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Impact of Technological Alliances Between Asymmetrical Firms on Icts Appropriation

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Abstract
The study evaluates the contribution of technological cooperation between asymmetrical firms to reduce the digital divide. To do this, we assess the impact of technological alliances between Euro-Mediterranean firms on ICTs appropriation by especially Tunisian firms. But it mustn't be studied independently of strategic and demographic contexts. The article presents a quantitative study based on a survey which was conducted among a sample of 155 companies. We led logistic multinomial regressions to estimate the model and valid the hypothesis.

Keywords: technological alliances, ICTs appropriation, strategic and demographic context

1. Introduction

Despite the efforts developed by various international organizations to bring somehow developed countries and developing countries a huge gap still evident and continues to widen between asymmetric firms especially in terms of ownership of ICT. A thorough analysis of the causes of the inter-firms digital divide has allowed us to identify the problem and question the strategies that might reduce it. Moreover after a site visit of Tunisian companies and a few interviews with experts on the matter we note that the South firms in the Mediterranean tend to resort to technological cooperation with those of the other side of the Mediterranean to share the costs of the competitiveness and facilitate ICT appropriation. It is in fact in this context that we are interested in analyzing the effect of technological alliances between euro-Mediterranean companies on the reduction of inter-digital divide. For this we pose the following research questions:

- What are the causes of the digital divide between asymmetric firms?
- What are the contexts of appropriation of ICT by a firm?
- What is the impact of technological alliances between asymmetrical firms on the appropriation of ICTs?

To answer these questions we designed the elaboration of a theoretical model to evaluate the contribution of technological cooperation between Euro-Mediterranean firms to reduce the digital divide and its empirical validation in the Tunisian context.

2. Theory and hypothesis:

To do this, a review of the literature supported by an exploratory qualitative study appeared to us necessary to clear our research hypotheses and consequently our conceptual model.

Moreover a comprehensive study of the causes of the digital divide has allowed to define the concept of ICT ownership by firms in Southern countries of the Mediterranean (Tlich, 2013) and has rather corroborated with the study of Proulx (2015) and Giffard (2006) that identified the concept in a triangle formed by:

- The access or use of ICT which is reflected in the interaction between human and computer: The scope of the study discussed in this case is the Human-Computer Interaction (HCI). It's the holding of the tool and it implies a lower access costs by Hollenstein and Woerter (2008) and Bellon et al. (2005).
- Thereafter the term use of ICT in a sociological context refers to the evolutions of organizational capabilities required by different authors such as Ben Youssef (2004), Antonelli (2003), Amabile et al. (2003) Birkinshaw et al. (2008), Hamel (2006, 2007, 2009), Camisón et al. (2014).
- This incidentally widens the concept to uses not only standardized aimed facilitating internal and external communication between the members and partners of the organization, but also to the creative uses that are intended for the creation of innovative and new value for the organization (Bellon et al., 2007; Sarooghi et al., 2015) .

The literature has also demonstrated that ICT appropriation takes various forms (Hussenot (2007), Boucher (2006) (Figure 2).

