms. The sample is representative of the Tunisian Economy. Respondents to the survey's questionnaire included firms active in Construction, Manufacturing, Less Knowledge Intensive Services (Less KIS) and Knowledge Intensive Services (KIS). Firms are located in all Tunisian regions and were randomly selected.

We obtained 311 usable surveys for data analysis, a response rate of nearly 90%. The high questionnaire response rate is related to Tunisian legislation obliging firms to respond to these types of surveys, our face-to-face procedure, and the inclusion of a statement about the purpose of the research and guarantee of confidentiality of interviewees' responses. We think that these characteristics make our study particularly interesting when it comes to investigating CC adoption and usage in Tunisia.

The survey is based on a set of questions related to the five core variables identified by the literature survey. The questionnaire asked about CC adoption and usage. In this

[4]International Monetary Fund (IMF) World Economic Outlook (WEO) database, October 2014

paper, we focus on the adoption decision; due to lack of data, we do not consider use and intensity of use.

Tables 1 and 2 below present some details related to the sample.

	CC Adoption	Mean(Age)	Mean(Size)
Yes	26.05 %	19.86	972.70
No	73.95 %	21.30	116.61

Table 1 – Characteristics of adopters and non-adopters of CC in Tunisia

	Construction	Manufacturing	Less Knowledge Intensive Services (Less KIS)	Knowledge Intensive Services (KIS)
Adoption (%)	6.17	8.63	39.52	45.68

Table 2 – Decomposition of the sample by economic sector

3.3. Estimate method in two stages

In our sample, the data by definition are truncated. Indeed, the aim is to see for firms that have adopted the CC, what degree it promotes innovation. Since the question on the degree to which CC promotes innovation is answered by firms that have adopted CC only. The estimation method should take into account a potential selection bias. Indeed, we estimate a first stage probit model and a second stage ordered probit model using the method developed by Heckman into 1979[5], named Heckman selection method, our model can be formalized as follows.

Let $d_i$denote a dummy variable which indicates if the firm i adopted CC $(d_i = 1)$ or not$(d_i = 0)$. The InnovationCC variable *InnovCC* is only observed if $d_i = 1$ which in turn takes on the value 1 (and 0 otherwise) it the latent variable d_i^* associated with d_i exceeds 0:

$$d_i = \begin{cases} 1 & if\ d_i^* = Z_i\alpha + u_i \\ 0 & otherwise \end{cases}$$

Where u_i denotes an i.i.d normal distributed error term. $Z_i$is a vector representing the variables that summarize the characteristics of the firm i. α is a vector of unknown parameters associated with the vectors Z_i. These coefficients are obtained by running a simple probit model. The variable InnovCC follows the usual ordered probit specification and observed if $d_i = 1$:

$$InnovCC_i = \begin{cases} 1 \ \ if \qquad InnovCC_i^* = X_i\beta + \varepsilon_i \leq s_1 \ and\ if\ d_i = 1 \\ 2 \ \ if\ s_1 < InnovCC_i^* = X_i\beta + \varepsilon_i \leq s_2 \ and\ if\ d_i = 1 \\ 3 \ \ if\ s_2 < InnovCC_i^* = X_i\beta + \varepsilon_i \leq s_3 \ and\ if\ d_i = 1 \\ 4 \ \ if\ s_3 < InnovCC_i^* = X_i\beta + \varepsilon_i \leq s_4 \ and\ if\ d_i = 1 \\ 5 \ \ if\ s_4 < InnovCC_i^* \qquad\qquad\qquad and\ if\ d_i = 1 \end{cases}$$

Where $InnovCC_i^*$ denotes the latent variable corresponding to $InnovCC_i$, the ss denotes the usual threshold parameters and X_i denote a vector of observable variables. The error terms u_i and ε_i are assumed to a bivariate normal distributed with correlation coefficient ρ and mean zero and variance 1 each: $(u_i, \varepsilon_i) \sim N_2(0, 0, 1, 1, \rho)$.

[5]For more details, please consult Heckman (1976), Siegelman and Zeng (1999) or Winship (1992).

The log-likelihood function corresponding to the ordered probit model with sample selection is:

$$\ln(L) = \sum_{d_i=0} \ln\big(1 - \Phi(Z_i\alpha)\big) + \sum_{d_i=1} \sum_{InnovCC_i=k} \ln(\Phi_2(s_k - X_i\beta, \alpha Z_i, \rho)) - \ln(\Phi_2(s_{k-1} - X_i\beta, \alpha Z_i, \rho))$$

Where α, β and ρ were obtained by estimating a probit model for $d_i$and then transferring the estimates of α to the standard ordered probit model. The terms Φ and Φ_2 represents, respectively, the univariate and the bivariate standard normal distribution.

