PRODUCTIVITY GROWTH AND COMPETITION IN TUNISIAN MANUFACTURING FIRMS

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Abstract *- This paper aims at measuring the impact of competition on productivity growth of the Tunisian manufacturing sector at the firm level. To investigate the impact of competition on productivity we use two procedures. The first one is a two-step procedure; the second one is a one step procedure. We test the robustness of our results to different methodology and to different measures of competition both at the firm level and at the industry level. We use firm data over the period 1997-2002 from Tunisian manufacturing sector, a developing country that has experienced significant liberalization reforms since 1986 to examine the possible impact of competition on TFP. We also use industry-level data over the period 1983-2007 to explore the competition process in Tunisian manufacturing sector. Our results suggest that, at low competition level, more competition raises TFP at the firm level. Competition policies provide sufficient incentives to increase productivity growth at firm level. Yet, with high levels of competition, a rise in competition has a negative impact on productivity, the Schumpeterian effect appears and the capacity of firm to innovate decreases. Policies that promoted competition could be appropriate. But, to gain from competition, even at a high level of competition, Tunisian authorities must sustain firms to be more innovative.*

Key-words: COMPETITION, PRODUCTIVITY, MARKET SHARE, PRICE-COST MARGIN, TUNISIAN MANUFACTURING, DYNAMIC PANEL DATA MODEL, GMM METHOD.

JEL Classification: L11, L60, O30

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1. INTRODUCTION

This paper aims at measuring the impact of competition on productivity growth of the Tunisian manufacturing sector at the firm level within a simple theoretical framework. We focus on the role of transmission mechanisms between increased competition and the firm productivity.

There is still some disagreement among empirical and theoretical analysis on the impact of competition on productivity. On one hand, more competition reduces the firm's market power and might force them to expand (or to exit). This would lead to a reallocation of output from less productive to more productive units and then to productivity gains at the industry level. On another hand, more competition and reduction of the firm's market power would lead to a decrease in the incentives to invest in new technology and to innovate which lead to productivity decrease. More competition would reduce the monopoly rents that reward successful innovators (this is the Schumpeterian effect). This effect reduces the benefits of competition. Recent empirical research finds that the relationship between competition and productivity is an inverted U-shape, where productivity is highest at moderate levels of competition (Aghion and al, 2005).

There is also some disagreement among analysts and empirical results on the impact of competition on productivity. Many empirical studies (Nickell, 1996; Griffith, 2001; Okada, 2005; Aghion and al, 2008; Vather, 2006) have concluded that there is a positive relationship between product market competition and productivity growth. Some other empirical studies have pointed to the absence of relationship between competition and productivity. One possible explanation of this is that these studies used various definitions and measures of competition. Another explanation is that the data and the econometric methods used in these studies are different.

Even if more competition raises productivity, such improvement does not occur without adjustment costs associated to the exit of inefficient units and reallocation of factors (Pavcnik, 2002). It is therefore important to evaluate the impact of more competition on productivity gains from a policy perspective. This is the aim of our paper.

Few studies have tried to analyse the impact of competition on the developing economies at the firm level. The main reason is that the underlying data necessary to carry out these studies are not available, especially at an enterprise level. The debate on the impact of competition on productivity is still open as regards to developing countries.

As regards the determinants of productivity other than competition in Tunisian manufacturing firms, many studies focused on it (particularly the impact of FDI on productivity) (Baccouche and al, 2009; Chafai and al, 2009…). But there is no research about the impact of market competition on firm productivity in Tunisia. This study attempts to partially fill this gap.

Our contribution to these debates is essentially an empirical issue. We first try to analyse the degree and the dynamics of product market competition in Tunisian manufacturing sectors. Then, the analysis of a Tunisian firm's data may be viewed as an attempt to apprehend how productivity in Tunisia, a developing country, is being adjusted to more competition.

To investigate the impact of competition on productivity we use two procedures. The first one is a two-step procedure; the second one is a one-step procedure.

With the two-step approach, we first derive estimates of firm level productivity and we focus on their evolution over time. Secondly, we use the productivity estimates in order to understand the role of competition in impacting upon productivity.

There are many complications that arise in calculating total factor productivity (TFP). The measurement of productivity has been considered by an extensive body of literature (Felipe, 1997; Van Beveren, 2007; Blundell and Bond 2000; De Loecker, 2007; Olley and Pakes,1996 ; Levinshon and Petrin, 2003; Katayama, Lu and Tybout, 2005; Ackerberg, Caves and Frazer; 2005; Mahadevan and Kalirajan, 2000; Kumbhakar and Lovell, 2000; Kim and Han,2001). In this paper, we consider an estimation of TFP which takes explicit account of the endogeneity problem generated by the relationship between productivity and input demands when estimating a production function (Olley and Pakes, 1996). We also adjust all our estimates for the selectivity bias due to plant entry and exit.

With the one-stage approach, the link between competition and productivity is verified by using a production function framework as (Nickell, 1996; Disney, Haskel and Heden, 2003). We consider a dynamic production function augmented by competition variables.

We test the robustness of our results to different methodology.

With the two approaches, we identify the impact of competition on productivity growth by using both the variation of productivity and competition measures over time and variation across firms.

There are different factors which could impact upon productivity, these include: access to export market, foreign participation, ownership structure, investment in human capital… in addition to competition. We will control for the role of these factors in impacting upon productivity.

We use firm data over the period 1997-2002 from Tunisian manufacturing sector, a developing country that has experienced significant liberalization reforms since 1986, to examine the possible impact of competition on TFP. Our current firm-level database is the only firm-level data available in Tunisia. The sample period covers an important phase of Tunisian trade reform. We also use industry-level data over the period 1983-2007 to explore the competition process in Tunisian manufacturing sector.

Since the competition variable at an aggregated industry level does not well capture the extent of competitive pressure faced by each firm, we use firm specific measure of competition. We also test the robustness of our results to different measures of competition both at the firm level and at the industry level.

The rest of the paper is organized as follows. Section 2 affords a discussion of necessary background analysis regarding the impact of competition on productivity. Section 3 presents a review of competition policy and reforms in Tunisia. Section 4 lays down the main models and methodology to be used as framework for the econometric analysis. Section 5 puts forward the data, and some basic descriptive statistics. Section 6 discusses the main econometric results. Section 7 is made up of the conclusion to this paper.

2. COMPETITION AND PRODUCTIVITY: THEORETICAL AND EMPIRICAL ISSUES

The theoretical discussions among economists on the relationship between productivity and competition are very old. It was discussed already when Adam Smith (1991) wrote in his Wealth of Nations that monopoly is a great enemy to good management.

How precisely does competition affect the economic performance and the productivity of firms?