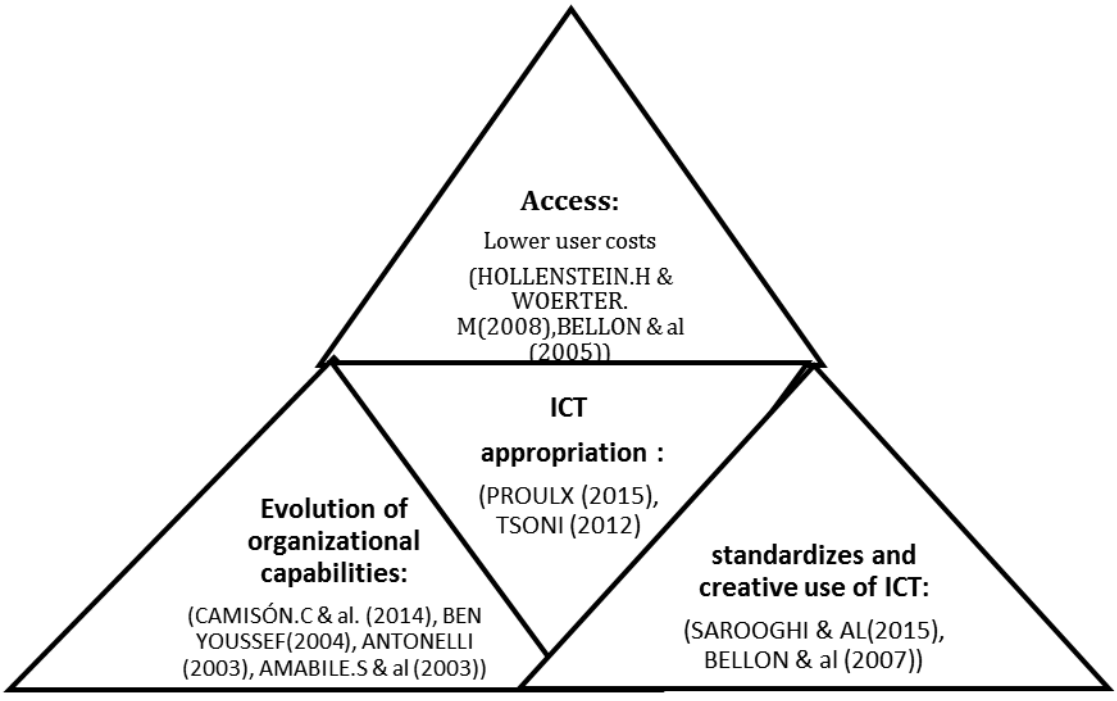
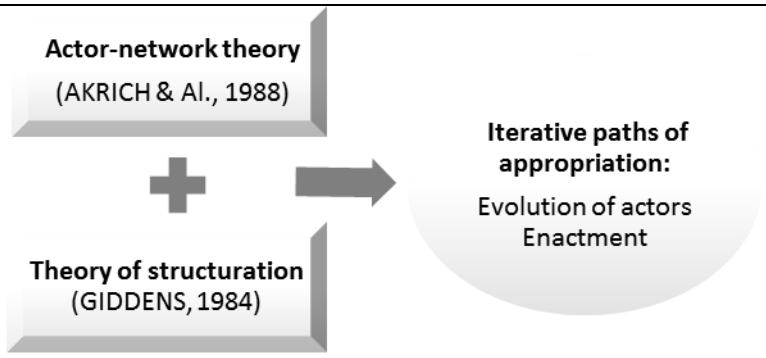


Figure 1. ICT appropriation



Infusion theory: (Possession report between the individual and the tool)

(BOUCHER, 2006)

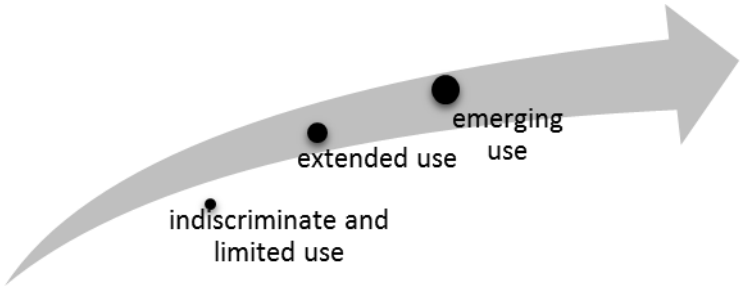


Figure 2. Dynamic ICT appropriation (Iterative paths of appropriation)
(HUSSENOT, 2007)

2.1. Technological Alliances

Before turning to the literature on technological alliances, we believe that a definition of the concept is essential. That's why we borrow the definition of JOLLY.D (2002) on technological alliances. Indeed the author defines the alliance with technological character, any kind of alliance where pooled, combined or exchanged resources with at least one partner are technological.

The technology would be an original and protected combination of scientific and technical knowledge and of specific firm's know-how (or a reduced number of firms) incorporated for economical purposes in a product, a service, a method of manufacturing, an information system, or a method of management.

2.2. Dependent variable: Behavior of the appropriation of ICTS

The previous studies showed that the Tunisian companies do not behave quite in the same way as term of appropriation of ICTs (Tlich, 2013). That's why a clarification of the classes representing ICT appropriation on which we are based is required.

