Innovation, cooperation network and economic growth, a Tunisian study

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Innovation, cooperation network and Economic growth, a Tunisian case

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Abstract

In this paper we investigate postulations on the relation between innovation activities and economic factors of growth. The old explication of innovation are limited to the notion of technological progress. Generally, technological progress deals about the number of patent and its impact on nation growth and firm modernity, in this case innovations actions are considered as an improvements activities. However, there is a new way to analyze innovation, it doesn't limit itself to the number of patents or a new technological products but it also deals with improvements in production process, organization, finance and distribution. This study analyze the determinant of innovations on a macroeconomic and microeconomic level. In this paper, we see the important role of innovation system, government role cooperation network and human resources capacity in improving Tunisian firm growth.

Keywords: innovation, economic growth, patent, open innovation, cooperation,

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Introduction:

The word innovation comes from the Latin Novus, this term sends back to multiple definitions: on one hand innovation is a result, it's the case of an offer of product or service or a change in the process of production. On the other, innovation is assimilated like a strategy that is the case of innovation in human resources, distribution or marketing. Then, innovation is a temporary competitive advantage that allows firms to develop a competitive strategy when the strategy developed answers the needs of the markets. In this context of environmental evolution, innovation becomes a vital tool anticipating the future of firms.

Often the terms inventions and innovations have been confounded. Invention and research consist in putting some inputs: capital and work to get outputs: scientific and technical knowledge. The result of this output are never certain and exploitation and merchandising can take several years as for example: the television that required about twenty years or the nylon about ten years. Innovation is therefore the activity that creates the value by regrouping these different efforts: research and development, inventions, to which it adds investments of exploitation. Empirical studies estimate that innovations coming from inventions turns about 10% of innovations, then, innovations comes essentially from improvements. In the beginning, the economic literature distinguishes only between two types of innovations: the radical and the incremental. In radical innovations we regroup new technologies or new applications that can make big change, we called inventions. But in incremental innovations we find a second type of innovations that can take different shapes: reduction of costs, improvement of performances, and addition of new component of use, as for example: the ABS braking or the GPS in the automotive manufacture. So the firsts definitions centered on technological innovations of product and process are considered nowadays as being limited. Indeed, the most important part of the innovations is currently commercial, organizational and financial. Then, we elaborated the following definition:

"Innovation defines itself like the creation of a new product or service, a new process, a new method of merchandising or a new organizational method in the firm often by establishing relations with the outside"

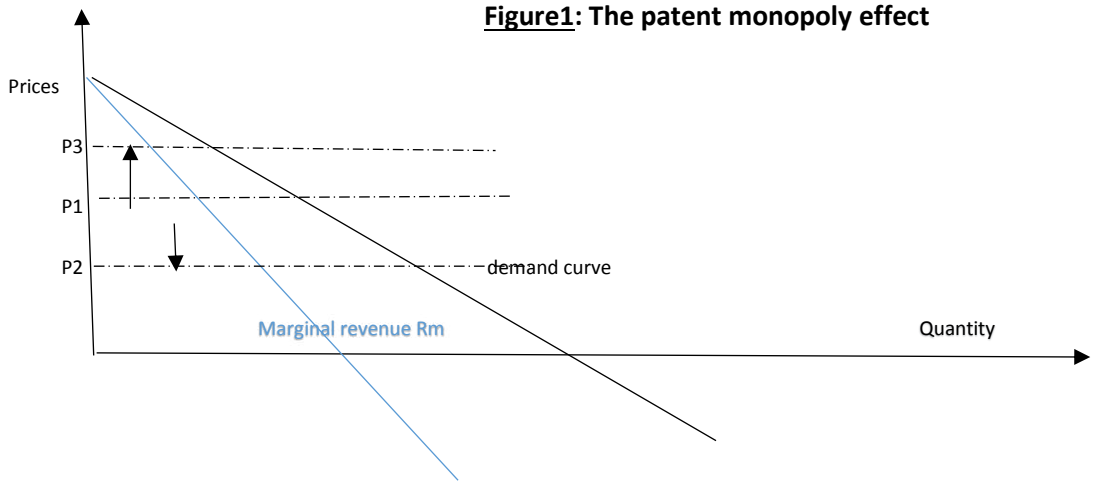
Actually, most innovations are on services, especially with the development of the new technologies of information that can created the e-commerce. Then, e-sales constitute an innovation of service that becomes a global commercial success. In this paper, I developed three parties, the first section

presents the patent strategy and the innovations models and networks. The second section, deals on the relation between growth economy and innovation and the third one, presents a Tunisian empirical study on innovation.

I-The patents studies and innovation models:

Microeconomic studies on innovations deals about the question of patents and the monopoly power of the innovative firm. Patent can be defined as a title of propriety of an invention, with this title the inventor obtain a monopoly exploitation of his invention for a maximal period of twenty years. The inventor can exploit his invention or he can sell it to a firm. The patent title is not a perfect solution it's a second choice that can encourage invention and diffusion of knowledge when inventor diffuse his invention and it will become a public good. The object of patent is to reduce secret because secret reduce knowledge diffusion. The studies of Arrow 1962 and Schumpeter 1942 supposes that innovation is a public good produced directly by government agencies. In reality, firms makes innovation to bring more profits. Successful innovations creates an artificial monopoly power that make differentiation strategy from others competitive firms. Firms can obtain a patent that can protect their invention from imitation. In others cases, firms can have a monopoly position if they use secret as a strategy. We can see in figure 1 how imitation and patent affect prices. In the first case, the absence of patent encourage imitation a lot that creates an important reduction of price from p_1 to p_2 but in the case of a patent law, prices rise from p_1 to p_3, this result affect social welfare, and consumer surplus reduce. Patent create then a monopoly power, that's why prices rise to p_3. In figure 1, we can understand why monopoly power doesn't generate more innovation similar to the situation were excessive competition not encourage innovation. Then, intermediate position between perfect substitution of goods (competition) and perfectly complementarity (monopole) is the best position for a maximum of innovations.