3.4. The Variables

Dependent variables: We estimate two models in two steps. On the first we estimate a simple probit model and on the second an ordered probit. Indeed, we construct two dependent variables:

1- *Adoption of CC*: a dichotomous variable that take the value1 if the firm adopts CC and 0 otherwise.
2- *Innovation CC*: an ordinary variable from 1 to 5.

Explanatory variables: In this paper we consider three types of explanatory variables: (i) firm's external environment, (ii) firm’s perception of the technology, and (iii) the technological absorptive capacity of the firm.

(i) Environmental context: Most of the literature shows a positive relationship between the adoption of a given technology and its context (external environment). We consider two main variables related to this context: competition intensity, measured by adoption of CC by industry competitors and Internet connection problems can lead to non-adoption of more radical innovations related to IT. This variable is binary and is based on self-reported answers. It takes the value 1 if the firm has Internet connection problems and 0 otherwise.

(ii) Firm’s perception of the technology: Here, we consider four variables. The two first variables are related to perceived advantages: cost reductions and perceived time savings. They are binary variables based on self-reported responses. It takes the value 0 if the firm perceives cost reduction and time saving as important and 0 otherwise. We consider also two variables related to perceived disadvantages of the technology. The first is lack of knowledge in the firm about the technology. This is a binary variable based on responses to the question about the firm's knowledge of the technology. It takes the value 1 if the firm has no knowledge of CC and 0 otherwise. Perceived complexity is the next variable which is also a binary variable based on the firm's self-reported answers. It takes the value 1 if the firm perceives the technology to be complex and 0 otherwise.

(iii) Firm's absorptive capacity: In relation with our literature review, we consider four variables related to absorptive capacity of the firm. Manager's skills measured as ICT knowledge (the variable is the score for the manager's use of IT based on the survey). The score varies between 0 and 5. The second variable is the proportion of IT

Staff. It denotes rate of employees using IT on the firm. This is a continuous variable. Firms were asked whether CC facilitate employee coordination in the firm. This binary variable takes the value 1 if the firm experiences improved coordination from CC adoption and 0 otherwise. The last variable concerns the Intellectual Property Rights (IPRs). Firms were asked whether CC could secure IPRs or not. This binary variable takes the value 1 if the firm says yes and 0 otherwise.

(iv) Control variables: We consider three more variables in order to control our results. Seniority of the firm measured as number of years since establishment, firm size measured as number of its employees, and firm's activity sector. This variable takes four modalities: Knowledge Intensive Sector (KIS), Less KIS, Manufacturing and Other Sectors. We have also control for the squared age of the firm in order to examine whether some non-linear relationships exist or not.

The variables are summarized in table 3.

Table 3.

	Codes	**Variables**	**Measures**	**Codifications**
Dependent Variable	**Bivariate Probit** CC adoption	CC adoption	Binary =1 if firm adopts CC =0 if firm does not adopted CC	Dichotomy
	Ordered probit with sample selection Innovation CC	CC promotes innovation	Ordinary From 1 to 5	Ordinary
	Control variables			
	Age of the firm	Binary =1 if Yes =0 if No	Dichotomy	Continuous
	Size	Number of employees	Logarithm of number of employees	Continue variable
	Size (squared)	The square number of employees	Logarithm of number of employees(squared)	Continue variable
	Sector	Economic activity of the firm	Others =0 Manufacturing =1 Knowledge Intensive Services (KIS) =2 Less KIS =3	Multivariate
	I. External Environment and Competition Pressure			
	Competition Pressure	Firms' competitors adopt CC	Binary =1 if Yes =0 if Not	Dichotomy
	Internet Connection Problems	Problems with Internet connection	Binary =1 if Yes =0 if No	Dichotomy
	II. Perceptions of the Technology			
	Cost Reduction	CC reduces cost	Binary =1 if Yes =0 if No	Dichotomy
	Time Saving	CC saves time	Binary =1 if Yes =0 if No	Dichotomy
	Complexity	Complexity of implementation of	Binary	Dichotomy

		the CC	=1 if Yes =0 if No	
	Knowledge	Problems related no knowledge of CC	Binary =1 if Yes =0 if No	Dichotomy
	III. Absorptive Capacity of the firm			
	Intellectual Property Rights	CC promotes IPRs	Binary =1 if Yes =0 if No	Dichotomy
	ICT use	Score of ICT use by firm	Continuous	Continuous
	ICT Manager Skills	Score of 5 ICT use by the manager	Binary =1 if Score=5 =0 if Not	Continuous
	Employees using IT	% of employees using ICT		Continuous
	Employees' Coordination	CC facilitates employees' coordination	Binary =1 if Yes =0 if Not	Dichotomy

4. Results and discussion

Table 2 summarizes the main findings from our estimates. Two models were tested. The first is a bivariate probit model of the adoption of CC by the whole sample. The second is an ordered probit model that focuses on the subset of firms that adopted CC to foster innovation. We discuss the results of each model in turn.