- The first class called "the passive firms" (Tlich, 2013) includes all companies that do not use any ICT. ICT culture even in its globality, does not exist insofar the infrastructure is not present. Leaders do not believe in their benefits and contributions. They are not sufficiently informed of these tools and do not think to adopt it. User costs are a huge brake on ICT adoption, and they prefer to keep their traditional structure without thinking to modify the relationship between hierarchical levels. They do not invest at all in the training of staff and the creativity and innovative culture is absent in this type of firms.
- The second class called the class of "proactive firms" represents the most equipped companies of the totality of the sample (Tlich, 2013). These companies use ICT for

different uses. Indeed, they seek not only the improvement of productivity and the facilitation of communication, but also the creativity and the creation of value.

The leaders of these companies are passionate by these tools and they think it is an opportunity for firms. Costs do not arise at all an obstacle to the adoption of these tools.

The organization of this company is constantly subjected to adapt to change, staff become more involved in the development of the company, more motivated and looking for new ideas and new innovations.

Relationships are more flexible and communication is more fluid.

Leaders are willing to invest more in the improvement of the qualification.

- The third class is named the "followers" (Tlich, 2013). It 's called such because they are all equipped ICT companies but use them excessively for the purpose of improvement of productivity and facilitate channels of communication in the organization only.

  However the culture of creativity and innovation is not yet diffused in these organizations.

  Moreover leaders introduce these new tools not passionately, but by obligation and requirement of membership in the development program.

  More importantly it is to follow the practices of external partners such as suppliers, customers and allies.

  The investment costs ICT Elements don't pose an obstacle to adoption, for these firms.

  However the requirement of organizational fit and information search seem expensive, which inhibits these companies to adopt these tools deeply and for the purpose of value creation. Moreover for this reason these companies seem reluctant to organizational change and prefer to adopt a standardized ICT usage without changing the relationships between staff or touch a hierarchical structure of the organization.

  The leaders of these companies don't seem to appreciate investment in the improvement of the qualifications.

2.3. Independent Variables

2.3.1. Technological Alliances and ICT Appropriation

Another stream of literature addresses the benefits derived from various forms of asymmetrical cooperations and allowed us to untap the following conclusions:

- Bellon et al. (2000) could reveal that strategic alliances provide an ineluctable technology's transfer.
- Hippel (1988) found that innovative processes need to work with outside vendors to develop new technologies;
- Reichstein and Salter (2006) have revealed that external sources of knowledge and cooperation with partners are important for innovation;
- The study of Ahuja (2000) found a positive effect of a higher frequency in forming linkages interfirms on the firms' innovative capacity;
- The influence of collaboration networks on organizations' exploitative and exploratory innovations depends on some structural features like direct or indirect ties(Guan & Liu, 2016)
- The inter-organizational collaboration is also an important method for the generation of process innovation capability (Shoenmakers et al., 2006)

- external relations and participation in cooperative agreements are positively with the development of the process of innovation capability (Camisón et al., 2010);
- The increasing of the linkages interfirms' strength has a positive effect on the ease of the knowledge's acquisition and the innovation's growth (Ding, 2003; Rowley et al., 2000)
- Knowledge acquisition through R&D alliances is positively associated with a firm's new product development (Wang, 2016) and it's more beneficial when technological link between the firm and its alliance partners is strong rather than weak. (Frankort, 2016)
- Finally, interfirms alliances affect negatively the user costs of ICT by Hollenstein et al. (2008). The study has also confirmed that in Swiss firms, developing partnership relations with foreign firms, user costs pose no obstacle to the adoption of ICT.

2.3.2. Strategic and demographic contexts:

The behavior of organizational ownership of ICT can't be studied independently of the general firm's context. Indeed two types of contexts affect the adoption of these technologies: strategic and demographic.

The strategic context includes the perception of the general direction of ICT as a strategic tool, as sources of competitive advantage and as tools that generate organizational changes (Kalika et al., 2007).

The existence of knowledge-oriented leadership encourages the development and use of Knowledge Management exploration (creation) and exploitation (storage, transfer, and application) practices (Donate et al., 2015).

The demographic context is measured by the size of the company (Kalika et al., 2007; Mol et al., 2009), its sector of activity and its original nationality which have a positive effect on the appropriation of ICT (Kalika et al., 2007).