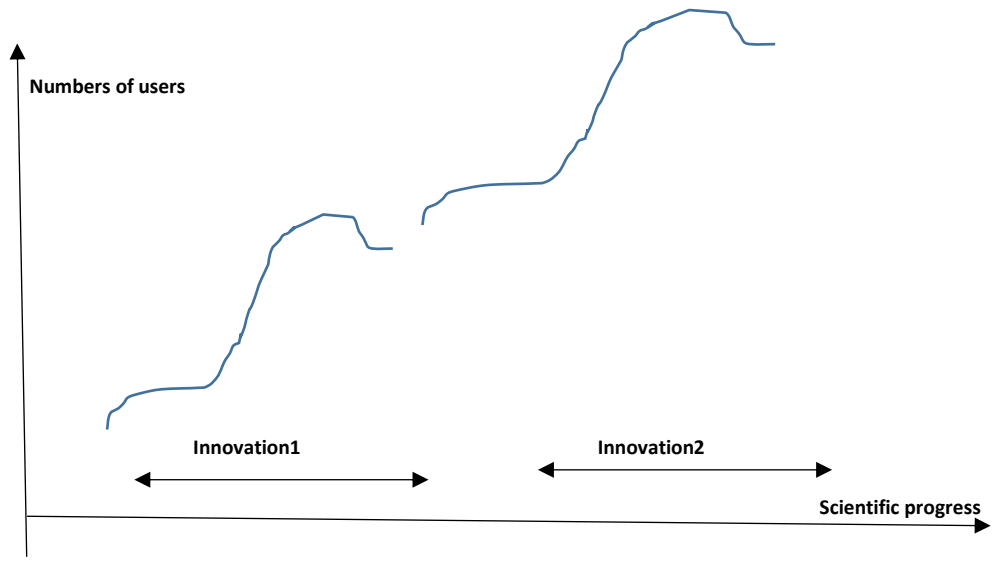
Figure1: The patent monopoly effect



Source : Author explanation

The use of Patent is limited to less than 10% of innovation in firms, generally, firms choose secret. Patent offer a protection for a limited period of time after patent becomes a public good. This means that a lot of valuable innovation are not captured by patent. The Levin 1987 study shows in different empirical works that complexity of product can protect innovative firm from imitation. For Bresnahan 1995 and Dosi 1988, innovation and imitation are related to a path dependency that determinate the capacity of firms to innovate or imitate in such sectors activity. Clayton M.C 1992, explain the trajectory of these firms similar to an S curve. Innovation activities affect market competitiveness and generally the patent allowed to the winner creates a difficult situation to the others competitive firms that are obliged to buy the patent to use it or to stop their activities. Patent offer to winner the possibility to cover its research costs and to have a monopoly position on market for a moment of time. After, innovation was replaced by another innovation, this creates a cycle: it's the destruction-creation technology.

Figure2: The curve S, the destruction-creation mechanism



Source : Clayton M. C 1992

The first microeconomic model on innovation is the Schumpeter study developed in 1942, this model is the "technology push". In this model, innovation emerges like a flux to unique sense descended from the activities of research and development to the merchandising. This first model developed in the sixties focus essentially on the technological progress. For Schumpeter, the innovations are born in cluster and propagate themselves in logic of creation-destruction. After, this first model has been

completed by others studies as for example the “demand pull” model by schmookler in 1966 whose explain that’s the elasticity of the demand of the market is the motor of the innovation process.

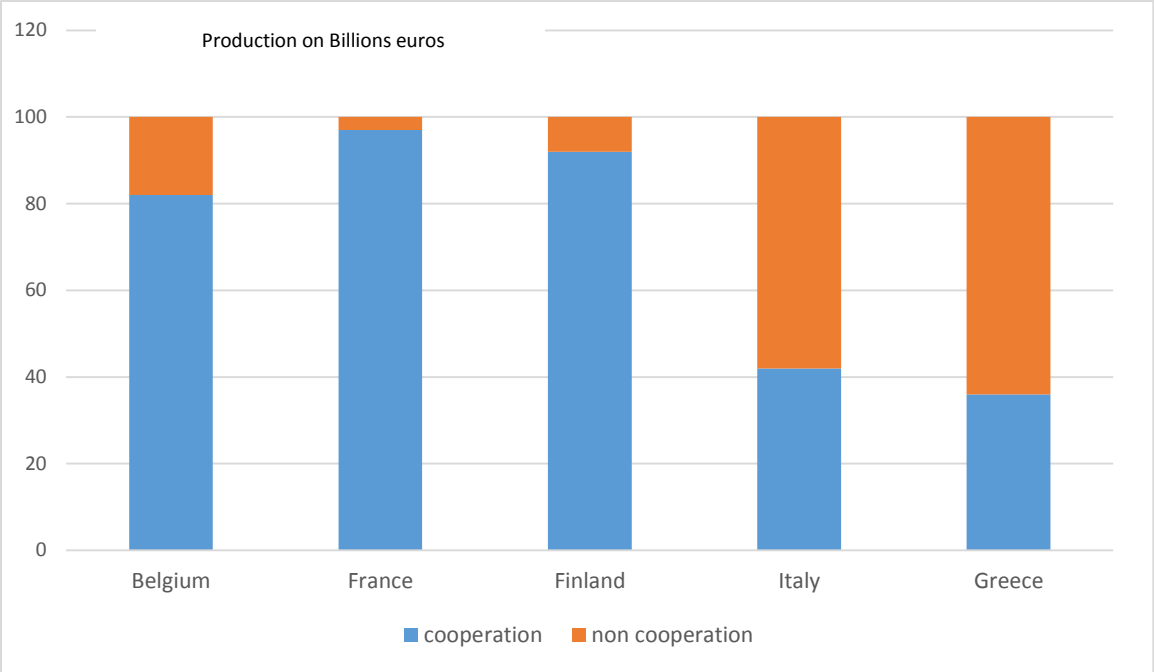
In the eighties, the evolutionist theory with the studies of Freeman 1982, Dosi 1988, Nelson and Winter 1981, brings a new analysis of innovation, they open the black box who turns inputs on outputs and widen the analysis to the process resolving problems. Innovation becomes a process of training, a cognitive process, it represents adjustments and evolution: it’s the birth of the “path dependency” studies. The evolutionary theory presents innovations strategies as a survival strategy in a changing environment. Like in biology, innovation protect firms from changing environment. In this sense, Rosenberg 1982 distinguishes between several varieties of trainings and put a lot of importance to the notions of “learning by using” and “learning by sharing”. Then, the acquired knowledge is not all formal and explicit they are also tacit and casual. The technological trajectories determine the future of firms especially there adaptation to the novelties. After, in the nineties, in applied economy, the chain linked model says as interactive model explains that innovation is not anymore an isolated phase but a process that incorporates different components of the organization with several ties and feedbacks it associate and coordinate research and development with the activities of production and sales. The activity of conception becomes then the essential motor to assure the success of innovation. These studies are inspired a lot of the Japanese organization and notably the lean system that offers new ways to organize the production of the firms as for example Aoki studies. In this sense, Nonaka and Takeuchi developed a model centered on the continuous training named SECI: socialization, externalization, combination and internalization. This model is composed of phases including a tacit and explicit sharing of the knowledge, it have multiple tasks: creation and diffusion.