	Bivariate probit CC		**Ordered probit with sample selection**	
	Coef.	*z-stat*	Coef.	*z-stat*
Control variables				
Age	-0.0164	*-1.46*	0.0154*	*1.73*
Age^2	0.0001	*1.14*	-0.0003	*-1.12*
Size	0.0003**	*2.04*	-0.0036	*-0.14*
Sector: *Other sectors*	Ref.		Ref.	
Manufacturing	-0.0470	*-0.13*	0.2408	*0.34*
Less KIS	0.6031**	*2.03*	-0.1698	*-0.27*
Knowledge Intensive Services	1.1769***	*3.77*	-0.0522	*-0.14*
External environment and competition pressure				
Competition Pressure	0.5120**	*2.29*	0.5755*	*1.68*
Connection	0.2517	*1.29*	-0.5199	*-1.33*
Perception of the Technology				

Cost Reduction	0.4147**	*2.17*	-0.2102	*-0.64*
Saves Time	0.2650	*1.24*	0.4884	*1.35*
Complexity	-1.0425*	*-1.76*	2.1165**	*1.97*
No Knowledge	-0.4465*	*-1.89*	0.0891	*0.85*
Absorptive Capacity of the Firm				
ICT Manager Skills	-0.1743	*-0.77*	-0.0243	*-0.56*
Employee Coordination	1.0317	*0.08*	0.7100**	*2.23*
% of employees using IT	0.3586**	*-2.04*	1.0425**	*2. 81*
ICT use of the firm			0.1046*	*1.67*
Intellectual Property Rights			0.86170**	*2.01*
# obs	311		81	
Prob > chi2	0.0000			

4.1. Adoption of CC: analysis of the entire sample

The bivariate probit model for the entire sample provides several important results with the respect of our hypotheses. Below we discuss the main ones.

4.1.1. Environment: adoption of CC by competitors leads to imitative behavior

Our results show that there is a competition effect and confirms H1a. The more that competitors adopt CC, the more other firms adopt it. CC is considered as a technology that can provide competitors with radical advantages, and reduce the focal firm's existing competitive advantage. At the same time, behind the competitors' pressure one can perhaps also link it to the pressure of the customers (Tiers et al., 2013). Adoption of technological innovation may depend on a mimetic mechanism. However, this dynamic adoption is not found in all sectors. In KIS, CC may be considered a vital "input", which is not the case for other industries and other sectors.

4.1.2. Technology: Perceived advantages of the technology lead to the adoption of CC

Our results show also that adoption of CC is pushed by the perceived cost reducing aspect of this technology. Adoption of CC is associated with the ability of this technology to reduce costs and to adjust to the real needs of the firm. It confirms the hypothesis H2a. Our findings confirm previous findings that the main driver of adoption of CC is financial (cost saving) (Reese, 2009; Marston et al., 2011). Reese (2009) suggests that cost savings can reach extraordinary levels since the pay-per-use model is significantly cheaper than the prepaid model. At the same time, CC is supposed to result in reduced maintenance and implementation costs (Ransome and Rittinghouse, 2010). Our findings confirm that Tunisian firms are adapting their ICT usage to their needs, and cutting unnecessary costs. At the same time, adoption of CC has been stimulated by CC providers offering CC services at reduced cost or even for free. These promotions have increased deployment of this technology.

Our results show also that the perceived disadvantages of CC (perceived complexity, and lack of knowledge about its purpose) are the main forces behind its non-adoption. It confirms our hypothesis H2d. Both perceived complexity and lack of knowledge about CC purpose are significant. The more the technology is perceived as complex and the firm is lacking information about its purpose the less is the probability of adoption of CC. It confirms the hypothesis H2c. CC is a new technology and there is little information available on its purposes; most Tunisian firms perceive it to be a complex technology which perception may be linked to the skills of the firm's managers and/or owners. The quality of the firm's management is considered a key determinant of the perception of the technology. Most models of technology adoption show that the complexity of a given technology depends on the perception of managers.

4.1.3. Organization: weak confirmation of the absorptive capacity effect

Our findings are contrasting. From the one hand, we found that the probability of adoption increases as the proportion of IT work increases in the firm. The more the proportion of employees uses IT the higher is the probability of CC adoption. It confirms the hypothesis H3e. The proportion of employees using IT can approximate accumulated tacit knowledge and the skills required for successful implementation of new generation IT. Adoption of CC depends on previous technology experience. From the other hand, we find that the firm's Manager IT skills do not play a role.

Generally, the adoption of technological innovation induces organizational change. In the case of CC we can expect deep organizational change Tunisian firms. Previous studies show that ICT are reshaping Tunisian firms' internal organization. Most firms adopt new organizational practices after the adoption of ICT innovation (Ben Khalifa, 2014; Ben Youssef et al., 2014). CC can accelerate this process and enhance organizational efficiency. However, our findings show that there is no link between the adoption decision and the coordination of work among employees. This is an unexpected finding and may reflect problems linked to the attitudes and skills of entrepreneurs. Most are unable to perceive all the advantages of CC and lack information on its potential, especially those related to the re-organization of tasks among employees.