2.4. Theoretical model:

The construction of our theoretical model also requires the elaboration of an exploratory qualitative study conducted on Tunisian field and has been primarily a survey by the method of Experts.

This is a non-structured interview conducted with some specialist-experts in the field of ICT, in order to define the concept contextualized with the Tunisian field.

Subsequently another semi-structured interview was conducted with a set of Tunisian companies' leaders in cooperation with a European company and belonging in the IAA, the IEEE and SIT sectors.

The combination of various above-mentioned literatures supplemented by our exploratory study has allowed us to put our research hypotheses and formulate our conceptual model.

Indeed, while various authors have shown that companies differ in the appropriation of ICT according to the stage, the study on Tunisian soil allowed us to observe that Tunisian firms do are not equal on the different types of ownership of ICT and do not behave the same way.

For this we assume, in a first hypothesis Hi, that Tunisian firms adopt different types of behavior towards the ownership TIC. This will be thereafter the subject of a cluster analysis.

The binding between the other hypotheses will be our conceptual model (Figure 3).

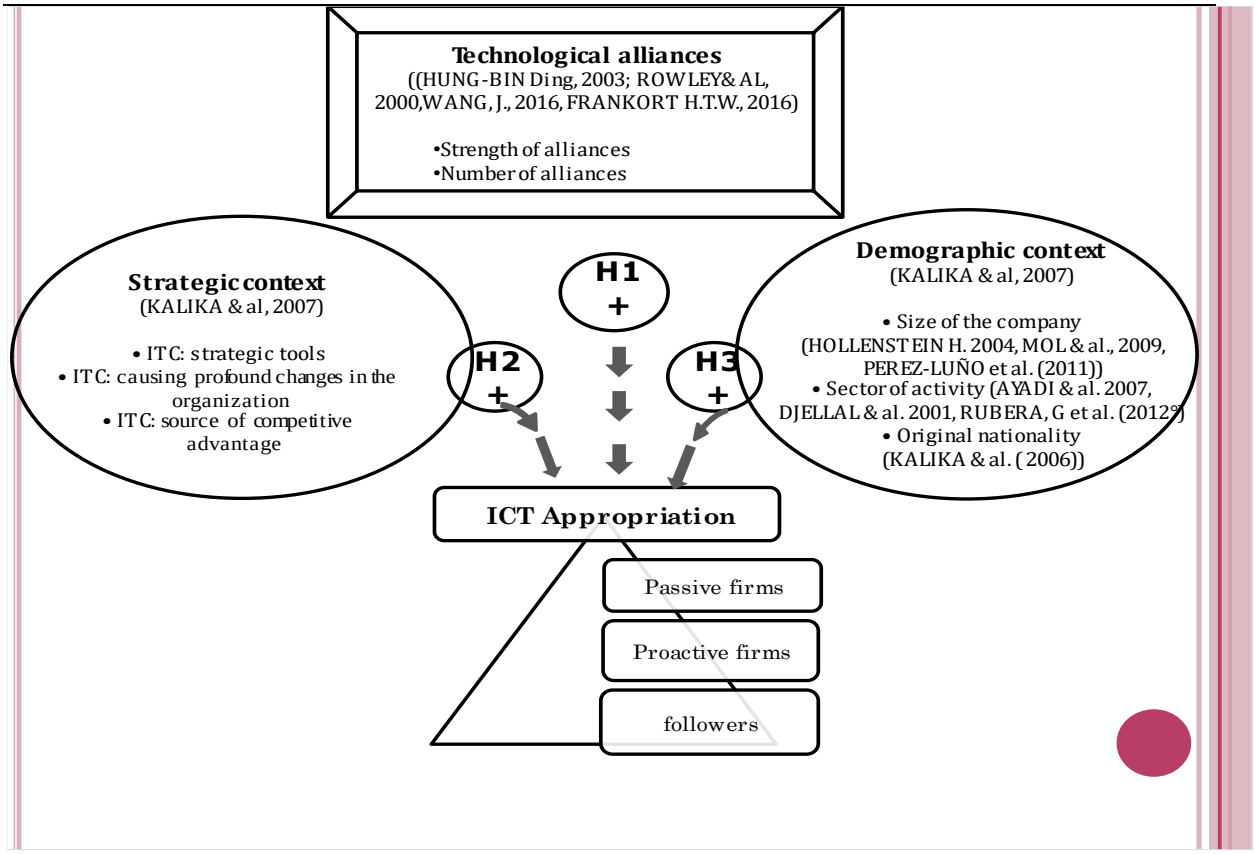


Figure 3. Theoretical model

Indeed we will approve that the strength and number of alliances positively influence the behavior of ICT appropriation (respectively hypothesis H1.1 and H1.2). We suppose also that the appropriation of ICTs is positively influenced by the perception of general director of ICT as strategic tools (hypothesis H2.1), causing profound changes in the organization (hypothesis H2.2) and as a source of competitive advantage (hypothesis H2.3).

The hypothesis H3 on the demographic context appropriate ICTs suppose that this behavior is influenced positively by the size (hypothesis H3.1), the sector of activity (hypothesis H3.2) and nationality of origin of the factory (hypothesis H3.3).

To validate our model a quantitative study based on a survey was conducted among a sample of 155 companies from the same population. Indeed the analysis of quantitative data followed the following steps:

- In a first phase we opted for the purification of ladders;
- A flat sorting was done in a second phase;
- Subsequently, a Principal Component Analysis was developed in a 3rd phase to facilitate the processing of data;
- And finally the 4th stage provides answers to the other research questions and has been the subject of multinomial logistic regressions.

3. Results of the multinomial logistic regression:

3.1. Test of Goodness of Fit of the Model

3.1.1. Chi-Square Test Measuring the Significance of the Change - 2 log Likelihood:

This is a ratio of the probability that tests the final model. Indeed the chi-square statistic presents the difference in -2 log likelihood from null model (model

