“Is financial innovation influenced by financial liberalization?: evidence from the Tunisian banking industry”

AUTHORS	Mabrouk Abir Mamoghli Chokri

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Mabrouk Abir (Tunisia), Mamoghli Chokri (Tunisia)

Is financial innovation influenced by financial liberalization? Evidence from the Tunisian banking industry

Abstract

We are interested in the identification of the determinants of financial innovations, where we focus more on the effect of the regulations relating to the financial liberalization process concerning the banking adoption of the financial innovations. We suggest the use of an approach based on the benefits of banking regulation promoting the innovative act to supplement the contributions of the constraint theory. During this study, we examine the adoption of the financial innovations of products and of process within the Tunisian banking industry during the period from 1987 to 2008. The results found let us better understand the innovative behaviors of banks within environmental and organizational context specific to the banks of an emergent market. In particular, we conclude that the legal framework influences in a large way the innovative behavior of the Tunisian banking system. So, opposite to the idea that the financial innovation is always a means to bypass the regulation, within a liberalization context the initiative boosting the Tunisian process of financial innovation often comes from the public strength.

Keywords: financial liberalization, regulation, financial innovation.
JEL Classification: G21, G28, F32, O31.

Introduction

The financial innovations are used by banks as fearsome strategic variables to get ahead of competition (Tufano, 2003). They become more and more important mainly within a context where banks get organized to give more loans. That way, their adoption has become a must for banks more than a choice and this even in the case of the emergent markets like the Tunisian ones. Despite the recent crisis, the financial innovation is necessary where certain products have become inevitable since they allow banks to have a certain confidence against the risk of failure and represent a measurement tool of the compensation risk. We cite, for example, the credit derivatives known as Default Swap Credit. Literature supports that a successful innovation act gives the bank a competitive advantage and a superior performance. This can't be maintained unless there is a permanent innovation and improvement of the product and of the process (Porter, 2004). Moreover, despite a large descriptive literature concerning the financial innovation phenomenon, there is a shortage of theoretical base treating the effect of the legal environment concerning the adoption process of financial innovation. Using the U.S.A as an example, Ebrahim and Hussain (2010) raised the fact that many regulation constraints have weighed on the U.S. banking system. For instance, the promulgation of the Glass-Steagall Act had the purpose to decrease the conflicts of interests, limit of the power of banks, etc. However, this legislation didn't predict the increase of the banks encouragements to innovate as well as the remarkable development of the American money markets (Boot and Thakor, 1997). The innovative mechanics of the financial system of many Anglophone countries is not easily transposable within the frame of the financial systems where the initiative boosting the innovation process often comes from the public authority as we can notice it in France, in Italy and even in some emergent countries like Egypt, Morocco or Tunisia. Thus, this research task makes it possible to show that unlike many developed countries where the financial innovation was a means to bypass the current regulations, these latter become more an engine of the adoption of the financial innovations in some emerging countries like Tunisia. In other words, in both cases the legal frame is such that it stimulates the adoption of the financial innovations, except that it's not in the same way. In fact, in some countries the constraint theory is justified while in others it is rather the regulation that forces the adoption of the financial innovation in order to make up the technological progress for the last time.

With consideration to the constraint theory we ask our selves the following question. Since the process of financial innovation is induced by the legal constraints inflicted, then will the deregulation stop the dynamic? The appearance of many innovations on the financial service markets during the last years forces us to doubt. Asaftei (2008) argues that the deregulation of the American banking sector in the early 90s has allowed banks to expand their product portfolio and improve their quality of service. It seems that this contradiction is only obvious, and is the result of an abusive and wrong use of the regulation term to qualify a movement towards a new form of banking regulation or else of the regulation alignment under the realities of the economy and its financing methods. It's indisputable that this constraint theory brings a very instructive lighting on the dynamic of the financial innovation in some countries like the United States. However, to complete its contributions, using a method based on the benefits of a

regulation favoring the innovative act seems very useful. This new kind of regulation can either integrate legal texts offering a convenient cadre to the adoption of financial innovations by instituting, for example, some measures of tax encouragement such as the overhaul of the tax system of investment societies, or it forces the introduction of certain types of innovation to Banks. This kind of regulation appears in some European countries like France and Italy or in other emerging countries like Tunisia, where it is introduced within the frame of financial liberalization process.

In this study, we are interested in the stream of research focused on the identification of the determinants of the innovations. This literature indentifies many external and internal factors which seem affecting the adoption of the financial innovations. This will help us to better understand the determinants of each kind of financial innovation which constitutes an objective of this study and thus, to free the profile of the innovative banks. However, we will focus more on the impact of some financial reforms introduced on the innovative behavior of banks. In fact, the main purpose of this research is to better define the impact of the regulations entering the financial liberalization process frame on the banking adoption of financial innovations. We propose to consider two types of financial innovation which are the most commonly cited by the literature review, that is the product and process innovation (Frame and White, 2009 and 2004; De Young et al., 2007; Batiz-Lazo and Woldesenbet, 2006). In fact, a distinction between product innovation and process innovation is important because the adoption of each type of innovation requires different organizational qualifications. The first kind of innovation processes has essentially a market focus while the second has an internal focus.

We propose the resort to an approach highlighting the stimulating effect of financial innovation that can play the banking regulation, to complement the contributions of the constraint theory. The results found through this empirical research help us to understand the innovative behavior of banks in an environmental and organizational context specific to a banking industry of an emerging country. This has allowed us to conclude that in general the financial liberalization process of the Tunisian Banking system influences largely the innovative behavior of this latter. In fact, the initiative boosting the financial innovation process in Tunisia often comes from the public strength. This paper is organized as follows. Section 1 presents the literature describing the relationship between financial innovation and its determinants where we focus especially on the legal context. Section 2 describes the variables and estimation methodology. Section 3 confirms the impact of financial liberalization on financial innovation in the context of Tunisian banks. The final Section summarizes our findings.

1. The factors influencing the adoption of innovation

During the literature review, we have noticed that there are many factors influencing at different degrees and in different ways the innovations adoption process. Therefore, impaired by the constraint theory, we will focus on the legal context as an environmental variable. This represents our main goal. We think it is relevant to explain the adoption of financial innovation by banks in emerging countries as in developed ones, but in a different ways. Frame and White (2004) state that when changes occur, we expect a burst of financial innovations that represents an initial response, which will settle down through time into a flow that is appropriate to the new environmental conditions. They explain the wave of innovations of the 70's and 80's that have inspired the descriptive literature as an answer to the changes of the important environmental factors of that period, such as the rise of the level of variability of the interest rates as well as the end of Bretton-woods system of fixed exchange rate. Based on this, we estimate that the legal change induced by the process of financial liberalization adopted by many countries is behind the wave of financial innovations that we witness in these countries.