Others more recent models exists, as for example the “system integration and networking” model say SIN. This model is characterized by an organization integrating several organisms: suppliers and customers having greatly access to the processes of information and communication and using new computers tools, it encourages firms to organize itself on a horizontal network that facilitates the fast communications between different groups, and it’s the birth of the technological platforms and networks creativeness. Then, the process of innovation becomes a multiple ecosystem that creates the value for different members. With the development of internet technology, firms develop more easily theirs cooperation network with: clients, suppliers, consultant, etc, it’s the beginning of the concept the “open innovation” that focus on cooperation network and co-development. These studies are relied to the theory of the costs transaction of Coase 1960 and Williamson 1982 that supposes a choice achieved by the firms: in the first case, firm make research inside the firm and

protect these results by secret or patent or choose a vertical integration politic though the acquisition of an innovative small firm via an operation of fusion. In the second case, firm develop an externalization strategy through cooperation network with co-contractor or a co-development with concurrent or partners: it's the "corporate spin off".

In figure 3, we can see the cooperation choices of European firms. In Europe, most countries choose cooperation on innovation as a strategy of development targeting a reduction on the high fixed costs of innovation. Only few firms choose to not cooperate for innovation as for example Italian firms and Greece where development strategy turns more on imitation than on investments on a high costs of research and development. In these countries expenses on research and development are limited.

Figure 3: Open innovation



Source : EUROSTAT 2015

After presenting the microeconomic studies on innovation that concentrate on patent monopoly and present different model of innovation: technology push, demand pull, evolutionary theory and l'open innovation, we focus now on the macroeconomic level that study essentially the impact of innovations on countries development.

II-The macroeconomic studies on innovation:

The macroeconomic studies on innovation focus on the effects of technical progress on economic growth. The technical progress deals generally about a modernization of the productive system that introduce division and specialization of the workers in the scientific organization of work, it permit an increase on the productive efficiency. In this sense, the technical changes are continuous and progressive, they propagates in a cumulative way according to the size of the market and spending power. But, innovations doesn't limit themselves to an improvement of the productivity by producing more outputs with a minimum of inputs, growth is not only quantitative it integrates components of differentiation of the inputs as motor of dynamic outputs grows. Then, innovations become a discontinuous process caring ruptures and changes in the methods of production. Innovations imply many changes in economy it's the processes of destruction and creation. Innovations arrive as a cluster were major innovations coming from fundamental scientific progress passed after in a variety of minor innovations. These cluster of innovations affect the global evolution of economy while encouraging the investments and creating an economic growth. Thus, a long period of minor adjustments concluded itself by a major innovation making a radical change. In the long cycle theory, Kondratieff shows the powerful played by innovations. They take the curves in S as a process of cycle passing by a phase of birth, maturity and decline. Every new innovation replaces the previous innovations in a logic of continuous improvement of performances.

The neoclassic growth model whose hypotheses are those of perfect competition consider the technical change like an exogenous factor. In this model, productivity growth is a result of the increasing capital investments. With a function of production of Cobb Douglas at constant return to scale we can write:

$$Y = A\, k^{\alpha} N^{1-\alpha} \qquad (1)$$

Y, K et N are the level of production, capital and labor and A is the technical progress. In this equation, we have the process of capital accumulation equal to:

$$K_{t+1} = (1-d)k_t + I_t \qquad (2)$$

In this equation I_t represent investment at period t and d the capital depreciation.

Nowadays, TIC investments and notably the decreasing of computers prices contributes largely to an increase of computers stocks capital and facilitated its renewal. In the nineties, these changes increase significantly growth statics in United States and Europe but, the neoclassical model of growth predict that in the long run the increasing growth will stop in an equilibrium, it's the stationary way. The reason is the economic law of marginal efficiency were the increase of inputs

don't increase output after a certain period of growth. In this equation, we have an increase of factor K but a decrease of productivity, then, only the increase of technical progress e^a can increase productivity. This model, confirm empirical studies on productivity growth. Indeed, empirical research of Solow 1956 on long run growth explains only a small part of the United States productivity, then growth can be explained by the residual that can explain a big part of the growth estimation, near 80% of total growth. Then, intangible factors can explain growth.

These studies on innovation and productivity were completed by modern ones that focus on the role of knowledge in growth theory. Indeed, in the nineties, new models integrate a new components as for example: the human capital, the infrastructures and innovations as motor of growth and development. The endogenous theory of growth focus essentially on the important role of knowledge in growth. Growth achieves itself thanks to the conjugation of three process: invention, innovation and knowledge. This phenomena can take many forms: education, training and imitation. This brings a dynamic between the effects of training, the experience and the cumulated investments. Thus, major innovations achieve themselves after a long time representing a result of improvements and accumulations of experience in the production. In this setting, economic growth depends on the rate of absorption of knowledge by firms which depends of capital investments and the ability of workers to training. The studies of Romer 1986 showed that innovations generate positive externalities. When a firm accumulates capital, it accumulates knowledge and contribute to its circulation and from it benefit others firms. We can write then this production function:

$$Y(H_y,L,x) = H_y^{\alpha} L^{\beta} \int x(i)^{1-\alpha-\beta} di \qquad (3)$$

In this equation, L represent labor and H_j the human capital and x (i) are the different inputs used by the firm. Then, we have total capital $K = \sum x(i)$, it's the addition of total goods used in production. In this context, A_j represent the stock of knowledge and we can get the rate of production in research equal to $\delta H_j A_j$.

In 1988, Lucas studies on education and growth show that human capital can be considered as information and can be appropriated by others humans and contrary to physical capital were return on scale is decreasing with growth, human capital have the power to create an endogenous growth. In this case, he write this equation:

$$H = \phi (1 - U) h \qquad (4)$$

U is the time of producing goods and 1-U represents the time for learning. The total time is equal to one. The production goods is a Cobb Douglas function and the model is:

$$Y = A\, k^{\alpha} (uh\, L)^{1-\alpha} \qquad (5)$$

In this equation K represent the physical capital and h the level of human capital. In this model, we can see the effects of collective learning on growth: It's the spatial economy were proximity and frequent exchange creates growth. Then, more investment on human capital ϕh are important, more economic growth is big. Technological capabilities of a nation are composed by a variety of knowledge and some innovations are tacit and disembodied and others are embodied and codified. Contrary to stock capital were marginal efficiency take place after time, in knowledge there's no congestion on learning.