4.1.4. Control variables: confirmation of the rank effect

Our study confirms the expected rank effect (i.e. firm size matters) found in the literature about the diffusion of IT innovation in the Tunisian context (Mouelhi Ben Ayed, 2009; Ben Youssef et al., 2012). Firm size is indicative of the firm's financial capacity, its human capital stock, and its capabilities. The rank effect is not linked to the country's level of development. CC is expected to allow small businesses to access resources, and benefit from technologies previously available only to large corporations (Marston et al., 2011). However, our results show that in early stage of adoption this does not hold. Big firms in ECs still benefit more from the potential of CC and their competitive advantage increases compared to small firms.

Our general model shows that in the Tunisian context the adoption of CC is more linked to Environmental and Technology perception than to the absorptive capacity of the firm. While we need to be precautious with such preliminary results one can argue by invocating two arguments. Firstly, given the readiness of the technology and its novelty in the context of ECs, firms may be more interested about the general implications of the technology than its impacts on the internal organization. As the knowledge about the purpose of the technologies and its application improves, firms will better value its links with the internal organization and previous knowledge. Secondly, in the context of ECs like Tunisia, most of the firms have small size. This fact reduces the role played by the internal organization and the internal knowledge. The profile of the manager is key for the process of adoption. Starting from there its perceptions of the technology and competitors behaviors becomes the key elements.

4.2. A focus on firms that have adopted CC for innovation reasons

The second ordered probit model was run for the subset of firms that have adopted CC to increase innovation, using the well-known Heckman procedure. This analysis was run to better understand the determinants of adoption among innovative firms. We focused mainly on the absorptive capacity of the firm by adding more variables. We found several interesting and original results with important differences with the first model.

4.2.1. Environment: Competitive pressure is still a key determinant of adoption of CC for innovative aims

The second model shows that the probability of adoption increases as the adoption of CC by competitors increases. Competition pressure is still a key driver of CC adoption for both the subset and the entire sample. This confirms work on the firm's environment and its role in the process of innovation adoption (Tiers et al., 2013). ECs generally experience less competitive pressure than DCs. As competition increases in these countries, one can expect more widespread adoption of technological innovation (especially CC).

In relation to physical infrastructure, our findings are surprising. The model shows that the probability of CC adoption for innovation does not increase with better Internet connection. This perhaps can be explained by the existing Internet connection in Tunisia being considered satisfactory. This contrasts with the findings of the literature, which show a particular role of Internet connection (especially bandwidth) in the adoption process.

4.2.2. Technology: Perception of the technology plays lesser role when it comes to innovation

Our results show that the perception of the technology is not linked to the decision of adopting CC for innovative aims. Three out of four variables are not significant in our estimation namely cost reduction, time saving and knowledge of the technology. This is contrasting with previous results about the adoption of CC for general purposes. One plausible explanation is the fact that firms seeking innovation are aware about the potential benefits and costs of CC and have the necessary information about its aims. However, our results show that perceived complexity is still significant and plays a role. The more the technology is seen as complex technology and the lesser firms adopt it for innovative goal. In fact, the perception of complexity is considered as an important dimension for innovation (Meeus et al. 2001). At the same time, the complexity of the technology may raise the fear of articulation between previous knowledge and routines of the firm and the new ones after the adoption of the new technology.

4.2.3. Organization: strong confirmation of the absorptive capacity argument

Our model confirms that adoption of CC depends strongly on the absorptive capacity of the firm. Most of the considered variables reflecting the absorptive capacity of the firm are significant. The percentage of IT staff is key to the adoption of CC for innovation reasons. The more the percentage of IT staff is high the more the firm adopts CC for innovative aims. At the same time our model shows that the firm's intensity of ICT use is important for CC adoption for innovation, and confirms that CC adoption depends on previous knowledge about ICT, which reflects the absorptive capacity argument.

The most important finding from our study is that CC adopting firms to it for both innovation reasons and to achieve better coordination among employees. This implies that one objective of CC adoption is organizational change. Our findings confirm the complementarity between adoption of NOP and ICT proposed in Milgrom and Roberts (1990), and the finding in Ben Khalifa (2014) of the important impact of IT on the performance of Tunisian firms. In his sample Tunisian companies invest simultaneously in IT and organizational innovation and human capital. Ben Khalifa (2014) points to the special role played by international contractors.

Another interesting finding is that firms seeking to increase innovation through CC adoption are also keen to secure IPRs. Firms seem convinced that CC adoption will secure IPRs for their innovation and their intangible capital. Given the lack of legislation regarding IPRs in ECs, and especially in Tunisia, CC is seen as a way of improving the situation of these firms. The appropriability regime, a key element in the absorptive capacity is found to be linked to the adoption of CC.