1.1. The legal environment. The justification of the financial innovation reports within the frame of the financial innovations theory of several analytical paradigms. The constraint theory is that which has more echo. In that theory, the constraints endured by the organizations generate innovations aimed at winning degrees of freedom. The most general interpretation of the phenomenon of the innovation induced by the constraint is the one presented by Silbert (1975). He puts the emphasis on the constraint resulting from the regulations. The idea according to which the regulation imposed by the monetary authorities is the engine of the financial innovation finds all its extent with Kane (1983, 1988). By putting the emphasis on the notion of "the dialectic" of regulation, he brings to the fore the relation between the innovative process and the legal constraints where the agents are prompted to bypass the regulation as soon as the balance benefit-cost of membership to the system becomes negative. White (2000) states that the regulation is a double edged weapon. On the one hand, certain forms of regulation must prohibit some innovations. On the other hand, other innovations can emerge from failed efforts of regulation in order to bypass this regulation. For example, a regulation preventing banks from owning insurance companies won't be able to issue innovations specific to this kind of ownership. What can incite banks to create products like insurance products and services because the cross-ownership is

forbidden. Therefore, it is a priori impossible to assign a positive or negative sign to the relation between the rigor of regulation and the dynamic of the financial innovation.

Taking the U.S.A as an example, Ebrahim and Hussain (2010) raised the fact that many regulation constraints press on the U.S. banking system. For instance, the promulgation of the Glass-Steagall Act didn't anticipate the important positive effect that this will have on the development of the American capital markets or on the motivations for the financial innovation. This explains the fact that the American financial market has known a fast and spectacular development compared to the German capital markets (Boot and Thakor, 1997). Thus, opposite to the American financial system and to the other Anglo-Saxon systems, where the innovation is generated by the regulatory constraints incurred, the financial innovation process in Tunisia often results from the public strength as we can observe it in France or in Italy. In fact, in a context of a financial liberalization and in order to prepare the Tunisian banking sector to face the opening to financial services, the rhythm of the financial innovations introduced by the public authorities has become faster. However, any initiative coming from the financial institutions requires the support of the monetary authorities. This second kind of regulation can either integrate legal texts enabling the offer of a propitious setting to the adoption of financial innovations or that it bluntly imposes to banks the introduction of certain types of innovation. Hence, the predominance of the public financial innovation, due to the fact that it is the legislative and legal system which influences the adoption of new financial products in Tunisia.

1.2. Financial liberalization – financial innovation relationship. There are a number of channels through which the financial liberalization by the capital account liberalization can contribute to the financial system development of a country. In fact, the exposition to the international competition can improve the financial system efficiency of the country via the introduction of the international standard as well as by the threat of "flight to quality" imposed by the foreign intermediaries (Klein and Olivei, 2008). The entry of foreign Banks via the establishment of their branches may introduce some financial innovations able to enlarge the panoply of the financial services offered. In Tunisia, the entry of foreign banks in a context of openness to financial services is realized essentially through participation into the capital of domestic banks. Thus, the benefits of the financial liberalization on the financial innovation can be done through the liberalization of the capital account. Moreover, a series of legal and institutional changes entering within the context of a liberalization during the 80's, the Turkish banking system has replied by investing more in modern technologies, to ensure its viability, that was represented by a significant rise of the technological progress (Isik and Hassan, 2002). Thus, in a general way, this aspect of the financial liberalization, via a decrease of the barriers at the entry of the foreign banks, is likely to increase the banking initiatives in terms of financial innovation. Furthermore, in their study, Ebrahim and Hussain (2010) identify the financial liberalization, the financial deepening, the risk management and the financial innovation as the key transmission channels of the financial system development. With reference to the definition given by Abiad et al. (2008), they define the financial liberalization as a decrease of the government's role and an increase of the market's role in allocating credit. We notice that Ebrahim and Hussain (2010) don't suggest a clear and precise connection between financial liberalization and financial innovation. In short, we notice through the literature a shortage of studies underlining the impact of the financial liberalization on the banking behavior in terms of financial innovation.

1.3. The responsibility of the financial innovation in the crisis. Kaminsky and Reinhart (1999) show that most historic crisis are preceded by the financial liberalization. The new theories of financial liberalization at present take account of the imperfections prevailing in the financial markets of the emergent countries which contributed to its failure. However, the current financial crisis is caused by this deregulation in the United States which has contributed to the degradation of the quality of subprime loans and has also allowed a more liberal framework. Consequently, the securitization mechanism, now being called into question, has had negative repercussions and a disproportionate propagation. In fact, following the regulatory constraints weighting on the U.S. banking system in the 70s (Ebrahim and Hussain, 2010; Boot and Thakor, 1997), the latter has known a vast wave of deregulation in the early 90s (Asaftei, 2008).

Opposite to what happened during the 80s and 90s, the emerging countries have neither been responsible nor, except exceptions, victims of these recent disturbances. Thus, the first crisis is due to deregulation miscontrolled in the emerging countries while the second is due to an aspect of financial innovation. In light of what happened recently, we can conclude that the prudent financial liberalization in Tunisia, with well-controlled products including the securitization, can obviously avoid the financial and banking crises. Reinhart and Rogoff (2008) argue that the new financial entities, more or less regulated, played an important role in the financial sector, by strengthening the

stability against some types of chocks and increasing the vulnerability toward others at the same time.

1.4. Other determinants of innovation. The standard theory is in favor of a positive relation between competition and innovation (Porter, 1990; Van de Klundert and Smulders, 1997; Boone and van Dijk, 1998). The recent empiric literature examining this relation has found a little obviousness to the Schumpeterian hypothesis and concludes that a strong rivalry on the market encourages banks to innovate in order to increase their competitive advantages. Allen and Santomero (2001) suggest that the release of the financial innovation process undertaken by banks in the United States appears to be a response to intensified competition in financial markets. Milnes (2006) compares the banking payment infrastructures in various countries such as the UK and Finland, where he finds that in the banking systems, the adoption seems to be also relatively concentrated. In a study on the banking sectors of 11 countries of Latin America, Yildirim and Philippatos (2007) state that a bank rivalry pushes banks to engage in a differentiation of their products offered and allows the financial innovation stimulation. However, the competition is only a stimulus among others. Many arguments exist supporting a big size. The previous researches suggest that the size of the financial institution is an important factor for the adoption of the financial innovation and that the large financial institutions are more able to pay the fixed costs of developing new technologies. A second argument in favor of the positive impact of a large size is based on the existence of imperfections in the financial market. In fact, the availability of internal funds is important in the large firms that will allow the financing of the investment associated with the innovation process (Galande and Fuente, 2003). Dow (2007) examines the influence of the size on the decision of the adoption of the web and the PC banking by the credit unions. He finds that the large credit unions adopting more new technologies, are the first to adopt them and offer the most advanced technological versions. The study of Buzzacchi et al. (1995) confirms the positive effect of the size on the distribution of the new technologies such as the ATM's.