In this context, capabilities to innovate depends hardly on the ability of a country to generate the successful exploitation of technology. The role of government in innovation policy becomes central. Education and human capital is an essential motor to ameliorate national innovations. Of course, capital accumulation is an important element it contributes to ameliorating rates of growth but it's insufficient. Business infrastructure, modern financial system and stable politic environment are also a vital requirements for innovations. Then, qualified workers, honesty and trust on government, stable macroeconomic aggregates, liberalization and modernization of financial system are all important skills. In this sense, barro 1990 developed this model:

$$Y/k = \phi(g/k) = A\,(g/k)^{\alpha} \qquad (6)$$

g represents the government expenses and K total physical capital, Y production with $0<\alpha<1$.

In this model we suppose that return on scale are decreasing and government expenses are efficient for production. Then, we can see the government action on economy in the goal of increasing social productivity. Moreover, studies of Mansfield 1988 and Lundvall 1992 confirm the importance of the external environment. In this context, government works hard to create an innovative environment. In the nineties, in Europe many government developed an innovation systems. The specificity of each system is related to its institutional structures and government choice and laws. The advantage of an efficient territorial system is the reduction of unemployment in the region, but also, the creation of a competitive advantage, when small firms can exchange qualified workers and compete at the international. Then, the creation of an innovation network between firms, universities and government research center encourage the diffusion of formal and informal knowledge which reduce risk and creates performances. In this sense, geographical concentration like district creates a new relations of exchange between people who generate externalities and contributes to the creation of a new cluster of innovation in high technologies, as for example Silicon Valley and also in low technologies like : textile, food made, etc. These low technologies sectors can export and develop

small innovations (not especially technological) that can offer numerous job to unemployed. Moreover, imitation can brings some externalities that creates a reduction of prices and an improvement of productivity. In this sense, a good innovation is an innovation that's ameliorates private efficiency and social welfare. Indeed, private fixed costs of innovation are large, government must help firms by distributing specific grants for innovation.

The government strategy of supporting innovation begins after Second World War in United-States at 1945 with the birth of National Science Foundation NSF and in France with the development of the National Center of Scientific Research CNRS. At that time, the government strategy takes the form a research program like: Eureka in France and Advanced Technology Program ATP in the United-States.

These government progress was after completed by others means like: subsides and credits with favorable rates for innovative firms, this strategy contributes to reducing the costs of research and development. In this sense, OSEO-Innovation distribute in France more than one billion euros a year essentially to small firms. Government help innovative firms with reducing their taxes. In Europe, the development of the credit taxes-research as an indirect grants contribute to encourage research and innovations in firms. Then, more firms expend in research more they obtain taxes reductions: research expenses are reduced from benefits. For example, if a firm obtain a grant on taxes-research of 50% of it's research cost. It can also beneficiate the second year at 40% of taxes-research reduction on benefits. All these strategies are developed to help firms to compete the new industrialized Asian countries who developed, in the eighties, a national strategy encouraging importation and imitation of new technologies in many sectors. Indeed, numerous Asian firms rise from the statute of poorest country to the leader of market. They begin works by importing technology and progressively innovate in producing imitation by introducing incremental improvements, actually, they become a market leader by moving from the statute of producer to the level of innovator by developing new products. These important progress was support by Asian government that hope is to help firms to innovate. This situation, creates a climate of international competition between countries and encourage in Europe the development of a systemic innovation approach: it's the birth of the national innovation system were laws and social environment interact and affect hardly growth and firms strategies and later growth economy.

Successful innovations are related to finance and risk. In this sense, many international statics confirm the difficulties of firms to obtain credits. In some European studies we can see the rates of success and fail of entrepreneurship, we find that more than 50% of project fail and more than 20% fail for a financial reason and 32% because they make a bad technological choice. Numerous banks don't accept to finance a risky project specially the technological ones. In this context, old and big

firms are more favored than the smallest ones in obtaining credits. Government must then maintain not only a certain level of public research and development to help firms in theirs appropriation strategies of technologies and innovations but also develop new instruments like venture capital that can be declined on: capital conception for seed stage development and capital creation for stat-up, capital creation for early stages and capital development for growth stage. Government must then encourage the development of a new financial instruments like capital-risk that can bring more finance to innovative firms than traditional subsidy in research. These financial instruments are vital for new firms and complete others instruments like business angel or love saving. In United States the program Small Business Innovation Research encourage start-up birth and finance more than 10 000 projects the year. These public encouragement was completed by private ones like the corporate venture, the private equity and the hedge fund whose focus on helping some middle size firms to growth more. In France, the capital risk was less developed then in United States, actually, the fund CDC-PME is the first French capital risk. This fund was composed a half public and a half private and contributes to finance stat-up.

In section I and II we have presented the microeconomic and the macroeconomic effects of innovation, we focus now on section III in the study of the Tunisian market and its innovations specificities.

III-The Empirical study:

The evaluation of the innovations activities uses several methods. The first studies, focus globally on the measure of the inputs of the innovation process through the measure of the research intensity. Indeed, to produce a new knowledge it requires combination of several factors as for example: expenses costs in research and in output: research results. These tools inform us on the resources allocated to the process of innovation, it represents the efforts of research and development achieved by firms. On the macroeconomic level, the measure of innovations and their impact on growth can be realized with the gross domestic expenditure on R&D called GERD. This measure cover total expenditure in research and development for a country and not only expanses on research wages of a national territory. The first empirical study on R&D inputs is the Arrow study, he studied the structure of the United States economy and the role of technical change in growth. Then, we can emphasis more the assessments of the R&D output and determine the relation between technical change and final demand. In Chenery 1960 and Kubo 1986 studies, we can see the relation between gross output and technical change increase. With these study, we can calculate the impact of an

increase in technical change on gross output changes. The results obtained confirm that a growth in technical change affect positively the gross output. We can write this relation:

$$X = (I-A)^{-1} (F+E-M) \quad (7)$$

Where: X is the gross output, F is the domestic final demand, E is the export and M is the import.

(I-A) is the technical change measuring the intermediate goods.