There are several reasons why productivity and growth might change when there is a change in the competition at the firm level. In most analysis of competition impacts, three mechanisms are distinguished (OFT, 2007):

The Within firm effects: Leibenstein (1966) asserted that competition eliminates the X-inefficiency and consequently increase total factor productivity**.** Competitive pressure is expected to discipline inefficient producers and to provide incentives for firms to improve their operations through internal changes, such as organisational change and downsizing. The benefits of this for a firm include savings of inputs, general cost reductions enhancing market position, higher flexibility and improvement in product quality, which will improve the overall efficiency, thereby enhancing productivity. In sum, competition improves managerial performance and then productivity.

Raith (2003) presents a theory of how competition in an industry interacts with the design of managerial incentives within firms. An increase in competition provides stronger incentives for firms to reduce costs, and hence agents work harder.

The relationship between competition and efficiency incentive has been considered by an important body of literature as Griffith (2001), Schmidt (1997), Disney, Haskel and Heden (2003), Vickers (1995) and Leibenstein (1966). These papers suggest that competition is an important determinant of within firm effects, which in turn has an impact on TFP growth. As an example, Griffith (2001) examined the relationship between product market competition and efficiency using a panel data of UK establishments observed over the period 1980-1996. The results suggest that the increase in product market competition led to an increase in overall levels of efficiency.

The Between firm effects: Competitive pressure is expected to discipline (the within effect) or eliminate inefficient producers. These may be replaced by new entrants. Competition increases the probability of bankruptcy. Competition forces firms with low productivity to exit, while more productive firms remain in the market. This turnover effect leads to productivity gains at an aggregate level even without productivity improvement within firms.

This creative destruction process leads to economic growth also because innovative firms discover new goods and new process and make old products and capital obsolete.

The role played by exit and entry in increasing productivity is confirmed by many studies as Hahn (2000), Disney, Haskel and Heden (2003), Melitz (2003).

Hahn (2000) examined the relationship between entry and exit and productivity. He suggested that plant level entry and exit account for 45 percent of productivity growth, using firm's data from Korea.

Disney, Haskel and Heden (2003) find that external restructuring (the process by which less efficient establishments exit and more efficient establishments enter) accounts for 90% of TFP growth in UK manufacturing over the period 1980-92.

Melitz (2003) specifies a model with imperfect competition and heterogeneous firms in which opening to trade leads to reallocation of resources within industries towards more productive firms. The results of this study suggest that exit end entry of firms leads to an increase in aggregate productivity.

The innovation effect: The relationship between competition and innovation is a priori ambiguous (Ahn, 2002), even in the theoretical debate. A positive relationship between competition and innovation, and then productivity is argued already by Arrow (1956), "Firms facing competition might be expected to have stronger incentives to innovate than monopolists who already gain monopoly rent without needing to innovate" (OFT, 2007). But Schumpeter argued that competition was not necessarily good for innovation. In fact, a firm needs to be guaranteed a monopoly position post innovation and not be competed to have incentives to innovate. This is particularly the case of incumbent firms. More competition reduces the monopoly rents that reward successful innovators. In this sense, to innovate and to create, firms must be able to charge prices greater than marginal costs (Segarra and Teruel, 2006). The availability of internal sources of funding is useful for investment in R § D (Blundell and al, 1999).With high levels of competition, the capacity of firm to invest in new equipment and to innovate decreases.

In sum, the entry of new firms may enhance the dynamic of creation and innovation but reduces the income of incumbents and their ability to innovate. But the trade-off between incumbents and entrants is ambiguous (Segarra and Teruel, 2006). A priori the net effect remains ambiguous, though.

Aghion and al (2005), Segarra and Teruel (2006) and some others have found empirical evidence in favour of an inverse U shaped relationship between competition and productivity. They confirm the fact that when market competition is at low level, it promotes productivity growth, but when it is at high level it has a negative effect on innovation and then on productivity (a Schumpeterian effect).

3. TUNISIA REFORMS

Until the late 1980, a price regulation system was used in Tunisia. Since 1986, numerous measures and reforms have been taken to further liberalise trade and economy: the structural adjustment plan (1986), adherence to the GATT (1989), adherence to the WTO (1994) and the ratification of a free-trade agreement with the European Union (1995).

The reforms concern several domains: liberalization of the trade, the liberalization of prices, deregulation, the privatization of government-owned firms, liberalization of the investment, the modernization of banking sector, reforms of the financial market, the restructuring of government-owned firms, The code of instigation to the investment, Fiscal reforms, The Code of investment and the Code of instigation to the foreign investment.

The scope and speed of trade liberalization process is apparent from table1. The mean effective rate of protection[3] fell from 555 in 1985 to 56 in 2001 for the IAA sector, from 203 in 1985 to 67 in 2001 in the ITHC sector and from 203 in 1985 to 50 in 2001 in the ICH sector. Disaggregated by industries, the percentage declines in effective rates of protection, particularly between 1986 and 1990, which are impressive in all industries.

The economic reforms included deregulations in industry as well as trade liberalization. The policy of competition is based on the law of July 29th, 1991. This law made the object of several reviews (on 1993, on 1995, on 1999, on 2003) which reflect a will to reinforce competitiveness, to forbid anticompetitive practices and discriminators practices, as well as predominant abuses and establish the control of concentration. This deregulation reform includes:

- Deregulation of the price system, prices are fixed by market forces (with some exceptions)

[3] The effective rate of protection is defined as the proportional increase in value added resulting from the imposition of protective measures. It measures the percentage by which value added can increase over the free-trade level as a consequence of a tariff structure. The effective rate of protection captures protection of intermediate and final goods. It also captures tariff or non-tariff protective measures. A negative rate implies that input industries are particularly favoured. These negative rates indicate higher tariffs on input imports than on final goods.

- No restrictions to market access
- No restrictions to investments and technical progress
- Prohibition of the abuse of dominant position
- The number of procedures that a firm has to follow to get registered for business and the time cost of doing business falls. Entry regulatory barriers had been further removed.
- Licensing requirements for projects were abolished
- Foreign direct investment were encouraged.