Studying the impact of the diversification on the activities of firm's innovation, most authors have shown the existence of a negative relation. Boot and Thakor (1997) find that, in a universal banking system, the financial innovation is stochastically inferior to those in a financial system where commercial banks and investment ones are functionally separated. They deduce that the natural tendency of a universal bank is less innovativeness. The model of Kanatas and Qi (2003) is based on the fact that it is the importance of the economies (low informational cost and economies of scale and scope) that motivates the banking integration of both the credit and emission activities, which causes the reduction of innovation within the industry where there is integration of financial services. Moreover, the literature has suggested that the diversified firms suffer from serious agency costs linked to the investments innovation, that discourages managers to get involved in the innovation process (Denis et al., 1997; Francis and Smith, 1995). Furthermore, private firms are considered as being more innovative than the public ones. The latter innovate less because of their social mission as provider of last resort that reduces their resources and therefore, limits their innovative capacity. Mohieldin and Nasr (2007) and Megyery and Sader (1996) state the promotion of technological innovation as one of the many objectives of the government in the privatization process. Several authors consider that the foreign property has a positive effect on the innovation, because of the additional resources to those of the domestic firm that may use the foreign parties (Lofts and Loundes, 2000; Love et al., 1996). Yildirim and Philippatos (2007) find that a high level of foreign participation in the bank capital is associated to a high level of competitiveness, that allows the improvement of the quality and the differentiation of the products offered and stimulates the financial innovation by the introduction of skills, management techniques and modern technologies. In addition, the financial resources not only provide the necessary inputs to the innovation but also allow the firm to absorb the costs of the innovation as well as the losses resulting from possible failures and to pursue innovative projects (Fuentelsaz et al., 2003). We estimate that the bank that uses important financial resources is more likely to adopt product and process innovations. According to Dow (2007), the decision of technologies adoption and that of the spread rate is a common decision. Banks developing process innovations can end up with high costs, obliging them to increase their spread. Alternatively, banks using technologies in order to reduce their costs are able to offer a lower spread. Within the Tunisian banks context, they continue to charge high lending rates to cover their credit risk.

2. Description of the variables

2.1. Banking activity of the financial innovation. We have tried to identify the key innovations rising up within commercial banks between 1987 and 2006. For that two questionnaires have been successively run. The first was addressed to banking experts, where we proceeded to eliminate the less important and less diffused innovations in order to assure that the innovations selected were homogeneous. Then, the second

was administered to banking managers affiliated with the banks in the sample. We estimate that sometimes it takes several years for innovations to become widely important and diffused. The results of the first questionnaire confirm our idea. We mean by innovation every new product or process introduced for the first time within the Tunisian banking industry. Table 1 illustrates the dynamic of innovation within the Tunisian banking sector.

The list of the innovation appearing in Table 1 includes some products innovations belonging, on the one hand, to the classical intermediation activity, that is credits and saving products, on the other hand, of the non-classical intermediation activity. This latter encloses some placement products such as the certificates of deposit and the bond open-ended investment company. Exchange products are also illustrated as the transfer of funds and the forward cover. We, thus, find telematic services like the telephone, the fax, the SMS and the net banking. Concerning the process innovations, all these include services fitting into the monetic activity, the system of risk appreciation as well as the electronic compensation system.

Table 1. List of product and process innovations

Product innovations (17)	Process innovations (8)
Traditional intermediation activity:	Electronic payment services:
Lease credit	Magnetic strip card (debit)
Express credit	Magnetic strip card (debit and ATM card)
Auto loan	Magnetic strip card (ATM and credit card)
Flexible interest rate mortgage	Automatic cash dispenser
Line of credit (up to 3 times the sum in savings)	Automatic teller machine
Child savings plan loan	Electronic payment terminal
Investment account	
Foreign currency deposits	Risk assessment system
Non-traditional intermédiation activity:	
Certificates of deposit	Electronic compensation system (checks, transfers, withdrawals)
Bond open-ended investment company	
Transfer of funds	
Forward cover	
Phone banking (voice server)	
Fax banking	
Sms banking	
Net banking (account access and consultation of operations on the account)	
Magnetic strip card (business card with privileges)	

Note: The financial innovations are adopted by Tunisian banks between 1987 and 2006, where they are extracted from an initial questionnaire on the basis of importance and diffusion criterias.

2.2. Methodology. We try to exploit the effect of the regulations, in the frame of the financial liberalization process, on the adoption of the banking innovations. We seek to demonstrate empirically our constat that unlike many developed countries where the financial innovation was a means to avoid the regulation in force, these latter have another stimulator effect of financial innovation in other emerging countries like Tunisia.

We suggest then the following models associated to each kind of financial innovation, where we introduce some explanatory variables approximating the environmental and the organizational context of the banking firm. Model (1) is relative to the product innovation while model (2) is associated to the process innovation.

$$PDIV_{i,t} = \alpha_1 \cdot LF_t + \lambda_1 \cdot X_t + \beta'_{i1} \cdot Y_{i,t} + \\ + \lambda_1 \cdot SPR_{i,t} + \mu_{i,t1}, \quad (1)$$

$$PCIV_{i,t} = \alpha_2 \cdot LF_t + \lambda_2 \cdot X_t + \beta'_{i2} \cdot Y_{i,t} + \\ + \lambda_2 \cdot SPR_{i,t} + \mu_{i,t2}, \quad (2)$$

where $PDIV_{i,t}$ and $PCIV_{i,t}$ present each the adoption of the financial innovations of the bank i at the time t, LF (DUMMY 1, DUMMY 2, DUMMY 3, DUMMY 4, DUMMY 5) presents some dummy variables indicators of financial liberalization, X_t ($IHHD_t$), Y_{it} (DIV_{it}, PUB_{it}, FRG_{it}, $SIZE_{it}$, FR_{it}, SPR_{it}). The dummy variables are introduced one after one in each model (1) and (2), because they cause an important multicolinearity when they are introduced within a same equation. The description of the research variables is provided in the next subsection.

We use Hsiao test to verify the total homogeneity hypothesis of the model. The results of the test converge towards the non-existence of individual effects and of the complete homogeneity of both models. We explain the absence of individual effect by the fact that the majority of innovations undertaken by the Tunisian banks, whether in terms of product or process innovation, are fundamentally public in character. Indeed, they were imposed by public authorities or governed by legal texts in order to prepare for the opening of the banking sector to financial services. Moreover, SPR_{it} is endogenous because of the possibility of reverse causality. We, thus, need to use instruments. We use the Sargan test and that of Hansen overidentification to test the validity of the instruments. We use some instruments within both models (1) and (2). The instruments must verify cov ($Z_{i,t}$, $\mu_{i,t1}$) = 0, et cov ($Z_{i,t}$, $\mu_{i,t2}$) = 0.

Wooldridge (2005) impose a level of significativity of the instruments not superior to 5% in order to ensure consistency.

The estimators are obtained in two steps by the estimation technique "Control Function Approach". Let's consider the model (1). The first step consists in regressing the endogenous variable SPR_{it}, on the exogenous variables (X_t and Y_t) as well as the instruments Z_{it} and in obtaining the fitted value of the error term. In the second step, we regress the product innovation on the exogenous variables of the model (1), the spread and the fitted value of the error term. During this second stage, a poisson regression is more appropriate than a negative binominal regression, as the financial innovation is a counting measure. We use the same estimation method for model (2).

2.3. Research variables. *2.3.1. Financial innovation measures.* Each type of financial innovation of product and that of process is reflected through a measure established on the basis of the activity of financial innovation during the previous five years. For each year of the study, each bank has a measurement reflecting its innovative activities during the previous five years. This applies to the two types of financial innovation. The data are, thus, in the form of panel data. We estimate that the period is long enough to show certain variability at the level of the adoption of the product and process innovations.