However, our model confirms that the manager's IT skills do not play any role in the adoption of CC. This contrasts with the findings in the literature that managers' IT skills are important for the adoption of IT in Tunisia (Bellon et al., 2006). For CC, the picture seems different perhaps because CC is seen as a complex technology. One plausible explanation is given by Raza et al., (2015). In fact, the managers’ take their decision based on the IT staff skills. In our context CC adoption depends strongly on IT workers beliefs and skills.
Taken all together, our model confirms the strong role played by the absorptive capacity of the firm in the innovation process in the context of ECs.

4.2.4. Control variables: Adoption of CC for innovative aims depends on the firm’s seniority

While the rank effect applies to the entire sample it does not hold for adoption of CC to improve innovation. We found opposite dynamics for firm age. We found that the adoption of CC was not linked to firm age when we considered the whole sample but that the effect of firm age holds for firms that adopt CC to increase innovation. The experience and maturity of the firm is important for innovation in the context of ECs.

4.3. Limitations of the work

Our model needs to be considered as a preliminary work. It contains several original results. However, we need to stress three main limitations that will be challenged in the near future. Firstly, most of the variables in our survey are binary and dichotomy.

They do not allow examining the depth of adoption. Future investigations will need to make change in the nature of the variables and investigate more quantitative variables. Secondly, adoption of CC has an important effect on the firm's internal organization. Unfortunately, our data allowed us to exploit only one dimension of organizational change but not to observe several New Organizational Practices (NOP). Beyond adoption of CC, effective economic gains depend on the ability of ECs to challenge organizational change and to adopt NOP. Without changes to internal organization the adoption of new IT can produce disorganization. Thirdly, understanding the pattern of adoption needs to take into account the dynamic of the process of adoption and use of CC and to examine the firms' decisions for several years. This is not allowed by our current data. Finally, an laternative research strategy consists of considering a structural model of the decision of CC adoption with mediating variables and constructs. This may be considered as an extension of the current work in the near future.

6. Concluding Remarks

This article set out to identify the determinants of CC adoption in ECs. It aims at developing a theoretical framework that explains the decision of CC adoption in ECs. It emphasizes the specific role of the technological absorptive capacity especially when the firm is seeking innovation by adopting CC. It provides the first exploratory investigation based on a sample of 350 Tunisian firms, and several important results. The adoption of CC depends on various the external characteristics such as competitive pressure and technology perception such as perceived complexity or perceived cost savings. Our results show also that the adoption mechanism depends also on the firm's technology absorptive capacity.

Our paper goes beyond a simple explanation of the determinants of CC adoption and provides a deeper analysis by focusing on a subset of firms that have adopted CC for innovation reasons. We found contrasting results especially in relation to firm's perception of the technology and the absorptive capacity of the firm. However, both models confirm the specific role of competition pressure and that the manager's IT skills play no role. While the perception of the technology is key for the adoption process (for general purposes), the technological absorptive capacity is the main determinant when it comes to adopt CC for innovation.

Our results have several policy and managerial implications. They show that in the Tunisian case, the main forces driving CC non-adoption are lack of adequate skills and perceived complexity of the technology. Policy makers could address both issues through appropriate information campaigns aimed at firms' managers, to explain how the CC model works and what are its main benefits. At the same time, CC providers should advertise the advantages of the technology for firms. Adoption patterns are linked to the information provided, and the perceptions of managers. One of the main arguments for the adoption of this technology is its ability to cut unnecessary expenditure on ICT. Policy makers should also target this dimension.

Building skills in CC is difficult and is important in order to increase the competitiveness of Tunisia's economy. Several countries including South Africa have implemented national strategies such as the e-skills South Africa. These strategies are aimed at sensitizing firms to the application and value of these technologies and how firms can exploit them. South Africa has provided training sessions and seminars for several years. Its aim is to populate the national (South African) cloud. Tunisia should employ a similar strategy targeting firm managers, and adoption of a national CC strategy more generally.

ECs have the opportunity to leapfrog technology generations and adopt the latest technology at a faster pace (e.g. the case of mobile phone penetration). In order to benefit from opportunities governments need to promote a conducive environment and establish the institutional factors needed for SMEs to adopt CC. Many ECs such as India, Brazil, and South Africa have invested hugely these activities. Tunisia should follow their example.

6. References

Alam, S.S. and Noor, M.K.M. (2009). « ICT adoption in small and medium enterprises: An empirical evidence of service sectors in Malaysia », *International Journal of Business and Management*, Vol. 4, n°2, p. 112-125.

Alsanea, M. and Wainwright D. 2014, ‘’Identifying The Determinants of Cloud Computing Adoption in A Government Sector_ A Case Study of SAUDI Organisation’’. *International Journal of Business and Management Studies.* Vol 6, N°2, pp 29-43.