Table 1. Effective rates of protection in Tunisia in percentage terms

	IAA	IMCCV	IME	ICH	ITHC	ID	All
1983	191	185	67	161	175	150	178
1984	404	197	92	92	98	122	-
1985	555	232	104	100	203	134	-
1986	421	40	88	88	194	101	124
1987	120	36	73	67	107	88	81
1988	134	66	63	62	82	74	78
1989	110	91	98	70	76	78	87
1990	100	82	101	78	73	80	84
1991	80	61	55	49	58	54	-
1992	90	65	59	50	65	65	-
1993	85	75	65	60	105	90	-
1994	-	-	-	-	-	-	-
1995	71	85	64	65	126	102	90
1996	-	-	-	-	-	-	-
1997	51	154	126	136	69	196	92
1998	-	-	-	-	-	-	-
1999	50	120	100	106	91	140	90
2000	51	57	70	63	73	60	63
2001	56	58	44	50	67	46	57
2002				45	59	41	

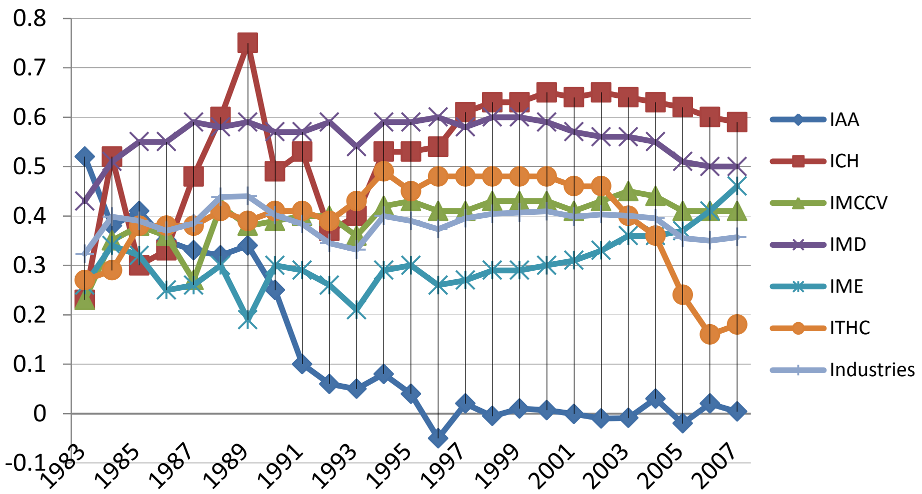
IAA: Agro-food industry.
IMCCV: Pottery, glass and other non-metalic mineral industry.
IME: Mechanical, electrical and electronic industry.
ICH: Chemical industry.
ITHC: Textiles, wearing apparel, leather and footwear industry.
ID: Other manufacturing industries.
All: All the manufacturing sector.
Source: Institut d'Economie Quantitative.

Such measures are assumed to promote entry and exit of firms leading to higher competition. To assess the degree and the evolution of product market competition in Tunisia we calculate the price cost margin which is a potential measure of competitive pressure at industry level. This is given by the differentials between value added and the total wage bill as a proportion of sales. We use an industry-level data over the period 1983-2007 from the IEQ.

Graph 1 shows the evolution of the price cost margin in the six Tunisian manufacturing sectors over the period 1983-2007. There is no declining trend until 2000. The price cost margin exhibits a timid and gradual decrease at the end of the period, since 2000 (except for the IME sector). This is in favour of a decrease in industry price-cost margin suggesting low profit margins in most manufacturing sectors due to a more competitive environment. This seems to indicate intensified competition which forces industries to lower the mark-ups and to limit their market power. These results are in conformity with those of Ben Jelili (2004). There are significant differences between sectors, though it is notable that the price cost margin is more pronounced in ICH sector and less pronounced in the IAA sector.

We have to note that Tunisia has adopted a gradual liberalization and deregulation program. The liberalization program remains relatively timid over the first period (1995-1999). This is mainly due to the government's preoccupation with maintaining social stability and preparing companies for competition. The government has adopted a more active liberalization policy after 2000.

Graph 1. Price cost margin evolution at industry level (1983-2007)



Author's calculation based on IEQ data.

The firm's level data which we used in this study cover the first stage of active liberalization program (1997-2002). Although data for a short period after effective liberalization may not be sufficient to fully evaluate the long-run implications of reforms, the analysis of productivity trends for the period should provide some insights. The cross section dimension of our firm level data covers different activities which are differently exposed to competition. This suggests that if competition has a significant effect on manufacturing productivity, it should be apparent in these data characterized by the two dimensions: the temporal and the sectoral dimensions.

4. PRODUCTIVITY GROWTH AND COMPETITION: ECONOMETRIC MODELS AND METHODOLOGY

To investigate the impact of competition on productivity we use two procedures : the first one is a two-step procedure; the second one is a one-step procedure.

The two step procedure : Olley and Pakes (1996)

With the two step approach, we first derive estimates of firm level Total Factor Productivity (TFP). The traditional methodology for estimation of TFP followed the neoclassical growth accounting framework and used the Solow residuals from a production function regression as the measure of TFP. Olley and Pakes (1996) demonstrated that this methodology does not account for the possible endogeneity of inputs and suggest a method to correct for the associated biases. Their approach is designed to deal with both the problem of simultaneity between the choice of inputs and the firm's productivity and the selectivity bias due to entry and exit in an unbalanced panel.

We begin by assuming that a firm-specific production function can be described by a Cobb-Douglas form as

$$y_{it} = A_{it}^{\gamma} K_{it}^{\alpha} L_{it}^{\beta} \qquad (1)$$

Where y indicates the output, K and L are capital and labour inputs, respectively. Capital stock is supposed to be fixed. α and β are parameters to be estimated representing factor share coefficients. The subscripts i and t make reference to the i^{th} firm and the t^{th} time period. A allows for total factor productivity.

Specifying the production function in log linear form, the following equation may be written :

$$\ln y_{it} = cte + \alpha \ln K_{it} + \beta \ln L_{it} + w_{it} + v_{it} \qquad (2)$$

w_{it} captures the productivity **s**hock and v_{it} captures all other shocks.

To deal with the problem of simultaneity between the choice of inputs and the firm's productivity, Olley and Pakes (1996) offer an approach which consists in using investments as a proxy of productivity shocks. The selection bias due to entry and exit is also controlled in the estimation of the production function. (See Annex 1 for more details on Olley and Pakes method).

Once the input elasticities estimated consistently, the TFP was deduced using the following equation:

$$TFP_{it} = \frac{y_{it}}{L_{it}^{\beta} K_{it}^{\alpha}} \qquad (3)$$

This means that we follow the neoclassical growth accounting framework and use the Solow residuals from the production function regression as the measure of TFP.

In a second stage, we attempt to link competition with changes in TFP. Following Aghion and al (2008), Vahter (2006), Griffith and Harrison (2004), Aghion, Blundell, Griffith, Howitt and Brantl, 2005) and to examine the effects of competition on productivity, we specify the following basic equation, where productivity growth depends on past productivity growth, measures of competition (Z), and unobservable firm characteristics (ui) :

$$TFPg_{it} = \beta_0 + \beta_1 TFPg_{it-1} + \beta_2 Z_{it} + u_i + v_{it} \quad (4)$$

We include past productivity growth as an independent variable. If there is a trend effect, with past productivity growth perhaps indicating the ability to innovate, the coefficient on this variable will be positive. On the other hand, the coefficient may be negative if firm innovation tends to be lumpy (Paus and al, 2003). The growth rate variables were computed as the difference in the natural log from t to t-1. Firm behaviour is also influenced by a host of other economic facts. These include macro-economic factors like inflation and interest rates, general market conditions, investors' confidence, etc. We therefore include industry effects and time dummies in our specifications.