2.3.2. Financial liberalization measures. Our main interest concerns the impact of the regulation on the financial innovation process. In an attempt to explore the impact of the financial reforms in the framework of financial liberalization process on banking innovation, we introduce some variables showing the financial liberalization and reflecting the legal framework of the banking system. The dummy variables adopt value 1 if the date of the financial reform is before t-1 and 0 otherwise. We estimate that the effects expected of a reform can only be noticed at least one year after the date of their introduction. This will allow us to explore the distinct effect of each reform introduced on the financial innovation process of product and that of process. We selected the financial reforms that are supposed influencing the innovative behavior of banks.

DUMMY1: a dummy variable representing the 1991 reform. We cite among the contributions of the circular relating to the reforms introduced in 1991 – the creation of new financial assets with a monetary aspect such as the certificates of deposit. Or also, the introduction of tax innovations relative to the bonds designed to encourage households to invest in transferable securities.

DUMMY2: a dummy variable representing the 1992 reform. We cite mainly the tax system recasting of the investment societies.

DUMMY3: a dummy variable representing the 1994 reform. The most important contributions of this reform is to allow deposit banks and development banks, respectively, to give mid and long-term loans and short-term loans.

DUMMY4: a dummy variable representing the 1999 reform. We mention the Finance Act of 1999 having for purpose the improvement of the quality of the banking assets and the best coverage of the bad debt, the fiscal law relating to the reflation policy of financial market aimed at encouraging the companies to open their capital to the public or even the establishment of an electronic compensation system for both the transfers and withdrawals.

DUMMY5: a dummy variable representing the 2001 reform. We cite the introduction of the law №.2001-65 relative to the credit institutions aiming at setting up the model of the universal bank. Moreover, the modernization program of the monetic has accelerated since the signature of the interbanking agreement in 2001.

2.3.3. Measures of environmental and organizational characteristics. In this research, we consider internal and external factors of banking firm which are specific to the Tunisian industrial banking industry. This will give us a better idea on the determinant of each kind of financial innovation and thus, to clear off the innovative banks profile. The choice of the measures concerning the explanatory variables of the financial innovation is delicate due to the fact that the adoption of the financial innovation is a cumulative process of five years: [t-4; t], that leads us to a possibility of simultaneity. In trying to circumvent any potential endogeneity problem by opting the values of independent variables before each period that is in (t-5), we think that such values are restrictive. Indeed, we thereby, omit taking into account the different values that occur over the course of each five-year period [t-4; t], that are certainly likely to influence the cumulative process of financial innovation. Moreover, we have included the values in (t-5), as we believe that they significantly explain the adoption of innovation during the course of year (t-4). In fact, a decision that is as strategic as undertaking financial innovation must evolve within the innovating bank before the latter can react to the organizational and environmental characteristics, in other words before the innovation is actually launched on the market. Likewise, we have not taken into consideration the values in t, as we do not expect them to have a noteworthy effect on the adoption of innovations during the course of the same year t for the same reasons explained above. We then, consider the average of the variables values which are explanatory between (t-5)

and (*t*-1). Here, we follow the example of Herrera and Minetti (2007), who use the average over a nine-year period, of the values of instruments explaining the credit relationship of firms with their banks.

Competition *IHHD* is measured by the average of the Hirshman-Herfindhal index of the concentration of bank deposits. Size *SIZE* is measured by the logarithm of the average of the total assets of the bank in order to diminish the problem of scale. Diversification *DIV* is measured by the average of D = (1-|2x-1|), where x = non-interest income/net operating revenue. This measurement takes into account the diversity of the establishment's revenues and has values between 0 and 1. It increases as the degree of diversification of the banking firm rises. It was recently utilized in studies of the banking industry by several other scholars (Baele et al., 2007; Leaven and Levine, 2007; Stiroh, 2006). The structure of ownership is measured by the average percentage of public share ownership *PUB* and of the percentage of foreign share ownership *FRG* in the bank's capital. The financial resources *FR* are measured by net profit.

We have initially a sample of 240 observations. However, given the fact that innovation is a periodic five-year variable, the number of transformed observations becomes from 1991 to 2008 for the values of the adoption of financial innovations and from 1990 to 2007 for the values of the variables exogenous to financial innovation. Moreover, the banking performance is reflected through the spread. We can't neglect the possibility of reverse causality between the financial innovation and the banking performance. The prior study has neglected the possibility of the existence of reciprocal causality between the innovations and the performance. From what we know, De Young et al. (2007) are exceptions by offering a first trial in the financial services sector, when they consider the endogeneity of the internet banking as an explanatory variable of the banking performance. The variable *SPR* is the variation of the spread between *t* and (*t*-5). The spread being the difference between the borrowing rates on loans granted and those paid on deposits collected. So, the number of observations becomes from 1991 to 2008 for the performance values.

Table 2. Summary statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
PDIV (all products)	180	3.6667	2.4857	0	11
PCIV (all processus)	180	2.2222	2.0539	0	8
IHHD	180	1189.869	49.2002	1134.936	1285.044
DIV	180	0.4408	0.0983	0.0599	0.7151
PUB	180	0.2643	0.3081	0	0 .995
FRG	180	0.1853	0.2043	0	0.6424
SIZE	180	20.9348	0.5659	19.6725	22.1497
FR	180	15.8695	1.1797	10.2405	17.2472
SPR	180	0.0018	0.0341	-0.1222	0.1712

Note: Means and standard deviations for all the variables used in the estimation of models (1) and (2). The data between 1986 and 2008 are transformed into 180 observations from 1991 to 2008.

2.3.4. Potential instruments of the performance. Among the potential instruments, we consider the market share of the deposit *MSD* and that of the credit *MSC*, reflecting the characteristics of each Bank. In fact, the detention of a large market share has become a real challenge of the banks since the competition has greatly intensified in the financial services industry. We estimate that these variables have a good explanatory strength as the Tunisian Banks rely mainly on the traditional activity of collecting deposits and granting credits. We use also the Hirshman-Herfindhal concentration index of the banking assets *IHHA* as a characteristic of the banking sector. Scholtens (2000) states that to improve their performances, many banks opt for the mergers and acquisitions activity, in order to increase their operations volume and to take advantage of a certain market power. Other potential instruments, such as the inflation rate *INFL* and the balance of trade *BT* reflect the macro economic conditions. In their study concerning the impact of the micro and macro economic factors on the banking profitability, Afanasieff et al. (2002) conclude that the macroeconomic variables are the most relevant to explain the banking performance in the emerging markets. These variables are measured in terms of variation between (*t*-6) and (*t*-1). Furthermore, we will take into account the possibility that the financial innovation can be an instrument of the spread because of the existence of this eventuality of reverse causality. We will choose among these instruments those that are the most valid.

2.4. Sample and data. The recent deregulation in the Tunisian banking industry, within the context of financial liberalization started in 1987, aims to prepare the banks to face the competition in a prospect of opening to financial services. This has increased the motivation of banks to use the new technologies in their production and distribution process and to diversify their range of products and services offered, in order to win competitive advantage. Our choice concerns only the former deposit banks. On the one hand, because these commercial banks have shown a noticeable innovative behavior and thus, proved to be more innovative than other banks belonging to the Tunisian banking sector. On the other hand, in order to avoid the difficulties due to the lack of homogeneity, and for a coherence of data and analysis. The Banks that have been chosen because they have given the necessary information during all the period from 1985 to 2008 are the 10 listed banks in the stock market. We have, thus, a panel data of 240 observations.