The evaluation of technical change can take many forms, in Schmookler 1953 and Griliches Z 1981, it's an assessment of the number of patent. They used the external patent application EXPA as a measure of progress and change in firms. In this context, we can calculate the growth impact by measuring the variation of the GPD per capital. The use of the external patent application EXPA is interesting because it can evaluate the knowledge progress. This method, complete the GIRD that focus only on the investments share on research, we can then evaluate the output of research. But the use of these indicators is limited, in reality, they give us a reducing assessment. For example, the use of the patent takes account only of the efforts of R&D and not on the set of the achieved innovations. Thus, the efforts made in the others activities are not considered. It's necessary to call therefore on new variables notably those that deals on innovation quality. Then, the measure of output must be more complete with the integration of others data as for example: the numbers of innovations achieved in the past, the number of patents, prototypes…In addition, financial and organizational performances can be introduced like a new measures of innovation, for example: parts of markets, innovation rates, ISo certifications, number of new products, improvements in productivity and profit…The importance of networks relations and cooperation strategies must be integrated also to these measures. In addition, foreign direct investment and multinational firms play an important role in transferring knowledge across countries with the use of license on a new technology and by developing exportation. These first group of tools can be completed by others as for example: the founder's professional experience, the technical human resource expertise, the capacity of assimilation of workers, the internal efforts of modernization, networks efficiency…

In this sense, I propose a new model that can take account from this reality, then, this model can integrate more variable explaining the reality of firms and don't limit itself to a simple estimation of research and development expenses GIRD or external patent application EXPA as we have shown earlier. The innovation model I developed is:

$$\mathbf{SINNO = \phi_1\ RDFORM + \phi_2\ SUBMIS + \phi_3\ ISOLIC + \phi_4\ PUBBREV + \phi_5\ INEQUI + \phi_6\ CREDFIN + \phi_7\ AGE + \phi_8\ EMPLO + \phi_9\ COOP + \phi_{10}} \quad \mathbf{(8)}$$

ϕ_{10} is a constant;

In this model we distinguish between the dependent variable and the independents variables. We start by presenting the dependent variable SINNO and after we present the nine independents variables:

The dependent variable SINNO is a scoring that evaluate the capacity of the firm to innovate by developing new product, process and organizational improvements. This scoring measure also the firm growth by improving their profits and by developing innovative strategies.

The first independent variable is the RDFORM it represent the research and development expenses and also the expenses on employees trainings. This variable provides a direct estimation on the effort of innovation choose by a firm. Innovative firm must have a qualified employees that can propose innovations and improvements in work.

The second variable is the SUBMIS, this variable evaluate the government encouragement to the sector, it measures the rates of subsides received by the firm and the government program which it participates. The third variable is the ISOLIC, this variable study the capacity of the firms to improve their products by introducing new licenses and certifications. The fourth variable PUBBREV is also an estimation of the work of the firm in developing innovation. This variable compare the number of publication and patent developed by the firms studied. This variable is interesting because it explain the capacity of the firm to recruit a high quality employees. Then, it measures the human capital investments that are beneficial for firm and it economy environment.

The fifth variable is INVEQUI this variable measure the capacity of the firm to develop new investments, in this study, we distinguish between two types of investment: investments on material and technological and communication investments. After, the CREFIN variable constitute an excellent evaluator of the capacity of the firm to growth and to innovate. For each progress, we need investments and with this variable we can see the capacity of the firm to obtain classical financing like credits or modern ones as capital-risk or not.

The others variables are AGE and SIZE, with these variables we can make a comparison between firms. Studies on economy distinguish between two ways the big firms that have various product and permanent employees and small ones with restrictive product and non-qualified labor. Furthermore, the variable of AGE help us in studding the specificities of firm innovations. We choose in this study 3 years old as reference of comparison. We think that small firms can be more innovative than big firms that have more administrative heaviness, that affect their flexibility.

The last variable is the COOP this variable evaluate the capacity of the firm to develop cooperation network with foreign firms or with local suppliers and clients, consultants, or sub-contractors. The study of this variable is essential to value the effort of innovation because innovative firms, generally, develop more theirs connections to obtain new license and improve their product or imitate a successful sales.

After, presenting the dependent and the independent variables, we focus now on the hypothesis of this study. The object of this model is to bring some responses to these hypothesis:

Hypothesis 1: innovations and firm growth are driven by technological change as for example, more investments on new equipment and also more expenses on research and development.

Hypothesis 2: more firms use new patents, licenses and certifications, more they increase their innovation scoring and their market share.

Hypothesis 3: More a firm accesses to banking credits and government subsides more it increases her scoring on innovation and growth.

Hypothesis 4: More a firm accesses to cooperation network, more innovation becomes easy and more firms get better scoring.

Hypothesis 5: big firms are more innovative then the average sample.

Hypothesis 6: old firms are less innovative then young firms.

Hypothesis 7: foreign cooperation like joint-venture encourage innovation.

Hypothesis 8: the use of digital technologies improve firms scoring.

Hypothesis 9: market concentration helps firms to be innovative.

To responses to these hypothesis, I developed an econometric regression on two Tunisian sectors: food and textile markets. In this study, I used a questionnaire to collect the different responses for the sample. The questionnaire is composed of twenty questions on innovations practices in firms. The sample studied a one hundred firms: fifty of them are from food sector and the other fifty are from textile sectors. The choice of these sectors is essentially motivated by their growth rates and the diversity of theirs products.

The results obtained shows that these sectors are composed from more innovative firms than expected. We find 64% of the firm sample are innovative, they are composed of 36 food firms and 28 textile firms. In table 1, we can see the dispersion and the diversity of the innovations activities.

Moreover, we can distinguish between innovations in product that concern 43% of firms studied and 17% for the process innovations and 4% for the organizational ones. These rates of innovation are interesting, they can be explained by changes on Tunisian consumer revenues and preferences and also by the introduction of numerous imitations that are conducted by changes in market concentration. Indeed, Tunisian markets are less concentrated than before and this situation offer to numerous firms the possibility to invest, innovate and contribute to growth economy. Moreover, firms benefit largely of the imported technologies and license, they developed imitation and innovate by adapting some international products to local choice. Furthermore, we suppose that the introduction of a new product on market as an innovation for the firm producer but this new product can be considered, in reality, as an imitation for an another firm.

Table 1: Diversity of Innovation

Innovation on :	Innovative firm	Non innovative firm
Product	43%	-
Process	17%	-
organizational	4%	-
Total sample	64%	36%

Source: Author empirical study

To understand Tunisian specificities on innovation, I used a specialized econometric software STATISTICA version 10 to estimate the model. In this study, the econometric regression is composed on one hand of one hundred firm from textile and food in Tunisian market and on the other hand of 10 variables. At the end of the information collection, we obtained 1000 observations that resume numerous firm strategy and attitudes.

First, we begin with a structural analyze of the results. In table 2, we have the principal results obtained with the different coefficients estimation parameters[2] : the bêta coefficient analysis offer these results. We find all the variables we choose significant, the different coefficient are: 0.172 for the variable expenses in research and development and training, 0.313 for cooperation network with others firms, 0.25 for license and certification, 0.218 for easy access to banking credit, 0.308 for investments in TIC and machinery, 0.225 for subsides and quality program, 0.192 for size of the firm, 0.189 for the age de firm, and 0.192 for publication and patent.