Amabile, S. and Gadille, M. (2003). « Les NTIC dans les PME : stratégies, capacités organisationnelles et avantages concurrentiels », *Revue Française de Gestion*, Vol. 29, n°144, Mai-Juin, p. 43-63.

Apulu, I. and Latham, A. (2011). « Drivers for information and communication technology adoption: A case study of Nigerian small and medium sized enterprises », Canadian Center of Science and Education. *International Journal of Business and Management*, Vol. 6, n°5, p. 51-60.

Basant, R. Commander, S. Harrison, R. and Menezes-Filho, N. (2006). « ICT Adoption and Productivity in Developing Countries: New Firm Level Evidence from Brazil and India », Institute for the Study of Labor, IZA Discussion Paper n°2294, September, Germany.

Battisti, G. and Stoneman, P. (2005), « The intra-firm diffusion of new process technologies », *International Journal of Industrial Organization*, Vol. 23, n°1-2, February, p. 1-22.

Bellon, B. Ben Youssef, A. and M’Henni, H. (2006), « Le maillon manquant entre adoption et usage des TIC dans les fonctions managériales des economies du Sud Méditerranéen », *Revue Française de Gestion*. Vol. 166, p. 173-89.

Ben Khalifa, A. (2014), « Déterminants de la diffusion des TIC dans les pays Sud-Méditerranéens: Cas de la Tunisie », *Economics and Strategic Management of Business Process (ESMB)*. Vol. 2, p. 185-190.

Ben Youssef, A. Hadhri, W. and M’Henni, H. (2012), « Intra-firm diffusion of innovation: Evidence from Tunisian SME’s regarding Information and

Communication Technologies », *Middle East Development Journal*. Vol. 3, n°3, p. 75-97.

Ben Youssef, A. Hadhri, W. and M'Henni, H. (2014), « Adoption of Information and Communication Technologies and New Organizational Practices in the Tunisian Manufacturing Sector », *Economics Bulletin*, Vol. 34, n°4, p. 2237-2252.

Bertscheck, I. Cerquera, D. and Klein, G. (2013), « More bits – More bucks? Measuring the impact of broadband Internet on firm performance », *Information Economics and Policy*, Vol. 25, n°3, p. 190-203.

Boynton A.C., Zmud R.W. (1994), "The influence of IT management practice on IT use in large corporations.", *MIS Quarterly*, vol. 18, n°3, p. 299.

Bradshaw, S. Millard, C. and Walden, I. (2011), « Contracts for clouds: Comparison and analysis of the terms and conditions of cloud computing services »,*International Journal of Law and Information Technology*, Vol. 19, n°3, p.187-223.

Bresnahan, T. Brynjolfsson, E. and Hitt, L. (2002), « Information Technology, Workplace Organization and the Demand for Skilled Labor : Firm-Level Evidence », *The Quarterly Journal of Economics*, Vol. 117, n°1, p. 339-376.

Brynjolfsson, E and Milgrom, P. (2012), « Complementarity in Organizations » in *The Handbook for Organization Economics*, R. Gibbons and J. Roberts (Eds), Princeton University Press, p.11-55.

Cardona, M. Kretschmer, T. and Strobel, T. (2013), « The Contribution of ICT to Procutivity : Key Conclusions from Surveying the Empirical Literature », *Information Economics and Policy*, Vol. 25, n°3, p. 109-125.

Caroli, E. and Van Reenen, J. (2001), « Skill-biased organizational change? Evidence from A Panel of British and French Establishments », *Quarterly Journal of Economics*, Vol. 116, n°4, p.1449-1492.

Cohen, W.M. and Levinthal, D.A. (1990), « Absorptive capacity: A new perspective on learning and innovation »,*Administrative Science Quarterly*, Vol. 35, n°1, Special Issue: Technology, Organizations and Innovation, March, p.128-152.

Fuentes, O. and Gilchrist, S. (2005), « Skill-biased technology adoption: Evidence for the Chilean manufacturing sector », Department of Economics, The Institute for Economic Development Working Papers Series n°150, November, Boston University.

Ganguly, A. Nilchiani, R. and Farr, J. (2010), « Defining a Set of Metrics to Evaluate the Potential Disruptiveness of a Technology »,*Engineering Management Journal*, Vol. 22, n°1, p. 34-44.

Grazzi, M. and Jung, J. (2015), «ICT, Innovation and Productivity: Evidence from Latin American firms », http://hdl.handle.net/123456789/53074

Gréczy, P., Izumi, N et Hasida, K. (2012). « Cloudsourcing : Managing Cloud Adoption ». *Global Journal of Business Research.* Vol 6, Number 2, pp. 58-70.

Gupta, P. Seetharaman, A. and Rudolph Raj, J. (2013), « The Usage and Adoption of Cloud Computing by Small and Medium Businesses », *International Journal of Information Management*, Vol. 33, n°5, p. 861-874.

Greve, H.R. (2011), « Fast and expensive: The diffusion of a disappointing innovation ». *Strategic Management Journal*, Vol. 32, n°9, September, p. 949-968.