3. Results

3.1. The performance instruments. In order to opt for valid instruments, we first proceed by progressive regressions and then in a second time by validity tests. We explain the positive effect of the deposit market share by the fact that the bank holding a higher deposits market share supports higher interest charges, thereby forcing them to increase their spreads. By analogy, the bank with a rising credit market share is likely to obtain a higher volume of interests and incomes on credits, prompting it to reduce its rate of spread. Moreover, from Table 3 it appears that a more concentrated market lets the bank profit from certain market power, allowing it to reduce its spread. The macroeconomic conditions seem not to influence the bank's decision concerning the rate of its spread. Furthermore, the variable $PDIV_{i,t}$ in column 6 is relative to the adoption of the product innovations belonging to the non-classical activity. We estimate that this has the effect of increasing the volume of the commissions, which will enable banks to offer their customers a rate of spread significantly lower at the 10% level. Moreover, the effect of the adoption of new technologies on the spread in column 7 remains insignificant. This corresponds to the reality of Tunisian banks. In fact, the Tunisian Central Bank continues to administer the money market rate so that the banks can make use of high borrowing rates in order to help them make provisions for risk and charges to cover their credit risk.

Thus, we opt for the variable *MSD*, *MSC*, *IHHA* to instrument the spread within models (1) and (2). The test of Sargan and that of Hansen confirm the validity of the instruments. The estimation results of the first stage of Control Function Approach show that these instruments have a good significativity at the level of 1% and 5%.

Table 3. Selected determinants of spread

	1	2	3	4	5	6	7
	Market share	Market structure	Macro-economic factors	Product innovation	Process innovation	All	All
Intercept	-0.0028 (-0.62)	-.0178*** (-5.63)	0.0093 (0.88)	-0.0125 (-1.27)	-0.0128 (-1.30)	-0.0206*** (-3.56)	-0.0143** (-2.39)
MSD	0.9268** (2.02)					0.9914** (2.23)	0.9605** (2.27)
MSC	-1.0079*** (-4.08)					-1.0626*** (-4.50)	-1.0101*** (-4.21)
IHHA		-0.0002*** (-4.14)				-0.0001** (-2.28)	-0.0002** (-2.02)
INFL			-0.8518** (-2.07)			-0.4035 (-0.82)	-0.4204 (-0.92)
BT			0.0002** (2.18)			0.0001* (1.88)	0.0001 (1.37)
PDIV				0.0027* (1.80)		-0.0036* (-1.71)	
PCIV					0.0045* (1.72)		0.0018 (0.87)
adjusted R^2	0.1560	0.0802	0.0701	0.0708	0.0438	0.2401	0.2264

Notes: The data between 1985 and 2008 are transformed into 180 observations from 1991 to 2008, because that financial innovation is a periodic variable. The dependent variable is spread. The regressions 6 and 7 allow us to choose the spread instruments respectively in model (1) and model (2). The t-student robust to heteroscedasticity and autocorrelation appears in parentheses. ***, ** and * indicate statistical significance, respectively at the level of 1%, 5% and 10%. All variables are defined above in the text.

Otherwise, the effect of the error term in the second stage of Control Function Approach is not represented in Tables 4 and 5 below. This one is significant at the level of 5% and 1% respectively on the adoption of product innovation and that of the process, that proves the endogeneity of spread for both kinds of financial innovation.

3.2. Validation of the regulation effect on the financial innovation. We notice from the result represented in Tables 4 and 5 that the reforms introduced in 1991 and 1992 don't seem to encourage the adoption of the product innovations belonging to the non-traditional activity, significantly at the level of 5%. Moreover, the 1991 reform strengthened by the 1992 one has the purpose to encourage the investment of the saving in transferable securities. Thus, collecting funds on the capital market through floating bond debts requires that the bank identifies the quality of such borrowers stimulating its development of a risk assessment system.

The introduction of the 1994 reform affects positively the adoption of innovations belonging to the traditional activity of deposits collect and credits granting at the significance level of 1%. In fact, this reform contributed to progressively bring closer the interest rates on the given credits to those in the monetary market and to ensure a better mobilization and resources allocation. Consequently, this resulted in a better deposits remuneration, which is likely to increase the savings volume and in parallel the banking offer of new finan-

cial products, credit and savings. Moreover, we find that this reform encourages significantly the adoption of innovations entering the monetic activity (at 1%) as well as the elaboration of a risk assessment system (at 1%). Among the magnetic cards we cite the ATM and credit card that enables its holder to benefit from a deferred debit on his transactions and this, with an authorized plafond agreed monthly. In other words, it offers a new type of short-term credit through the electronic payment services.

The DUMMY 4 has a significant positive effect of 1% and 10% respectively on the adoption of the innovations belonging to the classical activity and on those related to the non-traditional activity. We conclude that the reorganization of the Tunisian banking sector strengthened by the measures of the Finance Act 1999 had for consequence to diversify the offer of the banking innovations. Moreover, the fiscal law relating to the reflation policy of financial market, permitting to encourage the firms to open their capital to the public, is likely to stimulate the convertible bond issue. This has for result to make attractive the investment of the saving in the investment societies, bond open-ended investment company, and thus to incite banks to adopt this kind of mutual funds.

Concerning the process innovation, this reform has also for consequence to encourage significantly the banking adoption of a risk evaluation system (at a level of 5%). In fact, their portfolio management of transferable securities of compulsory kind pushes them to better mention the quality of the issuing of obligatory loans. Indeed, managing a portfolio of bond-type securities pushes them to better the issuer's quality of debenture loans. Also, its positive impact (at the level of 1%) on the adoption of the electronic payment services is probably due to the beneficial effects of the Finance Act 1999, which allows banks to have enough funds to finance the setting up of parks of distributors and automated teller machines. We also find a significant positive effect (at the level of 5%) on the introduction of the electronic compensation.

The reform appointing the principle of universal banking has a significant negative effect (at 1%) on the adoption of new non-traditional products, while it is positively significant (at 10%) for the adoption of product innovations integrating the classical intermediation activity. This is conforming to literature as well as to the result found below in Table 4 concerning the diversification impact. Boot and Thakor (1997) argue that because the credit is more profitable than the market activity, where the universal bank hasn't a comparative advantage compared to that specialized, encourages it to engage in the first rather than the second. Besides, since the constitution of the Universal Bank is motivated by the scale of economies, then this reduces its incentive to undertake costly efforts in financial innovation (Kanatas and Qui, 2003). We cite, for example, the elaboration of a web site. Furthermore, in accordance with the principle of the scale of economies associated with universal banking, the results suggest that DUMMY5 has a stimulating effect of the adoption of process innovations, supposed improving the banking efficiency. Indeed, the introduction of new payment systems based on the monetic and telematic accelerates the payments and reduces the costs relating to the use of checks and promissory notes of bank fund. Also, the adoption of a risk appreciation system is supposed to decrease the credit risk of the bank and, thus, the costs which is associated. We find, moreover, a significant positive impact (at the levels of 1% and 5% respectively) on the adoption of the monetic and the risk assessment system. We also consider that the signature of the interbanking convention in 2001 aimed at modernizing the monetic, explains also this effect found on the adoption of the innovations related to the monetic.