The one step methodology

The link between competition and the productivity is verified indirectly by using a production function framework (Nickell, 1996; Disney, Haskel and Heden, 2003).

We begin by assuming that a firm-specific production function can be described by a Cobb-Douglas form as presented in equation (1). In this equation γ allows for factors affecting and changing the productivity (Milner and Wright 1998). A is a productivity index. The factors considered here are related to competition. These factors vary over time and across firms in the following manner:

$$A_{it} = \exp(\sum_t \gamma_t D_t) Z_{it}{}^{\delta} \quad (5)$$

Where the Z's are measures of competition. D_t is a dummy variable having a value of one for the t[th] time period and zero otherwise and where γ_t are parameters to be estimated. The dummy variable D_t is introduced to model exogenous shocks. This time dummy model allows for the time effects to switch from positive to negative and back to positive effects. Other explanatory variables of the firm's characteristics are also introduced.

However, to take into account the fact that when firms face a change in their environment, particularly economic and liberalisation reforms, they do not necessarily adjust immediately their output level to the new business conditions we introduce the dynamic. This would allow us to examine whether a firm's response to liberalisation and deregulation shocks is related to the speed with which it adjusts to changes in desired production levels.

Specifying the production function in log linear form, the following equation may be written:

$$\ln y_{it} = cte + \lambda \ln y_{it-1} + (1-\lambda)\alpha \ln K_{it} + (1-\lambda)\beta \ln L_{it} + \delta \ln Z_{it} + \sum \gamma_t D_t + u_i + v_{it} \quad (6)$$

u_i captures the heterogeneity between firms.

v_{it} captures all other shocks to sector productivity, and we suppose this error to be serially uncorrelated. Absence of serial correlation is assisted by the inclusion of dynamics in the form of a lagged dependent variable (Mouelhi, 2007).

Specifying the first difference of this equation, a growth rate form equation is derived. Since the lagged dependent variable is correlated with the transformed disturbance term (first difference of v_{it}), it needs to be instrumented in order to obtain consistent estimates. The GMM techniques enable us to tackle the endogeneity problems.

To resolve the problem of selectivity bias we use the two-step method suggested by Heckman (1979). In the first step, we estimate a probit model on firm survival. The probit equation we use include investment effort or stock of capital as regressors. The inverse Mill's ratio obtained from this probit model is then introduced as an additional explanatory variable in the dynamic specification.

We estimate the dynamic models specified in equations (4) and (6) by the generalised method of moment (GMM) [4] as suggested by Blundell and Bond (1998), without assuming any distribution for the error terms, taking into consideration the dynamic form and the presence of variables that are invariants over time. Estimation of the dynamic error component model is considered using an alternative to the standard first-differenced GMM estimator of Arellano and Bond (1991). It is a system GMM estimator deduced from a system of equations in first differences and in levels. This estimator is defined under extra moment restrictions that are available under quite reasonable conditions relating to the properties of the initial condition process. Exploiting these extra moment restrictions offers efficiency gains relative to the Arellano and Bond (1991)

[4] An alternative method to achieve the consistency of coefficients is the standard instrumental variables method (IV). To achieve consistency of the IV estimator two requirements have to be met. First, instruments need to be correlated with the endogenous regressors. Second instruments need to be uncorrelated with the error term. The IV estimator has not been particularly successful in practice. One of the obvious shortcomings of the technique is the lack of appropriate instruments in many data sets. Blundell and Bond (1999) attribute the bad performance of standard IV estimators to the weak instruments used for identification.

estimator and permits the identification of the effects of time invariant variables.

Data

The available data is taken from the National Annual Survey Report on Firms (NASRF) carried out by the Tunisian National Institute of Statistics (TNIS). The data covers firms from different manufacturing sectors over the period 1997-2002. The survey looks at economic accounts of enterprises.

In the first stage, the data set has been "cleaned" from observations which could be seen as erroneous or which were clearly outliers. The empirical analysis could be based on an unbalanced panel consisting of a sample of about 2564 firms from the agro-food (IAA), the chemical (ICH), the ceramic (IMCCV), the diverse (IMD), the electric (IME) and the textiles, wearing, leather and footwear (ITHC) industries (see table 2). These firms were observed from between 1 and 6 annual observations over the period 1997-2002. The firm's activity is described by a one-digit Tunisian nomenclature of economic activities which leads to the above six manufacturing sectors. The two, three and four-digit nomenclatures are also available.

The data set includes: value added (y) measured in constant prices (deflated by a four digit industry specific price deflator), tangible and intangible fixed assets, labour (number of employees L). The number of employees is adjusted according to whether it is part or fulltime equivalent employment.

We have also information about the "ownership", a private or a public firm, the percentage of foreign capital participation, the exporting rate which is the percentage of foreign sales. These variables were included in our regressions to control for some firm's characteristics and some other aspects which may affect individual firm's productivity.

Measures of competition

Available data permits us to calculate some competition related variables both at the firm level and at the industry level:

Market share at the firm level: small market share is associated to the existence of many rival firms and more competitive pressure. It is measured as firm output as a proportion of four-digit industry output (we also examine the effects of using shares of three and two digit industries). It is a measure of the inverse of competition. Changes in market shares are likely to capture changes in competitive pressure across time and between firms.

$$Marketshare_{it} = \frac{sales_{it}}{\sum_i sales_{it}}$$

However, measures as market share and herfindhal index are not very good, because they depend on the definition of the relevant market and do not fully reflect foreign competition (Okada, 2005).

Table 2. Number of firms by industry

Industry	IAA	IMCCV	IME	IHC	ITHC	ID	Total
Number of firms	319	189	407	201	1170	278	2564

Table 3. Summary statistics

Variable	Mean	Std. Dev	Minimum	Maximum	Observ.
Value added	799105.3	3814494	7.285109	1.51e+08	8103
Capital	1648626	9628098	1	5.73e+08	8123
Labor	102.3484	203.7456	1	4177	8303
Market share	.0147873	.0570736	0	1	8318
Import penetration	.4751665	.2269877	.0642862	.6877885	8319
Price cost margin	.0972101	.0869389	.0000229	.9468393	4498

The Price cost margin at the firm level would be a more desirable measure of competition.

$$\text{Price cost margin}_{it} = \frac{\text{valueadded}_{it} - wages_{it}}{sales_{it}}$$

We eliminated those observations whose price cost margins were more than unity.