Harrington S.J., Guimaraes T. (2005), "Corporate culture, absorptive capacity and IT success.", *Information & Organization*, vol. 15, n°1, p. 39‑ 63.

Heckman, J.J. (1976), « The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models » in *Annals of Economic and Social Measurement*, Sanford V. Berg (Editor),Vol. 5, n°4, p. 475-492.

Heckman, J.J. (1979), « Sample Selection Bias as a Specification Error », *Econometrica*, Vol. 47, n°1, p.153-161.

Helvacioglu Kuyucu, A.D. (2011), « The Playground of Cloud Computing in Turkey»,*Procedia Computer Science*, Vol. 3, n°12, p. 459-463.

Hollenstein, H. and Woerter, M. (2008), « Inter-and intra-firm diffusion of technology: The example of E-commerce: An analysis based on Swiss firm-level data»,*Research Policy*, Vol. 37, n°3, p. 545-564.

Ichniowski, C. Shaw, K. and Prennushi, G. (1997), «The Effects of Human Resource Management Practices on Productivity: A Study of Steel Finishing Lines »,*The American Economic Review*, Vol. 87, n°3, p. 291-313.

INS, 2012, "Enquêtes nationale sur les activités économiques", Tunis.

Ja-Shen Chen, Ching R.K.H., Chen J. (2004), "An Empirical Study of the Relationship of IT Intensity and Organizational Absorptive Capacity on CRM Performance.", *Journal of Global Information Management*, vol. 12, n°1, p. 1‑ 17.

Knights, D. and Vudurbakis, T. (2005), « Information technology as organization/disorganization », *Information and Organization*, Vol. 15, p.181-184.

Kossaï, M. Lapa De Souza, M.L. and Roussel, J. (2010), « Adoption des Technologies de l'Innovation et Capital Humain : le Cas des PME Tunisiennes », *Revue Management et Avenir*, Cahier Le Concept de Capital Humain Aujourd'hui : Quel bilan ? Quelles perspectives ? Janvier, n°31.

Kossaï, M. and Piget, P. (2012), « Utilisation des TIC et performance économique des PME tunisiennes : une étude économétrique », *Cahiers Economiques de Bruxelles*, Vol. 55, n°3, p.1-24.

Kossaï, M. and Piget, P. (2014), « Adoption of information and communication technology and firm profitability: Empirical evidence from Tunisian SMEs », *The Journal of High Technology Management Research*, Vol. 25, n°1, p. 9-20.

Lal, K. (1999), « Determinants of the adoption of information technology: a case study of electrical and electronic goods manufacturing firms in India », *Research Policy*, Vol. 28, n°7, September, p. 667-680.

Lal, K. (2007), « Globalization and adoption of ICTs in Nigerian SMEs », *Science Technology & Society*, Vol.12, n°2, July, p. 217-244.

Lane P.J., Lubatkin M. (1998), "Relative absorptive capacity and interorganizational learning.", *Strategic Management Journal*, vol. 19, n°5, p. 461.

Lian, J.W. Yen, D.C., and Wang, Y.T. (2014), « An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital»,*International Journal of Information Management*, Vol. 34, n°1, p. 28-36.

Li, Q. Wang, C. Wu, J. Li, J. and Wang, Z.Y. (2011), « Towards the business-information technology alignment in cloud computing environment: An approach based on collaboration points and agents », *International Journal of Computer Integrated Manufacturing*, Vol. 24, n°11, November, p. 1038-1057.

Lin, A. Chen, N.C. (2012), « Cloud Computing as an Innovation: Perception, Attitude, and Adoption »,*International Journal of Information Management*, Vol. 32, n°6, p. 533-540.

Low, C. Chen, Y. and Wu, M. (2011), « Understanding the determinants of cloud computing adoption »,*Industrial Management and Data Systems*, Vol.111, n°7, p. 1006-1023.

Lumsden, J. R.I. and Gutierrez, A. (2013), « Understanding The Determinants of Cloud Computing Adoption Within The UK », European, Mediterranean and Middle Eastern Conference on Information Systems, Windsor, United Kingdom, p. 1-16.

McFadden, D. (1981), « Econometric models of probabilistic choice », in *Structural Analysis of Discrete Data with Economic Applications*, C.F. Manski and D. McFadden (Eds), MIT Press, Cambridge, MA, p. 198-272.

Marston, S. Li, Z. Bandyopadhyay, S. Zhang, J. and Ghalsasi, A. (2011), « Cloud Computing-The business perspective », *Decision Support Systems*, Vol. 51, n°1, p. 176-189.

Meeus M.T.H., Oerlemans L.A.G., Hage J. (2001), "Patterns of Interactive Learning in a High-tech Region.", *Organization Studies (Walter de Gruyter GmbH & Co. KG.)*, vol. 22, n°1, p. 145.