The results of the estimations prove that most reforms introduced within the framework of the financial liberalization process have a significant impact on the adoption of the financial innovations by the Tunisian banks. Thus, we conclude that, generally, the regulatory framework of the Tunisian banking system influences greatly the innovative behavior of this latter. In fact, the initiative impulsing the financial innovation process in Tunisia results generally from the public strength.

3.3. Effect of other determinants of financial innovation. Tables 4 and 5 show the results of the Poisson regressions concerning the relation between the adoption of the financial innovation and its determinants, approximating the environmental and organizational context of banks.

3.3.1. Competition. Competition significantly stimulates the adoption of product innovations belonging to the two departments of the banking intermediation: classic and non-traditional. Concerning the process innovation, we have taken into account in the regressions of the two types of banks, private and public. We find that: 1) competition stimulates the insertion of monetic products more significantly in private banks at the level of 1% versus 10% in public banks, what helps to guess the important role taken by the monetic activity in private banks; 2) competition encourages private banks to elaborate their own risk assessment system in order to better select their credits (at 1%). However, competition doesn't encourage public banks to do likewise. We conclude that these are satisfied by the central database developed by the Tunisian Central Bank; 3) competition pushes all

banks to introduce the electronic compensation system, since it's an innovation imposed by the Tunisian Central Bank.

3.3.2. Diversification. In conformity with the literature, the tendency of a universal bank is to innovate less. The results show that the diversification of Tunisian banks is such that it inhibits, at the significant level of 1%, the adoption of non-traditional new products. Thus, the constitution of the universal bank motivated by the importance of economies, increases significantly, at the level of 1%, its incentive to adopt process innovations, meant to improve the bank efficiency, supposed improving the banking efficiency. We find that on the one hand, the automation of the transaction lets banks reduce the costs. Indeed, the fact that Tunisian banks enlarged their fields of intervention, incites them to adopt some monetary services (significantly at 5%) and this to clear the movement at the counters level, for cash withdrawal, in order to redeploy the staff in other services and therefore focus more on the other banking activities. On the other hand, we find that the diversification has a significant positive impact (at 5%) on the adoption of the risk assessment system, elaborated by the bank in order to minimize the risk in its credit activity. We estimate that the principle of the universal bank, according to which the acquired knowledge can be shared among several activities, motivates the adoption of new technologies. In fact, the information gathered via the risk assessment system can be used by other activities. This division eventually lets the bank decrease the costs associated to the information gathering.

3.3.3. Public participation. One of the objectives of the banking privatization is to promote competition and financial innovation, being low because of the public status. The estimation shows that the increase in the public participation discourages the adoption of product innovation belonging to the non-traditional activity (significantly at 5%). Moreover, the public participation is such that it inhibits the process innovation activity, precisely the adoption of a system of risk appreciation by each bank, because the fact that the Central Bank of Tunisia has elaborated a central database providing information allowing a risk appreciation. Besides, we explain the non-significativity of the negative sign on the adoption of monetic services by the fact that during the last years Tunisia has known an extensive upgrade program of the monetic system, driven by the central bank. In fact, an important state presence has the effect to lead the bank to finance the projects and economic sectors more, which are risky or unprofitable, because of their social mission what lessens their resources and consequently their innovative capacity. However, the results show that a high public participation stimulates the introduction of the electronic compensation system imposed by the Central Bank (at the significant level of 1%).

3.3.4. Foreign participation. The results show that the foreign property incites significantly at the level of 10% the adoption of innovations belonging to the non-traditional activity. Moshirian and Laan (1998) find that increased foreign ownership of banks has led to increased non-interest income due to the increased volume of commissions and fees. This result joins the remarks made by various authors such as Yildrim and Philippatos (2007), where a higher degree of foreign ownership improves the quality and differentiation of products. However, its impact on the innovations related to the traditional activity is significantly negative (at the level of 10%).

Opposite to our expectations, the increasing openness to the foreign capital doesn't encourage the adoption of monetic innovations significantly at the level of 1%. To explain this sign, we have used a financial innovation measure, reflecting the first mover behavior, which proved to be responsible of this unexpected foreign participation effect. We can explain this by the fact that the innovation process is a risky and costly act, not always successful, what forces foreign banks to adopt a risk-averse attitude when deciding to adopt first the innovation process. It seems that this attitude is explained by the uncertain environment of the banking systems of the emerging countries and developing ones. However, the increasing openness to foreign capital stimulates the bank to elaborate its own risk assessment system in order to reduce its credit risk.

3.3.5. Size. The results found push us to think that it's possible that even in case of increases of their size, the Tunisian banks are unable to exploit the economies of scale and scope present in their activity of product innovation, what discourages its adoption. A priori, the synergies between the activities of product innovations, those relating to traditional and non-traditional activities don't exist. Moreover, the largest banks aren't incited to adopt the monetic services and thus, don't seem to benefit correctly from scale and scope economies. In fact, the publicly owned banks which are large banks lack necessary funds to finance the high costs of the adoption and the setting up of some monetic innovations. The main mission of these banks is to finance the priority sectors like agriculture, industry and tourism, which reduced their resources. Also, the banks with high sizes have not flexible structures and their adoption of changes requires higher costs of implementation and training of their staff. This is responsible of the negative impact of the size. The results also show that the elaboration of a risk assessment system as well as the introduction of a compensation electronic system don't depend on the banking size.

Table 4. Determinants of the product innovation

Maximum Likelihood Estimation in Poisson regressions of the product innovation effect on a dummy variable representing the financial liberalization and some environmental and organizational determinants. The table reports the results of the second stage of Control Function Approach. The sample is formed of banks belonging to the Tunisian emerging market (between 1986 and 2008). If we consider the fact that the innovation is a periodic measure, we obtain 180 observations. We consider product innovations of both banking intermediation activities: traditional and non-traditional. The robust z-score to heteroskedasticity and autocorrelation appears in parentheses.