including only the constant) and the final model. We can judge that our final model provides an adequate prediction from the null model given that p-value or signification is equal to 0.000 lower to 0.05 (Appendix 1).

3.1.2. Review of the Classification Table (Appendix 2):

The classification table shows the practical results of using the multinomial logistic regression model. Indeed, in each case, the category of the foretold answer is chosen by selecting the category with the highest probability of prediction of the model.

The cells on the diagonal are correct predictions while the cells outside the diagonal are incorrect predictions.

Among the individuals forming the model, 20 from 35 "passive" firms are classified correctly.

23 from 50 "proactive" firms are assigned to their places.

Finally, 49 from 70 "followers" companies are classified correctly.

Overall, according to the table quoted in Appendix 4, the model allows to reallocate nearly 60% of the firms in their original classes. It is always preferable to null model that affects all observations in the class of the category of reference.

3.1.3. Test of the null Hypothesis:

The table of the fitting quality presents two tests of the null hypothesis that the model adequately fits with the data.

If the null is true, Pearson and Deviance statistics have distributions of chi-square with degrees of freedom posters.

If the value of the significance is low (lower was 0.05), then the model does not fit with the data sufficiently.

In our case, the significance levels associated with these two tests are highest than 10%. Then, the null hypothesis should be retained and therefore the model fits the data (see Appendix 3).

3.1.4. Pseudo R-Square Test:

R-square nicknames can't be computed accurately in the case of models of logistic regressions multinomial. For this reason the results must be taken with caution. High R-square nicknames indicate that more of the variation is explained by the model, on maximum of 1In our case, only close to 5% is explained by our explanatory model (see Appendix 4).

3.1.5. Likelihood Ratio Tests

Likelihood ratio test show the contribution of each explanatory variable in the model. Indeed, if the significance of the test is low (lower then 5%), so the variable contributes to the model. In our case, the variables "original nationality", "company size", " the perception of general director of ICT as causing profound changes in the organization " and " as a source of competitive advantage" does not contribute to the model (see Appendix 5).

3.2. The Coefficients of the Multinomial Logistic Regression

The estimation of the parameters table summarizes the effect of each explanatory variable (see Appendix 6).

The reference category is the set of companies "followers".

- The coefficient B: It's a correlation coefficient. And significant negative coefficients (B negative) decrease the probability of occurrence category. In other words, they reduce the likelihood of this category of response for the reference category (CHAN, Y.H., 2005). While the parameters with positive coefficients increase the likelihood of that response category.