With these results, we can distinguish between two types of variables: the first group that have more impact on innovation scoring SINNO is composed with these variables: cooperation network

[2] The use of the Statistica analyze, offer two parameters: the standardized called the bêta coefficient and the non-standardized called the b parameter, see appendix 1 for more details.

with 0.313 coefficient and physical and TIC investment at 0.308 coefficient and license and certification at 0.250 coefficient. After, we have a second group of variable that have a significant impact on innovation scoring but less important than the first group. These second group is composed from: firm investment in training which coefficient is 0.172, age of the firm 0.189 and firm size 0.192. Furthermore, we are surprised with the results of the variable publication that have a few impact on innovation with a limited coefficient 0.193. This few impact can be explained by the long term impact of this variable. In that sense, license and certification with a coefficient of 0.250 or cooperation network with 0.313 have a more immediate impacts on innovations. The model got a constant, the ordering-origin equal to 1.009. Furthermore, in table 2, the analysis of the different results of the p-value are significant. In this study we have p-value<0.01 in all the cases, we can say there is a big presumption against the null hypothesis. Then, all the independent variables we have choose explain significantly the results obtained in the SINNO scoring. We can also make some others verification, the evaluation of the global test represented with the variables R^2: a synthetic coefficient of determination which estimate the variance of SINNO in the model, offer also a significant result because R^2 is equal to 0.99 and it's near 1. Our choice of the variables is then significant because our independent variables can explain very well the dependent variable SINNO.

Table 2: Author principal results of the econometric study

N=100	COEFFICIENT	PVALUE
ORDORIG		0,017610
RDFORM	0,171637	0,0000012***
SUBMIS	0,224500	0,000015***
ISOLIC	0,249580	0,000019***
PUBREV	0,192107	0,0000001***
INVEQUI	0,308285	0,000001***
CREDFIN	0,217604	0,000012***
AGE	0,188509	0,0000011***
EMPLOY	0,192352	0,000011***
COOP	0,312655	0,000011***
constant	1.009811	
R	0.99875255	
R^2	099750665	
R^2ajusted	0.99725732	
STAT F	400.67	

In addition, the study of correlation between the different variables show, in table 3, that tree independents variables are heavily correlated: the RDFORM, the CREDFIN and the INEQUI, with these coefficient of correlation 0.58 and 0.51. Moreover, all the independent variables have an interesting correlation with the innovation scoring, the dependent variable, but the results obtained presents

some differences. The variable RDFORM expenses on research and development and training obtained the best level of correlation, it have a coefficient of correlation equal to 0.82 with the SINNO, the dependent variable. Also, others variables present an interesting results as for example the variable INEQUI investments on equipment and TIC with a 0.68 correlation coefficient and the variable CREFIN that measures the facility to access to credit and capital risk with a correlation coefficient equal to 0.55. Furthermore, we find that some important variable have obtained a significant coefficient of correlation but less important than the first group as for example: cooperation network that get a correlation coefficient equal to 0.42 similar to the variable license and certification that have obtained an identical coefficient of correlation. Both these variables have a significant impact on the dependent variable but reduced in comparison with the first group of variable that have more impact than this second group. Al these results confirm then the important influence of some variables on innovation effort and economy growth.

Table 3: correlation analyze

	RDFORM	SUBMIS	ISOLIC	PUBREV	IEQUIP	CREDFIN	AGE	EMPLOY	COOP	SINNO
RDFORM	1,000000									
SUBMIS	0,118621	1,000000								
ISOLIC	0,229962	0,056751	1,000000							
PUBREV	0,353000	0,039527	0,282507	1,000000						
IEQUIP	0,580609	0,117406	0,166871	0,178508	1,000000					
CREDFIN	0,517794	0,002944	-0,024290	0,102504	0,304470	1,000000				
AGE	0,364502	-0,074167	-0,090861	0,131468	0,212877	0,174019	1,000000			
EMPLOY	0,338348	-0,082804	0,152869	0,164631	0,192934	0,154891	0,025342	1,000000		
COOP	0,227754	-0,093483	0,040901	-0,104200	0,097640	0,235907	0,043044	0,069184	1,000000	
SINNO	0,820145	0,244315	0,427285	0,433285	0,684259	0,550986	0,358826	0,421207	0,423807	1,000000

Source: Author empirical study

The results obtained justify the conclusions of some macroeconomic studies on endogenous economic growth were we can see the impact of human capital on economic growth and specially the effect of government subsidies to improve growth economy. In this sense, we can conclude to the important role of the training and the expenses on research and development on improving innovation scoring and profit growth. Moreover, easy access to bank credit and investments in equipment and technology constitute an important factor for improving innovation and growth. These variables have a heavier role than others like cooperation network, subsides, license and certification that also are important for innovation progress but less significant in this study. These results confirm then the hypothesis 1, 2 and 3 in that we suppose that the driven of innovation are the increasing of investment on equipment and technology, the easy access to credits, improves in human investments and the increases of expenses on training and research and development.

This study offer others results, when we emphasis on hypothesis 7 that deals on firms cooperation network, we find that firms have developed local cooperation essentially with client and suppliers that represent 22.5% of innovative firms and cooperation with government structures on a rate of 16% and only 6.7% of a firms sample have a foreign cooperation. The cooperation with consultant concern essentially the development of a new certification. Indeed, we can distinguish in food sector between six types of certification: iso 9001, iso 9002, iso 14001, iso 22000, HACCP and OHSAS. In our sample, all firms in food sector have more than two certification and the empirical results show that the certification Iso 9001, iso 22000 and HACCP are the most developed actually by firms. These certification are considered as vital for exporting firms, 32% of the firms. But, these improves in innovations performances are not relied only to certification, others factors also have an important role, as for example, age and firm size.

Table 4: Innovative firms and cooperation network

Form of cooperation	Firm develop cooperation	Firm not develop cooperation	Total sample
Cooperation with suppliers and client	22.5%	-	-
Cooperation with concurrent or consultant	13.43%	-	-
Cooperation with government structures	16%	-	-
Foreign cooperation	6,7%	-	-
Total sample	58%	42%	100%

Source: Author empirical study

Furthermore, in this study we find that the number of large firms these that have more than 50 employees are equal to 56% of the sample, these firms are more innovative, generally, they have more than two innovations and they correspond to 39% of the innovative firm. Moreover, firms with a number of employee less than fifty represent in our study 25% of the innovative firms. This result confirm then our hypothesis (5).