Total sample										
Product financial innovation (PDIV)										
	Product innovation (traditional intermediation activity)					Product innovation (non-traditional intermediation activity)				
	1	2	3	4	5	1	2	3	4	5
Intercept	21.9589*** (2.60)	17.9042** (2.18)	14.8034* (1.80)	32.8298*** (4.71)	25.4992*** (3.47)	13.4307* (1.79)	13.4511* (1.73)	15.2945* (1.90)	18.5905*** (2.64)	
DUMMY 1	0.4736 (1.03)					1.2308** (2.46)				
DUMMY 2		1.2234 (0.90)					0.5727** (2.19)			
DUMMY 3			1.3299*** (4.98)					0.2273 (1.01)		
DUMMY 4				0.8737*** (3.88)					0.1791* (1.71)	
DUMMY 5					1.0249* (1.78)					-0. 4692*** (-2.60)
IHHD	-0.0091 *** (-3.32)	-0.00702** (-2.52)	-0.00366*** (-2.92)	-0.01798*** (-6.63)	-0.0158*** (-6.71)	-0.0059*** (-2.62)	-0.0057** (-2.31)	-0.0062** (-2.17)	-0.009*** (-3.48)	-0.0104*** (-5.15)
DIV	0.5403 (0.79)	0. 3051 (0.45)	00651 (0.10)	0.053 (0.07)	0.6816* (1.81)	-0.8744*** (-2.59)	-0.9098*** (-2.77)	-0.9004** (-1.98)	-0.8835*** (-2.79)	-1.2975** (-1.97)
PUB	-0.00103 (-0.00)	-0.0297 (-0.07)	0.0583 (0.16)	0.0254 (0.07)	0.1668 (0.48)	-0.1133** (-2.03)	-0.1229** (-2.14)	-0.0834** (-2.22)	-0.0946** (-2.07)	-0.159** (-2.30)
FRG	-0.8715* (-1.91)	-0.7991* (-1.65)	-0.8207** (-2.55)	-0.797** (-2.49)	-0.5917** (-2.02)	0.0509* (1.89)	0.0181* (1.88)	0.0603* (1.78)	0.0487* (1.71)	0.0413* (1.81)
SIZE	-0.6577 ** (-2.51)	-0.6163** (-2.45)	-0.6396*** (-2.63)	-0.613** (-2.28)	-0.5917 ** (-2.02)	-0.4242* (-1.76)	-0.4034* (-1.66)	-0.4415* (-1.84)	-0.43* (-1.75)	-0.3184* (-1.84)
FR	0.1762** (2.38)	0.1779** (2.30)	0.1635** (1.96)	0.1571** (2.04)	0.1117** (2.33)	0.1434** (2.34)	0.1386** (2.32)	0.1355** (2.25)	0.135** (2.23)	0.1138** (2.00)
SPR	1.9894*** (3.79)	2.1763*** (2.75)	0.196*** (2.59)	0.5188*** (3.11)	1.4828*** (2.59)	-2.7604** (-1.99)	-2.3191** (-2.05)	-2.8637* (-1.95)	-2.6856** (-2.23)	-4.0513* (-1.92)
Pseudo R^2	0.0992	0.1136	0.1301	0.1240	0.1580	0.0776	0.0728	0.0717	0.0787	0.0797
Log pseudolikelihood	-295.5081	-290.7887	-285.36104	-287.38504	-276.21174	-262.02144	-263.39978	-264.55036	-264.56223	-261.42031

Notes: ***, ** and * indicate statistical significance, respectively at the 1%, 5% and 10% levels. Columns 1-5: models with introduction of a dummy variable representing the financial liberalization.

Table 5. Determinants of the process innovation

Maximum Likelihood Estimation in Poisson regressions of the process innovation effect on a dummy variable representing the financial liberalization and some environmental and organizational determinants. The table reports the results of the second stage of Control Function Approach. The sample is formed of banks belonging to the Tunisian emerging market (between 1986 and 2008). If we consider the fact that the innovation is a periodic measure, we obtain 180 observations. We consider process innovations fitting in to the monetic activity, the system of risk appreciation and the electronic compensation system. The robust z-score to heteroskedasticity and autocorrelation appears in parentheses.

Total sample															
Process financial innovation (PCIV)															
	Process innovation (electronic payment services)					Process innovation (risk assessment system)					Process innovation (electronic compensation system)				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Intercept	2.8862 (0.30)	-3.2634 (-0.36)	-5.5868 (-0.60)	21.7519*** (2.71)	9.8346 (1.10)	27.4502 (1.23)	35.3993 (1.63)	47.1016** (2.15)	-16.8733 (-0.71)	15.7952 (0.69)	89.8457*** (5.68)	82.2501*** (5.34)	81.5622*** (5.25)	96.9639*** (4.64)	103.801*** (6.39)
DUMMY1	1.7338 (1.31)					2.8212*** (2.71)					9.4306 (1.43)				
DUMMY 2		0.3224 (1.44)					3.3524* (1.85)					16.6179 (1.14)			
DUMMY 3			1.8172*** (4.66)					5.279*** (4.69)					16.3551 (1.26)		
DUMMY 4				1.566*** (5.33)					3.1598** (5.00)					0. 1354** (2.11)	
DUMMY 5					1.4818*** (6.05)					0.3848** (2.37)					0.8812 (1.35)
IHHD	-0.0015** (-2.10)	-0.0053** (-1.97)	-0.00898** (-2.47)	-0.0132*** (-4.10)	-0.0075*** (-2.63)	-0.0244** (-2.15)	-0.0312** (-2.51)	-0.0491*** (-4.36)	-0.0093** (-2.15)	-0.0157** (-1.99)	-0.0507*** (-7.40)	-0.0505*** (-7.46)	-0.0497*** (-7.06)	-0.0488*** (-4.12)	-0.0628*** (-7.36)
DIV	1.509** (1.98)	1.19896** (2.12)	1.7537** (2.31)	0.6194** (2.05)	0.3548** (2.18)	1.4003** (1.97)	1.3395** (2.02)	1.3450** (2.28)	1.3999** (2.15)	1.5426** (2.28)	7.8903 (0.50)	7.5667 (1.23)	7.4921 (0.86)	7.8799 (1.17)	6.8403 (1.09)
PUB	-0.2716 (-0.48)	-0.3865 (-0.68)	-0.1484 (-0.27)	-0.1827 (-0.34)	-0.3262 (-0.63)	-0.4065** (-2.04)	-0.3571** (-2.15)	-1.1121* (-1.83)	-0.2487* (-1.73)	-1.364* (-1.80)	2.3937*** (3.75)	2.4464*** (3.86)	2.4409*** (3.87)	2.3884*** (3.72)	1.9055*** (3.01)
FRG	-3.1103*** (-5.01)	-2.9764*** (-4.84)	-2.9677*** (-4.84)	-3.1124*** (-5.02)	-2.4951*** (-3.95)	1.6912** (2.24)	1.7587** (2.27)	2.2786*** (2.84)	1.7032** (1.98)	1.6311** (2.15)	-0.3246 (-0.74)	-0.1887 (-0.48)	-0.2684 (-0.69)	-0.1976 (-0.50)	0.0051 (0.01)
SIZE	-2.888*** (-6.09)	-2.8548*** (-6.13)	-2.8459*** (-6.14)	-2.8849*** (-6.03)	-2.279*** (-4.52)	0.1321 (0.26)	0.1471 (0.28)	0.6623 (1.18)	0.1115 (0.19)	0.0475 (0.09)	-0.333 (-1.09)	-0.2511 (-0.92)	-0.2982 (-1.11)	-0.2253 (-0.84)	0.0467 (0.15)
FR	0.0388*** (3.79)	0.0343*** (2.89)	0.0051** (2.32)	0.0187*** (2.75)	0.0607*** (2.91)	-0.0242 (-0.14)	-0.0267 (-0.16)	-0.0547 (-0.32)	0.001 (0.01)	-0.0047 (-0.03)	0.9531*** (3.36)	0.9293*** (3.35)	0.9195*** (3.31)	0.9516*** (3.37)	0.8026*** (2.86)
SPR	6.3714** (1.97)	7.1361** (2.41)	3.3666** (2.29)	3.14315** (2.39)	2.048** (2.17)	9.4957** (2.11)	11.1037** (2.19)	21.0601** (3.80)	8.2071* (1.71)	9.2582** (1.98)	6.2371** (2.10)	8.8813*** (2.61)	8.5755** (2.48)	6.1156** (2.23)	6.8785** (2.05)
Pseudo R^2	0.0731	0.0984	0.1094	0.1202	0.1241	0.1466	0.1604	0.1995	0.1841	0.1345	0.3144	0.3180	0.3189	0.3144	0.3318
Log pseudolikelihood	-342.8926	-329.9663	-325.9277	-321.9692	-320.5395	-84.18912	-82.81893	-78.9677	-80.48926	-85.38054	-78.19459	-77.78018	-77.67724	-78.18885	-76.20946

Note : ***, ** and * indicate statistical significance, respectively at the 1%, 5% and 10% levels. Columns 1-5: models with introduction of a dummy variable representing the financial liberalization.