Example: Leaders who do not perceive ICT as a source of competitive advantage tend to adopt a follower behavior (B= -0,851, in the second equation where dependant variable is the binary variable of 0 if "follower" and 1 if "proactive").

Wald test: It tests the null hypothesis: the coefficient is zero. That is to say that the variable in question is not explanatory of the dependent variable.

- If the level of significance of the Wald statistic is small (lower then 0.05), then, the parameter is different from 0.
- The «Odds-ratios »: These "odds ratios correspond to the number of times of belonging to a group when the value of the predictor increases from 1" (DESJARDINS, J., 2007). This means that a higher odds ratio higher from 1 means an increased chance of belonging to the group of response rather than reference group. And contrary, an odds ratio lower than 1 decreases the probability of belonging to this group and increases the probability of being part of the reference group.

However, we can go to the interpretation of odds ratios which are in the column Exp (B), only when the Wald coefficients are significant.

In our case the software follows the following algorithm:

1st step: Creation of a binary variable (passive-followers):

The results of this first estimation are presented in the upper part of the table (see Appendix 6). Indeed this regression explains rather the behavior of "passive" companies.

2nd step: Creation of a binary variable (proactive-followers) :

The results of this second estimation are presented in the lower part of the table (see Appendix 6). And even this regression explains the behavior of "proactive" companies.

We move, thereafter, to the analysis of the results of the multinomial logistic regression. Indeed, after doing tests for the quality of fit of the model, the software sets the reference category all companies "followers" and followed the following log:

In a first phase it has created a "passive-follower" binary variable and the first regression model showed as the correlation coefficient B, the Wald test and odds ratios that companies with a low alliance (B= -2,100; $p < 0,05$) and whose leaders do not perceive ICT as strategic tools, are more likely to be part of the "passive" firms class. The odds-ratios are respectively 0,122 et 0,455. In addition, the results have demonstrated that belonging to sectors of the IAA much less the IEEE sector is more associates to passivity (B= -1,396; $p < 0,05$; the odds-ratio= 0,248).

We can declare that for the first logistic model:

- Digital divide between Tunisian-European firms is even more reduced that the alliance is strong.

  ⇒ **Hypothesis H1.1 is verified.**
- Digital divide between Tunisian-european firms is reduced when corporate leaders perceive ICT as strategic.

  ⇒ **Hypothesis H2.1 is verified.**
- Reducing digital divide inter Tunisian-European firms depends on the company's business sector.

  ⇒ **Hypothesis H3.2 is verified.**

However the results are different in the second logistic model.

Indeed, in a second step, the log has created a second binary variable "proactive-passive" and whose the results presented by the correlation coefficient, the Wald test and odds ratios have

proven that companies with a high number of alliances (B= 1,497; p < 0,10) and whose leaders perceive ICT as a strategic tool (B=0,892; p < 0,05) and as causing profound changes in the organization (B=0,706; p < 0,05) , are more likely to be part of the "proactive" firms class. The odds ratios are respectively 4,468; 2,439 and 2,026. While companies whose leaders perceive ICT as a competitive advantage sources are more related to the class of "followers" (B=0,851; p < 0,05; the odds-ratio= 0,427) .

Differently from the first logistic model we can declare that for this second model:

- Digital divide inter Tunisian-European firm is even more reduced that the company is well connected (having a high number of alliances).

  ⟹ **Hypothesis H1.2 is verified.**

- Digital divide inter Tunisian-European firms is reduced when corporate leaders perceive ICT as strategic.

  ⟹ **Hypothesis H2.1 is verified.**

- The inter Tunisian-European firms digital divide is reduced when corporate leaders believe that ICTs generate profound changes in the organization.

  ⟹ **Hypothesis H2.2 is verified.**

- Digital divide between Tunisian-European firms is not reduced when corporate leaders perceive ICT as sources of competitive advantage.

  ⟹ **Hypothesis H2.3 is verified.**

4. Discussion of Results

We can detect that the strength and number of alliances explain and positively the behavior of Tunisian firms in terms of ownership of ICT, and our results corroborate those of Ding (2003), Wang (2016); Rowley & Al (2000), Ahuja (2000), HIPPEL (1988) Reinchtein & Salter (2006), Bellon et al. (2000), Guan and Liu, (2016), Camisón et al. (2010), Frankort (2016). So the hypothesis H1 is verified. The results related to the strategic context differ from those of Kalika (2007). Indeed it is true that the strategic context in its globality is explanatory of the appropriation of ICT, but we were able to prove that the perception of the leaders of ICT as strategic tools and causing profound changes in the organization, positively influence this behavior while the perception of ICT as a source of competitive advantages negatively impact the appropriation of ICT. So only the hypothesis H2.1 and H2.2 are verified, but the hypothesis H2.3 is not verified.