This firm-level data were combined with a measure of the effective rate of protection (tpe) calculated by the Institut d'Economie Quantitative (IEQ) at one digit level (variable over the six manufacturing sectors and over time) as one potential openness indicator.

Exports and imports at a sectoral level are also available. Then, Import penetration at an industry-level is included as a measure of foreign competition. Imports as a fraction of home demand (imports-exports+sales) measured at three digit industries is used to measure the import penetration ratio.

The Herfindhal index for concentration which is an industry concentration measure is also used. It is the sum of squared market shares:

$$\text{Herfindhal index}_{jt} = \sum_i Marketshare_{it}^2$$

An industry is concentrated if a handful of firms account for a disproportionately large share of the output and are in position to earn supernormal profits. Another index for concentration is the proportion of total sales coming from the 4 largest industrial units in each of the 3 digit industries.

Summary statistics of the data are presented in table 3.The mean of employment variable is of 102 employees reflecting the Tunisian structure which is dominated by the small firms.

However some variables have missing points which means that when estimating a given model (econometric model) the number of available firms declines somewhat.

5. ESTIMATION RESULTS

5.1. TFP analysis

We first use the two-stage approach to investigate the impact of competition on firm's productivity. The critical technology parameters, the share of capital in output and the share of labour in output, are econometrically estimated and the usual assumption of identical technology across sectors is relaxed. We use different production function estimates for each sector.

Table 4. Parameter estimates of the production functions in manufacturing sectors

Dependent Variable : Log(y)

Sector	Olley Pakes (1996) method			Fixed effects model			
	ln L	ln K	Obs.	ln L	ln K	R2	Obs.
IAA	.5025 *** (.0786)	.2331 *** (.0591)	736	.1387 *** (.0484)	.1257 *** (.0267)	0.8227	933
IMCCV	.6845 *** (.1107)	.2840 *** (.0812)	490	.4308 *** (.1143)	.1629 *** (.0431)	0.7735	574
IME	.6528 *** (.0404)	.2593 *** (.0728)	1107	.3476 *** .(0512)	.0840 *** (.0234)	0.7866	1296
ICH	.5271 *** (.0813)	.2235 *** (.0461)	633	.2209 *** (.0605)	.1120 *** (.0311)	0.7765	719
ITHC	.7112 *** (.0276)	.2026 *** (.0290)	2996	.2711 *** (.0269)	.1118 *** (.0122)	0.7281	3507
ID	.8192 *** (.0502)	.1949 *** (.0674)	743	.5228 *** (.0778)	.0895 *** (.0281)	0.8075	900
TOTAL	.6357 *** (.0165)	.2090 *** (.0154)	6735	.2818 *** (.0197)	.1119 *** (.0090)	0.7679	7902

Sample Period : 1997-2002.
*Standard error in brackets. * significant at 10%, ** significant at 5%, *** significant at 1%.*
All computations are done using STATA.

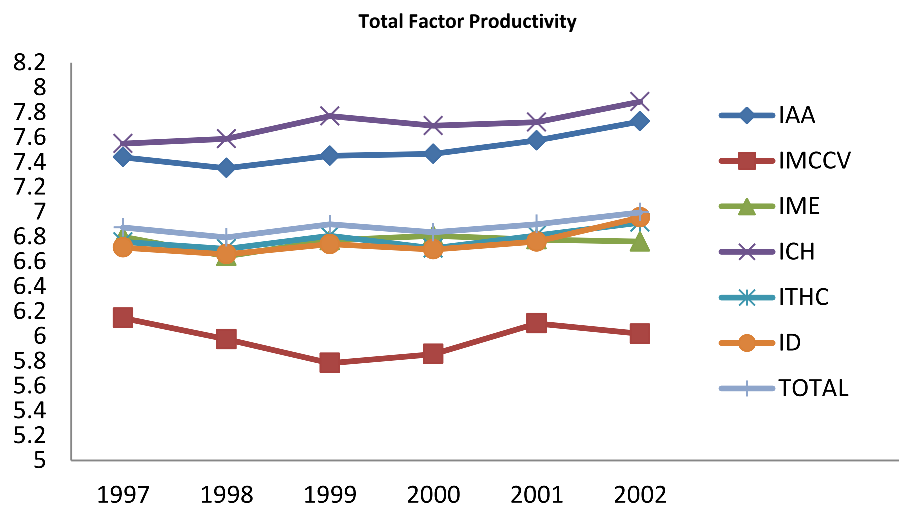
Table 4 presents the estimated coefficients of the labour and capital elasticities in the production function of different sectors. From this table, we can see that the results of the fixed effects method and the Olley Pakes method are significantly different. The elasticities estimated by Olley and Pakes method are more accurate and are in conformity with many other results on Tunisian manufacturing (Goaied and Mouelhi, 2003, Mouelhi, 2007). Thus accounting for endogeneity of inputs and for selectivity bias seems to be important to estimate accurate estimates of TFP for firms.

The elasticities of output with respect to labour are higher than the elasticities of output with respect to capital, reflecting the high labour use in Tunisian manufacturing.

Once the input elasticities estimated, the plant level TFP was deduced using the equation (3). Aggregate industry productivity is calculated annually as the share weighted average of the plant level productivity, using plant level output shares as weights.

Graph 2 shows the TFP evolution over the period 1997-2002 and by industry. TFP has on average been higher in the chemical and IAA sectors than in the other manufacturing sectors. TFP in IMCCV sector on average is significantly lower than in the other sectors. It also appears from this graph that, the TFP, on average, stagnated until 2000. It has increased gradually toward the end of the sample period in the IAA and ICH sectors. Productivity growth over the studied period was modest. The productivity stabilization probably reflects the cost of the reorganization and restructuring process.

Graph 2. Evolution of weighted average productivity by industry



To analyze this result, we go deeper following Olley and Pakes (1996) in decomposing the productivity into two terms. In fact, TFP differences across sectors and time can be composition effects:

$$TFP_t = \overline{TFP}_{it} + \sum_i \Delta pm_{it} \Delta TFP_{it} = \text{within effect} + \text{between effect} \quad (7)$$

$\overline{TFP}_{it}$ is the unweighted average of firm-level productivity

pm_{it} is the share of firm i in the given sector at time t

TFP_{it} is the total factor productivity measure of an individual firm i at time t

The change in weighted productivity depends in part on the change in any given firm's productivity (within effect) and in part on changes in aggregate productivity arising from the entry and the exit of firms (a reallocation of factors towards more productive firms), that is the between or turnover effect.

Table 5 presents the within and the between components of TFP and their evolution over the period 1997-2002 and by industry. It shows that the within effect is higher than the between effect in all the sectors. The within component, such as internal restructuring and organisational change, was the most important source of productivity growth in Tunisian's firms. The results also suggest that the weighted average productivity (the between component) has not changed much over the studied period. These results indicate that the reallocation of output from less productive firms to more productive firms was not very important. This reallocation process seems to be complicated.