3.3.6. Financial resources. The results show that a large quantity of resources encourage the bank (at the level of 5%) to adopt the product innovations related to its main activity and thus, face the credit risk associated to it. Moreover, high levels of financial resources motivate the bank (at the level of 5%) to adopt the products belonging to its non-traditional activity, and thus, to face the fluctuation risk of rates on the market and also to endure the costs associated to the telematic products as, for example, the elaboration of a web site. Besides, a large availability of financial resources stimulates (at the level of 1%) the adoption of process innovations related to monetic services and to electronic compensation system, because of the high initial investment which requires this kind of innovation.

3.3.7. Spread. The spread has a significant positive impact, at a level of 1%, on the adoption of the new products belonging to the traditional intermediation activity. In fact, banks practicing a high spread are incited to adopt more innovations belonging to their main activity, because this is likely to increase their intermediation margin. The results show that this penalizes (at 5% and 10%) the adoption of new products entering the non-classical banking activity.

Besides, concerning the financial process innovation, we find that the banks practicing high levels of spread are motivated (significantly at 5%) to adopt monetic services to increase their income and preserve their market shares and in order to take part in the program installed by the Tunisian monetic society. They are more ready to do it thanks to the high spread allowing them to face the high cost associated to the establishment of the automatic cash dispensers and teller machines parc. The spread has also a positive impact on the adoption of a risk assessment system (significantly at 5%). In fact, according to the contract theory, the bank is confronted to a problem of asymmetric information and moral hazard, consequence of the difficulty to determine if the borrowers respect the terms of their loans contracts. Thus, one of the reasons why the bank practices a high level of spread is to cover its credit risk. Consequently, the borrower can be incited to minimize his repayments by declaring a lower income of his project than the real one. Thus, conscious of the high probability of borrowers' opportunism, the bank is incited to elaborate its own system of risks appreciation. Moreover, the practice of a high spread seems to contribute significantly to the setting up and financing of the bank of an electronic compensation system.

3.4. The robustness of the results. We have divided the period of study in two sub periods, one before and the other after 1998, in order to take account of the modifications of the banking financial statements, that happened in 1999 and that banks have been taken into account since 1998. The estimation results for the two sub-periods are similar to those found for all the period of 1991-2008, however, with a varied degree of significativity. For example, we find a stimulatory effect of the diversification on the process innovation, which is weakly significant, as well as a negative effect on the product innovation belonging to the non-traditional banking, during the first time interval. In fact, the activity diversification of the Tunisian banks has increased since the introduction of the reform establishing the principal of universal banking in July, 2001. Concerning the size, its negative impact on the product innovation is less significant during the second sub-period. It seems that there is more opportunity for exploitation of economies of scale and scope present in the activity of financial innovation, thanks to the size of the banks which didn't stop increasing during the last decade, to the operational qualities and to the existing synergies between the innovation activities. Moreover, the process of bank privatization and openness to the financial services, which has clearly appeared since 1998, and had for consequence to decrease greatly the public participation and the rise of the foreign one in the Tunisian banking industry. This may explain the negative impact of PUB becoming nonsignificant, as well as the positive effect of FRG that has become significant (at 5%) on the adoption of the product innovations belonging to the non-traditional activity, during the second sub-period (1998-2008). Besides, the negative impact of the foreign participation on the adoption of the monetic innovations has become less significant (at 10%) during the last period. Also, we estimate that this significant evolution of the effect of property structure on the adoption of financial innovations is due to the strengthening of the prudential regulations and to the reorganization of the banking sector, which contributed to decrease the uncertainty and the risk degree characterizing this emerging country.

Furthermore, we notice a non significativity of the DUMMY 4 and DUMMY 5 during the first sub period (1991-1997), what is expected. Otherwise, using two financial innovation measures, each reflecting an adoption behavior of banking innovation (first mover versus imitation), we notice from the results that each regulation has generally the same impact on each of the two innovative behaviors.

Conclusions

Following this research, we identified the financial innovation determinants of internal and external nature to the banking firm. We have, in particular, explored

the effect of the financial reforms on the two types of financial innovation. It is undeniable that the constraint theory provides a very instructive lighting on certain aspects of the financial innovation dynamic. However, to complete these contributions, the use of an approach based on the benefits of a regulation encouraging the innovative act seemed to us very useful. Overall, the banking innovations are frequently linked, directly or indirectly to the regulation. The public authorities could define, control or modify the characteristics of these products or services, and even influence the modes of communication, the distribution channels, or pricing policies. The financial liberalization has then for result to encourage the financial innovation either directly if it was governed by legal texts or indirectly by increasing the competition between the financial intermediaries.

We aimed to apprehend the effect of the reforms within the financial liberalization process on the banking adoption of financial innovation in a context of an emerging country. The results obtained show that the reforms introduced have a significant impact on the adoption of the financial innovations by the Tunisian banks, what leads us to conclude that the regulatory framework of the Tunisian banking system influences broadly the innovative behavior of this latter. In fact, several reforms related to the restructuring and the dynamisation of the financial sector, have tried to diversify the finding sources of non-financial agents, to establish certain tax incentives to favor long-term savings and facilitate the access to financing at lower costs. Such reforms have contributed to erect an appropriate and incentive framework for the consolidation of financial innovation. We expect to find similar results in other emerging countries, showing a certain similarity about the historic of regulations in force and of the financial liberalization process started.

Even though each experience of financial liberalization is a particular case, it seems that the sequence of financial reforms used in Tunisia is similar to the strategy adopted by some countries where the financial liberalization has been successfully accomplished, and where each crisis during or after the reform has been avoided. In light of what has happened recently, we can conclude that the prudent financial liberalization in Tunisia, with well-controlled products including the securitization, can obviously avoid the financial and banking crises. It's true that the securitization is accused since it has contributed to the starting of a great financial crisis with no preceding sign. Therefore, the financial innovation phenomenon is thrown back into question into its totality. However, its renunciation doesn't exclude the necessity to make use of such techniques, because banks want to continue lending more than their depositors give them. So, it is necessary to consider the reforms put in place, relative to the regulation and risk assessment, to ensure a stable financial system, allowing the economies to grow.

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