Milgrom, P. and Roberts, J. (1990), « The economics of modern manufacturing: Technology, strategy, and organization », *American Economic Review*, Vol. 80, n°3, p. 511-528.

Mohammed, A.B. Altmann, J. and Hwang, J. (2009), « Cloud computing value chains: understanding businesses and value creation in the cloud », in *Economic Models and Algorithms for Distributed Systems*, Birkhauser Verlag, Basel, Switzerland, p. 187-208.

Morgan, L. and Conboy, K. (2013), « Key Factors Impacting Cloud Computing Adoption », *Computer*, Vol.46, n°10, p. 97-99.

Mouelhi Ben Ayed, R. (2009), “Impact of the adoption of Information and Communication Technologies on firm efficiency in the Tunisian manufacturing sector », Economic Modelling, Vol. 26, n°5, p. 961-967

Mughal, M. and Diawara, B. (2011), « Human capital and the adoption of information and communications technologies: Evidence from investment climate survey of Pakistan », Economics Discussion Papers n°21, July, Kiel Institute for the World Economy.

NIST, NIST cloud computing program available at http://www.nist.gov/itl/cloud/ 2012 (accessed November 01, 2012).

Nour, S. (2011), « The use and economic impacts of ICT at the macro–micro levels in the Arab Gulf countries », Working Papers, n° 059, United Nation University UNU-MERIT - Maastricht Economic and social Research Institute on Innovation and Technology.

Oliveira, T. Thomas, M. and Espadanal, M. (2014), « Assessing the Determinants of Cloud Computing Adoption: An Analysis of the manufacturing and Services Sectors», *Information and Management*, Vol. 51, n°5, p. 497-510.

Pan, M.J. and Jang, W.Y. (2008), « Determinants of the adoption of enterprise resource planning within the technology-organization-environment framework: Taiwan’s communications industry », *Journal of Computer Information Systems*, Vol. 48, n°3, p. 94-102.

Polder, M. Van Leeuwen, G. Mohnen, P. and Raymond, W. (2010), « Product, Process and Organizational Innovation: Drivers, Complementarity and Productivity Effects », Working Paper n°035, United Nation University UNU-MERIT - Maastricht Economic and social Research Institute on Innovation and Technology.

Ransome, J.F. and Rittinghouse, J.W. (2010), *« Cloud computing: Implementation, management and security»*, CRC Press, Florida.

Raval, V. (2010), « Risk landscape of cloud computing », *ISACA Journal*, Vol.1.

Raymond, L. and St-Pierre, J. (2005), « Antecedents and Performance Outcomes of Advanced Manufacturing Systems Sophistication in SMEs », *International Journal of Operations & Production Management*, Vol. 25, n°5/6, p. 514-533.

Raza, M.H. Adenola, A.F. Nafarieh, A. and Robertson, W. (2015), « The Slow Adoption of Cloud Computing and IT Workforce ». *Procedia Computer Science*, Vol. 52, p. 1114-1119.

Reese, G. (2009), « Cloud application architectures», http://www.salesforce.com/uk/saas (assessed on: 14 March 2010).

Sigelman, L. and L. Zeng (1999), "Analyzing Censored and Sample-Selected Data with Tobit and Heckit Models", *Political Analysis*, Vol. 8, Number 2.

Sultan, N. (2013), “Knowledge Management in the Age of Cloud Computing and Web 2.0: Experiencing the Power of Disruptive Innovations”, *International Journal of Information Management*, n° 33, p. 160-165.

Tiers, G. Mourmant, G. and Leclercq-Vandelannoitte, A. (2012), « Cloud computing : les composantes d’une rupture », 20ème Colloque de l’Association Information Management (AIM), May 22-23, Bordeaux, France.

Tiers, G. Mourmant, G. and Leclercq-Vandelannoitte, A. (2013), « L’envol vers le Cloud: un phénomène de maturation multiples », *Système d’Information et* Management, Vol. 18, n°4, p.7-42.

Todorova G., Durisin B. (2007), "Absorptive Capacity: Valuing a Reconceptualization.", *Academy of Management Review*, vol. 32, n°3, p. 774‐ 786.

Tsai W. (2001), "Knowledge Transfer in Intraorganizational Networks: Effects of Network Position and Absorptive Capacity on Business Unit Innovation and Performance.", *Academy of Management Journal*, vol. 44, n°5, p. 996‐ 1004.

Xu, X. (2012), « From Cloud Computing to Cloud Manufacturing», *Robotics and computer-integrated manufacturing*, Vol. 28, n°1, p. 75-86.

Zahra, S.A. and George, G. (2002), «Absoptive Capacity: A review, Reconceptualization, and Extension », *Academy of Management Review*, Vol. 27, n°2, p. 185-203.

Winship, C., and Mare, R. D. (1992), "Models for Sample Selection Bias", *Annual Review of Sociology*, Vol. 18, pp. 327-350.