Table 5. Productivity Decomposition (in %)

		1997	1998	1999	2000	2001	2002
IAA	Within	87.938	88.792	88.097	88.036	89.379	89.071
	Between	12.061	11.207	11.920	11.963	10.620	10.928
IMCCV	Within	90.078	90.875	87.879	84.261	86.349	86.154
	Between	9.928	9.124	12.120	15.738	13.650	13,845
IME	Within	91.675	91.399	91.225	91.483	91.289	91.767
	Between	8.324	8.600	8.774	8.516	8.710	8.232
ICH	Within	81.141	82.912	81.412	82.934	82.720	84.139
	Between	18.589	17.087	18.587	17.065	12.279	15.860
ITHC	Within	93.128	92.746	90.545	89.898	90.213	91.344
	Between	6.871	7.253	9.454	10.101	9.786	8.655
ID	Within	91.580	91.324	91.598	89.980	93.103	93.811
	Between	8.419	8.675	8.401	10.019	6.896	6.188

The unweighted average productivity (the within component) has changed little over the studied period indicating that the changes in the efficiency of the allocation of inputs and the restructuring process was not very important and not sufficient to lead to an increase in the overall productivity.

To put it in a nutshell, Tunisian liberalization reforms were in their first active stage in the observed period, which entails considerable structural adjustment in manufacturing activities that had so far been sheltered from competition. So one possible explanation for the stagnation in productivity growth and in its components is that improvement in competitiveness and productivity was expected to occur as the liberalisation of the economy led to more efficient resource allocation.

The sluggish adjustment in productivity growth conforms to the imperfections in the Tunisian factors markets. These include wage rigidity and Institutional factors, like exit and entry barriers. Various frictions inhibit factor mobility in the Tunisian industrial sector; these include several laws that prevent firms from firing workers and regulations that limit the establishment of new firms and the termination of old ones. Exit costs also include bankruptcy expenses or severance payments to employees. Entry costs also include licensing fees and irreversible purchases of capital goods.

In sum there is a temporal gap between the announced deregulation reform and the facts in Tunisia.

Regulations and limits upon factor mobility in Tunisia in the considered period are likely to impede adjustment and dilute the benefits of competition. This is mainly due to the government's concern with maintaining social stability and preparing companies for competition. In fact, Tunisia has adopted a gradual liberalization program.That why the PTF growth path remains unaffected, in the short run, and firms adjust to greater competition through other changes such as reduction in profit margins.

To take into account the existence of adjustment delays, we will use a dynamic adjustment process in the econometric modelling in the next section.

5.2. Impact of competition on TFP

To analyse the impact of competition on firm's productivity, we will use an econometric investigation. Our main specifications (4), from the direct approach, and (6), from the indirect approach are estimated.

To handle the causality problem between productivity and competition (higher productivity growth in a firm would tend to increase its market power and reduce competition), we treat the competition variables as endogenous and we also lag the competition variables one or two years (Nickell, 1996).

The equations (4) and (6) are only observed if firm i is a survivor at time t. To handle the sample selectivity bias due to entry and exit, we use an auxiliary equation containing variables that captures the probability of the firm surviving. The probability of staying in the market is a function of future profits which are positively related to the investment effort and to the size of its capital stock. We use the Heckman's procedure in a first step and we introduce the inverse mills ratio in the models to handle the selectivity bias.

Table 6 reports the estimation results of the dynamic productivity growth function defined by equation (4) and estimated by the system generalized method of moment (GMM). Table 7 reports the estimation results of the dynamic production function augmented by competition measures and defined by equation (6). We use the GMM suggested by Blundell and Bond (1998) as indicated above.

To avoid multi-colinearity problem among competition related variables we performed different regressions with each individual competition measure included. The different columns in tables 6 and 7 report the results with different measures of competition: the price cost margin, the market share, the import penetration and the TPE.

The number of observations is not identical for market share and price cost margins because some observations are differently missing with each other.

Table 6. Dependent Variable : TFP (equation 4)

	(1)	(2)	(3)	(4)	(5)
$(TFP)_{t-1}$	.8625 *** (.0420)	.5719 *** (.5719)	.7873 *** (.0428)	.5031 *** (.0559)	.6361 *** (.0621)
$(marketshare)_{t-1}$		-.4941 *** (.0360)		-.4379 *** (.0411)	-.4631 *** (.0584)
$(Price\ cost\ margin)_{t-1}$	-.2122 *** (.0254)		-.1969 *** (.0245)		
$(importpenetration)_{t-1}$			.2198*** (.0310)	.2010*** (.0292)	
Tex_{t-1}					.0659 (.1159)
Petrangere					.0019 ** (.0009)
Inverse mills	.0526 (.3053)	-.0390 (.2023)	-.1824 (.2902)	-.0297 (.3161)	.1872 (.4115)
Observations	2952	5400	2951	4346	2201
AR(1)	-5.7293 (p=0.0000)	-7.2162 (p=0.0000)	-5.6728 (p=0.0000)	-4.3856 (p=0.000)	-4.4053 (p=0.0000)
AR(2)	1.5179 (p=0.1290)	.97386 (p=0.3301)	1.1138 (0.2654)	.88729 (p=0.3749)	1.7131 (p=0.0867)

Sample Period: 1997-2002.
GMM estimates: The equations are estimated using the dynamic panel data model based on Blundell and Bond (1998).
*Standard error in brackets. * significant at 10%, ** significant at 5%, *** significant at 1%.*
All computations are done using STATA.
Asymptotic standard errors are reported in parentheses.AR(1) and AR(2) are Arellano-Bond tests that average autocovariances in residuals of order 1 and 2 are zero, i.e., they are tests for the null on no first-order and second-order serial correlations.

The competition measures are considered as endogenous. Consequently, these are instrumented by their lags (t-3 and earlier).

The validity of the instrument set is checked using a Sargan test. This is asymptotically distributed as chi-squared under the null. The instruments used in the first differenced GMM or in the system GMM are not rejected by the Sargan test of over-identifying. Tests of no serial correlation in the vit (M1 and M2) provide evidence to suggest that this assumption of serially uncorrelated errors is appropriate in the dynamic model as is shown in the different columns.

In the context of our models specified in first differences, we measure the impact of changes in the level of product market competition on productivity growth.