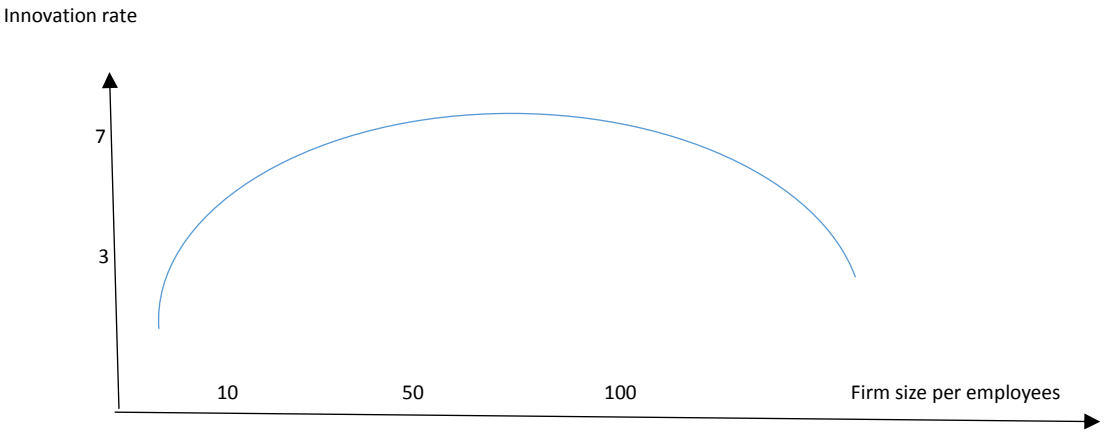
Table 5: Innovation and firm size

	Employees ≥ 50	Employees ≤ 50	Total sample
Innovative firm	39%	25%	64%
Non innovative firm	17%	17%	36%
Total sample	56%	42%	100%

Source: Author empirical study

Our results on the Tunisian food and textile sector justify then the theory of the U curve in that big firms are more innovative than small ones. We can see in figure 4, the evolution of the innovation rate in the theory of the U curve with different sizes of firms. But these results are different from our hypothesis 5 were we supposed that small firms as for example stat-up innovate more than big firms that have difficulties with their administrative red tapes. These results can be explained by the specificities of the Tunisian market were small firms (less than fifteen workers) have more difficulties than the others to access to more banking credits. Moreover, the few development of capital risk constitute an important handicap to innovation for these category of firms.

Figure 4: the inverted U curve



Source : Aghion and al 2005

These results on firm size can be confirmed by those on the variable facility access to banking credit in that we find that only 7% of the firms don't get difficulty to obtain a loan. These result explain then why small firms get more difficulties to innovate. Moreover, we can compare in table 6 the results relied to age. We find that firm with an age over 3 years, 61% of the total sample, get a better rate on innovation 36% than the young ones 28%. These results doesn't confirm hypothesis 6 in that we suppose that young firm are more innovative than old ones. We can explain this result by the difficulty of small firms to access to loans. At 3 years, firms are generally small and have difficulties to accede to banking credits than old firms that are bigger and have more facility to obtain a loan.

Table 6: Innovation and firm age

	Age firm≥ 3 years	**Age firm≤ 3 years**	**Total sample**
Innovative firm	36%	28%	64%
Non innovative firm	25%	11%	36%
Total	61%	39%	100%

Source: Author empirical study

With transfer of license and development of certification, firms improve not only their commercialization by developing generally an innovation of product but also by improving their productivity. The focus on sales progress show that 51% of the sample have an increase on benefits. Indeed, firms that have the best market share increase are the market leader that have more than 10% progress in one year. In our sample 7% of the firms have more than 10% increase on market share. We can see in table 7, the impact of innovations on productivity and benefits. The focus on productivity improvements show that 78% of the firms of the sample consider that they have improve their productivity results by improving their recruitment and training that increase theirs benefits by performing theirs strategy and process of production. In the sample, 82% of the innovative firms have make new recruitment in last year and some employees have beneficiate from training. Then, innovative firms have more qualified workers than the rest of the sample. These firms developed more their process of production and contributes after to the total improvement of the region knowledge and capabilities.

Table 7: innovation and improvements

	Innovative firm	Non innovative firm	Total sample
Improve in benefits	68% (43.52% of a total)	7.48%	51%
Improve on RH capabilities	82%(52.48% of total)	25.52%	78%
Exporting capacity	37%(23.68% of total)	9%	32.68%
Improve on productivity	21%(13.44% of total)	8%	21.44%

Source: Author empirical study

These results confirms different hypothesis on the growth endogenous theory that predict strong correlation between some measures: innovation system, competitiveness and economic growth. In this study we can see the firm efforts but also the environment impact on firms progress. With these results we understand more the necessary government efforts to help firms progress by creating the basic infrastructures for innovative economic district such as a high qualified diploma, future qualified employees, internet networks, mobile telephony networkers etc, these government expenses with others like subsides encourage firms to improve naturally their productivity and profits.

Furthermore, in this analyze, we discover some specificities to Tunisian market. In the questionnaire all firms studied respond that they consider their market sufficiently competitive and non-concentrated. In this sense, we can say innovations are largely conducted by competition. But when we emphasis more in the study of the results we find that firms sample don't invest a lot in research

and development, the majority of firms develop imitation on European product. The cooperation strategies developed with suppliers and subcontractor help them heavily in theirs innovations activities. Indeed, we have discover in the regression analyze the important role of cooperation network in innovations activities that support the coefficient of 0.31. Then, innovations activities in the Tunisian sample are not the results of an important investments in research and development conducted by important expenses in research as we can see it in Europe, it focus essentially on others concepts. In this study, we can see Tunisian firms investing in human capital by developing the best selection in recruitment that ameliorate the global knowledge stocks of the firms and encouraging employees to have the best trainings, we find that 78% of firms sample and 82% of the innovative group have choose these strategies.

Finally, we find in this study, that the principal difficulty for firms is to access with more facility to credits banking in the first stage of their development and after in the others stages, the difficulty focus more on improvements on theirs productivity.

Conclusion:

In the beginning, the economic literature distinguishes only between two types of innovations: the radical and the incremental. In radical innovation we regroup new technologies or new applications that make big change, we called inventions, and generally they represent 10% of total innovations. In incremental innovation we find a second type of innovation that can take different shapes: reduction of costs, improvement of performances, and addition of new component of use.

To protect these radical innovations, government have developed patents that create an artificial monopoly power by making differentiation strategy from others competitive firms. Firms with acquiring patents protect their invention from imitation. Also, firms can have a monopoly position when they use secret as a strategy. Then, patent offer to winner the possibility to cover its research costs and to have a monopoly position on market for a moment of time. After, innovation was replaced by another innovation, this creates a cycle: it's the destruction-creation technology.

The macroeconomic studies on innovations suppose that technical changes are continuous and progressive, they propagates in a cumulative way according to the size of the market and spending power. But, innovations doesn't limit themselves to an improvement of the productivity by producing more outputs with a minimum of inputs, growth is not only quantitative it integrates components of differentiation of the inputs as motor of dynamic outputs grows. Then, innovations become a discontinuous process caring ruptures and changes in the methods of production.