Regarding the demographic context, our study shows that only the activity sector of firms explains the behavior of ownership of ICT. This also confirms the results of Djellal et al. (2001), Ayadi et al. (2007), Boone (2001) and Baldwin et al. (2002).

However, we have shown that the size and nationality of origin of the firm does not explain this phenomenon. Which refutes the affirmations of Bertshek and Fryges (2002), Hollenstein (2004), Kalika et al. (2007), Baldwin et al. (2002), Mol et al. (2009), Perez-Luño et al. (2011) Rubera et al. (2012) and corroborates those of Hollenstein & al (2008) which established an insignificant effect of the size of the firm on the inter and intra firm diffusion of technology. So, only the hypothesis H3.2 is verified.

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Appendix

Appendix 1

Model Fitting Information				
Model	**-2 log likelihood**	**Chi-Square**	**Df**	**Sig.**
Intercept only	303,665			
Final	228,098	75,567	16	**,000**

Appendix 2

Classification				
	Predicted			
Observed	**passive**	**proactive**	**Followers**	**percent of correct**
Passive	20	1	14	57,1%
Proactive	6	23	21	46,0%
Followers	6	15	49	70,0%
Overall percentage	20,6%	25,2%	54,2%	59,4%

Appendix 3

Goodness-of-Fit			
	Chi-Square	**Df**	**Sig.**
Pearson	233,707	216	,194
Déviance	210,706	216	,589

Appendix 4

Pseudo R-Square	
Cox et Snell	,386
Nagelkerke	,438
McFadden	,230

Appendix 5

Likelihood ratio tests

Effect	-2 log likelihood of reduced model	Chi-Square	Df	Sig.
Intercept	239,787	11,690	2	,003
NUMBER	235,758	7,661	2	,022
STRENGTH	243,355	15,257	2	,000
SECTOR	242,706	14,609	2	,001
NATIONALITY	230,551	2,454	2	,293
SIZE	232,261	4,163	2	,125
ATTIT_1	243,263	15,165	2	,001
ATTIT_2	233,505	5,407	2	,067
ATTIT_3	233,351	5,254	2	,072

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Appendix 6

Parameter estimates									
		B	std. Error	Wald	Df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
Ward Method								Lower Bound	Upper Bound
passive	**Intercept**	5,639	2,299	6,018	1	,014			
	NUMBER	-1,363	,948	2,066	1	,151	,256	3,988E-02	1,642
	STRENGTH	-2,100	,687	9,338	1	,002	,122	3,185E-02	,471
	SECTOR	-1,396	,431	10,476	1	,001	,248	,106	,577
	NATIONALITY	,466	,703	,439	1	,508	1,593	,402	6,313
	SIZE	,706	,511	1,904	1	,168	2,025	,743	5,517
	ATTIT_1	-,789	,353	4,994	1	,025	,455	,228	,908
	ATTIT_2	,092	,322	,082	1	,775	1,096	,583	2,061
	ATTIT_3	-,483	,371	1,699	1	,192	,617	,298	1,276
proactive	**Intercept**	-2,925	2,132	1,882	1	,170			
	NUMBER	1,497	,795	3,543	1	,060	4,468	,940	21,232
	STRENGTH	,490	,461	1,131	1	,288	1,633	,661	4,031
	SECTOR	,183	,324	,319	1	,572	1,201	,637	2,264
	NATIONALITY	-,652	,533	1,498	1	,221	,521	,183	1,480
	SIZE	-,474	,436	1,180	1	,277	,623	,265	1,463
	ATTIT_1	,892	,414	4,629	1	,031	2,439	1,083	5,495
	ATTIT_2	,706	,318	4,933	1	,026	2,026	1,087	3,777
	ATTIT_3	-,851	,403	4,468	1	,035	,427	,194	,940