Table 7. Dependent Variable : Log(y) (equation 6)

	(1)	(2)	(3)	(4)	(5)
$ln(y)_{t-1}$	.6492 *** (.0636)	.6071 *** (.0379	.6173 *** (.6173)	.5235 *** (.0484)	.6078 *** (.0630)
$ln(L)_t$	.1363 *** (.0424)	.1593 *** (.0364)	.1356 *** (.0415)	.1641*** (.0412)	.2342 *** (.0764)
$ln(K)_t$	.2234 *** (.0617)	.1221 *** (.0258)	.2134 *** (.0620)	.2027 *** (.0527)	.1625 *** (.0577)
$(marketshare)_{t-1}$		-.3775 *** (.0450)		-.3451*** (.0508)	-.2882 *** (.0633)
$(Price\ cost\ margin)_{t-1}$	-.1442 *** (.0167)		-.1396 *** (.0165)		
$(importpenetration)_{t-1}$			.1662 *** (.0266)	.1029 *** (.0318)	
$Text_{t-1}$					.0114 (.1008)
Petrangere					.0028 *** (.0008)
Inverse mills	.4753 ** (.1979)	.0697 *** (.1220)	.3585 ** (.1587)	.0222 (.1979)	.0802 (.2702)
observations	2972	5444	2971	4376	2207
AR(1)	-5.0738 (p=0.0000)	-5.9385 (p=0.0000)	-5.1259 (p=0.0000)	-3.8789 (p=0.0001)	-4.052 (p=0.0001)
AR(2)	.88728 (p=0.3749)	2.0058 (p=0.0449)	.34198 (p=0.7324)	1.1856 (p=0.2358)	1.8238 (p=0.0682)

Sample Period : 1997-2002.
GMM estimates : Blundell and Bond (1998).

The results suggest that there is a positive impact of competition change on productivity growth. The coefficient for the industrial competitive measure, the import penetration ratio, is positive and significant at the 5 per cent level; this reveals a significant cross-sectional effect of competition on productivity growth. The coefficients for the firm measures of competition, the market share and the price cost margin, are negative and significant at the 5 per cent level. This suggests, as expected, that firm exposed to more competition and having less power in the market achieve a positive change in productivity. A 10 per cent decrease from the mean margin implies an increase on productivity of 1.9 per cent per year. A 10 per cent decrease from the mean market share implies an increase in productivity of 4.9 per cent. The coefficient associated to the past productivity growth in equation (4) is positive and statistically significant, indicating a positive trend effect.

The results also revealed a positive and significant relationship between foreign participation rate and productivity. Firms with high foreign capital participation are more productive than those with low foreign capital participation. Participating in export market and developing partnerships with foreign investors brings firms into contact with international best practices and fosters learning, and efficiency growth.

The coefficient of the ownership structure at firm level provides support for the hypothesis that private firms are not automatically more productive than public firms.

As for the protection variable, we obtain insignificant coefficient on the variable that captures protection (tpe).

Finally and in table 8 we consider specifications with a quadratic term on the right hand side of our productivity growth regression to test the fact that the relationship between productivity and competition is U-shaped as suggested by Aghion and al (2005). The relationship between competition and productivity would be an inverted U-shape, where productivity growth is highest at intermediate levels of competition. At higher levels of competition firms' incentives to invest in innovation disappear and firms moderate their productivity growth (Segarra and Teruel, 2006).

Evidence from our firm level data base is consistent with the non-linearity of the relationship between productivity growth and product market power. The coefficients associated to the quadratic terms are negative and statistically significant in table 8. The inverted U specification is supported by the results. This confirms the presence of Schumpeterian effect when the level of competition is higher.

In Sum, Our results suggest that competition has a dual impact for Tunisian firms. At low level of competition, more competition has a positive impact on firm productivity, yet with high levels of competition , a rise in competition has a negative impact on productivity, the Schumpeterian effect appears and the capacity of firm to innovate decreases.

Intensified competition (particularly competition due to trade openness) could discourage efforts for invention by lowering expected potentials profitability of a successful innovation. A country with abundant unskilled labour may be led by trade to specialize in traditional low technology manufacturing, and international competition with a technologically advanced country can bring about a slowdown in innovation and productivity growth in a country with a disadvantage in research productivity (Sharma, 2000). Tunisia is far from the world's technological frontier and then an excessive external competition plays a negative role in productivity growth.

Actually, Tunisia tends to specialize in products and industries that exhibit less linkage, spill over and potential for productivity than others. Since the independence, Tunisia choose the anchoring in Europe as a credo which strengthen the international specialisation (the South: bases technology, the North: high technology). Unrestricted border trade with the European Community (EC) since 1995 has led Tunisia to continue to buy high technology goods from the EC at competitive prices at the expense of its own economic viability. Tunisian industries choose the quicker option of importing the parts and components rather than encouraging parallel technology transfers to component manufacturers. Low innovation activity in firms and a limited use of in-house efforts, either for adaptation of imported technology or for locating technology imports, could explain the stagnation in productivity growth.

Table 8. Dependent Variable : Log(y) or TFP (equations 4 or 6)

	(1)	(2)	(3)	(4)
$(TFP)_{t-1}$			.8209*** (.0392)	.5085*** (.0639)
$\ln(y)_{t-1}$	.6231*** (.0559)	.6243*** (.0482)		
$\ln(L)_t$	.1350*** (.0409)	.1587*** (.0366)		
$\ln(K)_t$	.2255*** (.0562)	.1247*** (.0260)		
$(marketshare)_{t-1}$		-.2530 * (.1471)		-.8116*** (.1447)
$((marketshare)_{t-1})^2$		.0114 * (.0116)		-.0321** (.0134)
$(\text{Price cost margin})_{t-1}$	-.3716 *** (.0592)		-.5124*** (.0700)	
$(\text{Price cost margin})_{t-1})^2$	-.0298*** (.0072)		-.0399*** (.0084)	
Inverse mills	.4541 ** (.2049)	.0864 (.1300)	-.0642 (.2903)	-.2010 (.1511)
Observations	2972	5444	2952	5400
AR(1)	-4.1882 (p=0.0000)	-6.0169 (p=0.0000)	-5.4588 (p=0.0000)	-6.5869 (p=0.0000)
AR(2)	.73427 (0.4628)	|1.9985 (p=0.0457)	1.4844 (p=0.1377)	.9276 (p=0.3536)

Sample Period : 1997-2002.
GMM estimates : Blundell and Bond (1998).
First and second column are for log(y), third and fourth columns are for TFP.

From a policy perspective and to gain from competition, even at a high level of competition, Tunisian authorities must sustain firms to be more innovative. Policies that promoted competition could be appropriate when accompanied by an incentive program to assist and sustain industry to be more innovative. Tunisian government needs to set a favourable climate for innovation. Further progress in structural reforms such as setting up institutions to deal with contracting issues and to promote innovation as well as devising an effective legal and regulatory framework need to be quickly implemented in Tunisia. Tunisia needs to stimulate innovative activity in a more competitive environment using different instruments as: fiscal policy, technical assistance, developing institutions that promote innovation and support protection of intellectual property, patent copyright enforcement, funding incentives...