Innovations imply many changes in economy, it's the processes of destruction and creation. Innovations arrive as a cluster were major innovations coming from fundamental scientific progress passed after in a variety of minor innovations. These cluster of innovations affect the global evolution of economy while encouraging the investments and creating an economic growth.

The endogenous theory of growth focus essentially on the important role of government and knowledge in growth economy. In that sense, growth achieves itself thanks to the conjugation of three process: invention, innovation and knowledge. This phenomena can take many forms: education, training and imitation. This brings a dynamic between the effects of training, the experience and the cumulated investments. Thus, major innovations achieve themselves after a long time representing a result of improvements and accumulations of experience in the production. In this setting, economic growth depends on the rate of absorption of knowledge by firms that depends of capital investments and the ability of workers to training. Indeed, in Europe many government developed an innovation systems, the specificity of each system is related to its institutional structures and government choice and laws. The advantage of an efficient territorial system is the reduction of unemployment in the region, but also, the creation of a competitive advantage, when small firms can exchange qualified workers and compete at the international. Therefore, the creation of an innovation network between firms, universities and government research center encourage the diffusion of formal and informal knowledge that can reduce risk and creates performances. So, geographical concentration like district creates a new relations of exchanges between people who generate externalities and contributes to the creation of a new cluster of innovation in high technologies, as for example Silicon Valley.

In this study we focus on Tunisian food and textile market and we have tried to respond to these questions: what drives innovations? What determinate increase in scoring innovation? What's the role of cooperation, age, size, licenses and certifications in improving innovation scoring?

To responses to these hypothesis, I developed an econometric regression in which I distinguish between the dependent variable SINNO and nine independents variables. In this study, I used also a questionnaire to collect the different responses for the sample. The questionnaire is composed of twenty questions on innovations practices in firms. The sample studied a one hundred firms: fifty of them are from food sector and the other fifty are from textile sectors. The choice of these sectors is essentially motivated by their growth rates and the diversity of theirs products.

The treatment of the results was with the specialized econometric software STATISTICA version 10. We obtained 1000 observations that resume numerous firm strategy and attitudes. The results obtained justify our hypothesis. Our conclusions are near some macroeconomic studies on

endogenous economic growth were we can see the impact of human capital on economic growth and specially the effect of government subsidies to improve growth economy. In that sense, we have conclude to the important role of human investments throw the trainings and the expenses on research and development on improving innovation scoring and profit growth. Moreover, easy access to bank credit and investments in equipment and technology constitute an important factor for improving innovation and growth. These variables, have gained in our study a heavier role than others like cooperation network, subsides, license and certification which are also important but obtained a less significant results. Then, the determinant of innovations are essentially the increasing investment on equipment and technology, the easy access to credits and the progresses in human investments. Also, our results on the Tunisian food and textile sector have justified the theory of the U curve in that big firms are more innovative than small ones. Indeed, small firms as for example stat-up innovate less than big firms because they have difficulties in acceding to credits bank and capital risk, are also, less developed in Tunisia. In this study, we can see the firm efforts but also the environment impact on firms progress. With these results we understand more the necessary government efforts to help firms progress by creating the basic infrastructures for innovative economic district such as a high qualified diploma, future qualified employees, internet networks, mobile telephony networkers etc, these government expenses with others like subsides encourage firms to improve naturally their productivity and profits.

Finally, the evaluation of the concept of “open innovation” that focus on cooperation network and co-development show that firms studied have developed local cooperation essentially with client and suppliers on a level of 22.5% of innovative firms and cooperation with government structures on a rate of 16% and only 6.7% of a firms sample have a foreign cooperation. In this study, we find some specificities to Tunisian firms, they don’t develop important expenses on research and development like we can see it in Europe, but they encourage more investments in human capital by developing the best selection in recruitment that ameliorate the global knowledge stocks of the firms and encourage employees to have the best trainings, we find that 78% of firms sample and 82% of the innovative group have choose these strategies.

Lastly, we can say that the purpose of this study has been targeted and a straightforward extension can be to develop a regional comparison between some Mediterranean countries on this subject.

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Appendix 1

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Résultats Régress. Multiple

Synthèse de la Régression; Variable Dép. : SINNO (ZERZERI FERIEL)
R= ,99875255 R²= ,99750665 R² Ajusté = ,99725732
F(9,90)=4000,7 p<0,0001 Err-Type de l'Estim.: 1,3362

  Var dép. : SINNO            R Multiple =  ,99875255     F = 400,676
                                      R²=  ,99750665    dl =   9,90
  Nb d'obs. :   100            R² ajusté =  ,99725732     p = 0,000011
                 Erreur-type de l'estim. : 1,336241025
  Ord.Orig :  1,009811162  Err.-Type: ,4175792  t(   90) = 2,4183  p =
,0176

          RDFOR b*=  ,172        SUBMIS b*=  ,225       ISOLICE b*=  ,250
         PUBBRE b*=  ,193        INEQUI b*=  ,308        CREFIN b*=  ,218
            AGE b*=  ,189        EMPLOY b*=  ,192          COOP b*=  ,313

(coeffs b* significatifs)
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Author results of the econometric study

N=100	b*	Standard deviation b*	b	Standard deviation b	T (90)	Value p
ORDORIG			1,009811	0,417579	2,41825	0,017610
RDFORM	0,171637	0,008567	0,952906	0,047563	20,03468	0,0000012***
SUBMIS	0,224500	0,005473	0,960093	0,023407	41,01782	0,000015***
ISOLIC	0,249580	0,005756	1,036207	0,023896	43,36234	0,000019***
PUBREV	0,192107	0,005916	0,986525	0,030383	32,47004	0,0000001***
INVEQUI	0,308285	0,006498	0,981074	0,020678	47,44621	0,000001***
CREDFIN	0,217604	0,006333	0,965333	0,028095	34,35980	0,000012***
AGE	0,188509	0,005872	1,003359	0,031255	32,10252	0,0000011***
EMPLOY	0,192352	0,005710	0,983766	0,029205	33,68486	0,000011***
COOP	0,312655	0,005628	0,987638	0,017777	55,55677	0,000011***

The control of the slope show that the slope is significant at 1%, we obtained this result with the t variable: it's the student test evaluation that can measure the coefficient ^ϕi on their standard deviation ^σϕi: tϕi =^ϕi/^σϕi

This student test get a n-p-1 degree of liberty, that correspond to 90, the object of this test is to reject the hypothesis H0 with the α risk: tϕi > t1- α/2 ; we can estimate the quantile order of the student law equal to t(90) = 2,4183. Then, we can see in table 2 that all the results obtained are significant because all the variable studied respond to tϕi > 2.4183; the slope is then significantly different from zero at the risk of α equal to 1%.