6. CONCLUSION

In this study we first analyse the evolution of product market competition in Tunisian manufacturing sectors and then we explore the relationship between productivity growth and competition change in the Tunisian manufacturing sector. Two different methods were used to explore this relationship, the direct and the indirect one. Some econometric problems were handled, such as the endogeneity of the regressors and the selectivity bias. In this study we pay particular attention to the measure of productivity, we use a productivity measure that is based on consistent estimates of the production function coefficients. The sensitivity of our results to different specifications and to different measures of competition is also tested.

Our main findings are:

Tunisia has adopted a gradual liberalization program. Adoption of liberal economic policies in Tunisia has led to a decrease in the price cost margin as proxy of market power at the industry level, particularly since 2000. These results are in favor of more competitive environment in the Tunisian manufacturing sector particularly in the IAA and ITHC sectors.

But when looking for the productivity evolution by sector we find that productivity stagnated over the studied period. The evidence in this paper indicates that productivity growth over 1997-2002 for the key manufacturing sectors has been minimal. We measure the contributions of external and internal restructuring to productivity growth. The results show that internal restructuring accounts for over 90% of TFP growth, very little of TFP growth is due to external restructuring. Moreover, the two components stagnated over the studied period.

In fact, the liberalization reforms were in their first active stage in the observed period, as Tunisia has adopted a gradual liberalization program. This is mainly due to the government's concern with maintaining social stability and preparing companies for competition. Institutional factors, like exit and entry barriers, may also slow down the long-term adjustment process. For instance, the fact that the Tunisian government is concerned about social welfare suggests that it will be difficult to implement substantial liberalisation reforms. Therefore, any short run stagnation in productivity may be purely temporary. Our analysis needs to be reconducted for a longer period (after 2003), covering an extended period of the liberalization program, to evaluate the long-term impacts of liberalization, when all factors are reallocated.

Policies could help palliate the transitional costs while taking care not to hinder the reallocation process. The policies that hinder the reallocation process or otherwise interfere with the flexibility of the factor markets may delay or even prevent a country from reaping the full benefits from liberalisation (Melitz, 2003).

Whether considering a direct approach or an indirect one to investigate the impact of competition on productivity, our results suggest that, at low competition level, more competition raises TFP at the firm level. Competition policies provide sufficient incentives to increase productivity growth at firm level. Yet with high levels of competition, a rise in competition has a negative impact on productivity, the Schumpeterian effect appears and the capacity of firm to innovate decreases. This finding is robust to several econometric specifications and various measures of competition. Controlling for selectivity bias and for potential endogeneity of regressors does not change the finding.

There may be important policy implications of our work. A policy measure that deprives firms of market power may conduct to productivity growth. Policies that promoted competition could be appropriate. But, to gain from competition, even at a high level of competition, Tunisian authorities must sustain firms to be more innovative.

To make its liberalisation process work effectively for productivity growth, Tunisia needs to make further progress in structural reforms such as setting up institutions to deal with contracting issues and to promote innovation. Tunisia needs to stimulate innovative activity in a more competitive environment using different instruments as: fiscal policy, technical assistance, developing institutions that promote innovation and support protection of intellectual property, patent copyright enforcement...

With a more open policy environment and increased competition, Tunisian industries must realise that to bridge the technological gap, they need to direct their efforts to building capabilities for technology generation, rather than depend on imports.

Thus, appropriate reforms appear to be essential if the potential benefits of liberalisation and competition are to be fully achieved.

ANNEX 1.
(Olley and Pakes, 1996)

Olley and Pakes (1996) consider that the capital is specified according to the following function

$$K_{it+1} = (1-\delta)K_{it} + I_{it} \quad (1)$$

where I is investment and δ is the rate of capital depreciation.

As regards the investment function, it is defined according to w_{it} and k_{it}

$$i_{it} = f_t(w_{it}, k_{it}) \quad (2)$$

The investment is strictly monotonous according to w_{it}.

So, inverse function is defined by (Arnold, on 2005) :

$$w_{it} = f_t^{-1}(i_{it}, k_{it}) \quad (3)$$

The production function can be written as follows:

$$y_{it} = \beta_l l_{it} + \beta_k k_{it} + f_t^{-1}(i_{it}, k_{it}) + e_{it} \quad (4)$$

In this perspective, we define

$$\phi(i_{it}, k_{it}) = \beta_k k_{it} + f_t^{-1}(i_{it}, k_{it}) \quad (5)$$

Olley and Pakes (1996) suggest an approximation of the function ϕ by a high, usually 3rd or 4th order polynomials in log investment and log capital.

In a first stage, we can estimate the labour elasticity β_l.

In a second stage, we can estimate capital elasticity β_k

In this perspective, we shall define

$$v_{it} = y_{it} - \hat{\beta}_l l_{it} \quad (6)$$

and we estimate

$$v_{it} = \beta_k k_{it} + w_{it} + e_{it}$$

Assuming that productivity is a markovian processus:

$$v_{it} = \beta_k k_{it} + g(\phi_{t-1} - \gamma\ k_{t-1}) + \mu_{it} + e_{it} \quad (7)$$

where g is an unknown function of lagged values of $Ø_{t-1}$ and capital k_{t-1}. We estimate equation 12 by non-linear least squares.

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LA CONCURRENCE ET LA CROISSANCE DE LA PRODUCTIVITÉ DANS LES ENTREPRISES MANUFACTURIÈRES TUNISIENNES

Résumé - *L'objectif de ce travail est d'étudier l'impact de la concurrence sur la croissance de la productivité (PTF) dans le cas des entreprises manufacturières tunisiennes. Nous utilisons différentes mesures de la concurrence au niveau de la firme. Les méthodes statistiques et économétriques nous permettent de tester la robustesse de nos résultats aux changements de méthodologie et aux changements des mesures de la concurrence. Nous utilisons une base de données d'entreprises manufacturières tunisiennes observées durant la période 1997-2002 et une base de données sectorielles portant sur les industries manufacturières tunisiennes observées durant la période 1983-2007. Nos principaux résultats montrent que, pour un niveau de concurrence initialement faible, l'intensification de la concurrence entraine une amélioration de la PTF via plus d'incitations à l'effort et une amélioration de l'efficacité au niveau de l'entreprise. Cependant, lorsque le niveau de concurrence est initialement important, une intensification de la concurrence entraîne un effet négatif sur la capacité des entreprises à innover et ainsi sur la productivité (effet Schumpeter).*

Mots-Clés : CONCURRENCE, PRODUCTIVITÉ, PARTS DE MARCHÉ, INDUSTRIE MANUFACTURIÈRE, TUNISIE, MÉTHODE GMM