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Abstract

The aim of the present paper is to analyze the impacts of the upgrading policies adopted by Morocco for almost ten years. We apply the stochastic frontier approach initiated by Battese and Coelli (1995) to a panel of 282 firms from Morocco during the period [1998–2005]. Such parametric methodology leads to estimating the technical efficiency for Moroccan firms and we obtain an average of no more that 13.3 percent, which is considered very low. Yet what is important is the possibility to conduct, in a second stage, an evaluation of the impact of some environmental factors on pure technical efficiency. In this sense, improvement of technical efficiency is detected for firms which have officially subscribed in the upgrading process.

ملخص

تهدف هذه الورقة إلي تحليل الآثار المترتبة على سياسات رفع الكفاءة التي انتهجتها دولة المغرب منذ حوالي عشر سنوات. و قد قمنا بتطبيق نموذج تحليل الحد العشوائي لباتيس و كولي (1995) علي مجموعة مكونة من 282 شركة من المغرب في الفترة من 1998-2005. و هذه المنهجية القياسية تؤدي إلى تقدير الكفاءة الفنية للشركات المغربية التي لا تزال منخفضة للغاية حيث حققت معدل لا يزيد عن 13.3%. ولكن الأهم هو انه يمكن في المرحلة الثانية إجراء تقييم لتأثير بعض العوامل البيئية على الكفاءة الفنية. و بناءا علي ذلك, فالكفاءة الفنية يتم البحث عنها في الشركات التي اشتركت رسميا في عملية رفع الكفاءة.

1. Introduction

Since the beginning of the 90s, Southern Mediterranean countries have been urged to build a competitive industry by modernizing their firms and diversifying their products in order to take advantage of the Euro-Mediterranean Integration Process. Countries like Egypt, Jordan, Morocco and Tunisia have since implemented upgrading policies and have tried to improve the competitiveness of their firms.

In a broader sense, upgrading policies are considered processes by which the performances of the firms are boosted in order to survive in an open and competitive context. These policies aim to improve both the competitive capacity of the firm and also the environment and infrastructure of the industry. In practice, there are no standard rules to follow. Southern Mediterranean countries have taken the Euro-Mediterranean free trade area as an opportunity to finance these policies and each country has implemented its own set of policies in a trial and error process (Achy et al., 2007).

Ten years after the launch of these specific policies, there is little empirical evidence of their impacts and efficacy. However, two papers have begun to scratch the surface. The first, (Cammett, 2007), discussed the implementation of these policies in Morocco and Tunisia and the efficacy of the institutional settings adopted and showed the sensitivity of the performance of these policies to institutional designs. However, the author had little to say on the economic performances of the firms. The second paper, that of Goaïed and Jendoubi (2007), tried to analyze the impacts of the upgrading policies adopted in Tunisia through examining the performances of 1,440 firms. Applying a non parametric frontier analysis, the paper concluded that the technical efficiency of Tunisian firms was still low (around 53.1 percent).

The aim of the present paper is to contribute to this line of research by analyzing the impacts of the upgrading policies adopted by Morocco ten years ago. We apply the stochastic frontier approach initiated by Battese and Coelli (1995) to a panel of 282 Moroccan firms during the period [1998-2005]. Such parametric methodology leads to estimating the technical efficiency for Moroccan firms, which is still considered very low as demonstrated by the resulting average of no more than 13.3 percent. However, what is important is the possibility to conduct a second stage evaluation of the impact of some environmental factors on pure technical efficiency. In this sense, improvement in technical efficiency is detected for firms which are officially subscribed in the upgrading process.

This paper is structured as follows. Section 2 presents the specifics of the upgrading policies which have been undertaken by Morocco almost ten years ago. Section 3 discusses the theoretical debate on upgrading policies with a focus on the main variables for the empirical study. Section 4 presents the econometric methodology and a description of the data. Section 5 discusses the findings and empirical results. Finally, Section 6 offers concluding remarks.

2. Upgrading Programs in Morocco

During the last decade, Morocco, among other MENA countries embarked on a relatively comprehensive upgrading program to modernize its manufacturing industries so as to face the challenges resulting from the free trade zone with the European Union (EU).

The manufacturing sector in Morocco represents around 17 percent of GDP and employs 12 percent of the labor force. The sector's share in GDP has remained roughly unchanged over the last two decades. The formal manufacturing sector is made of some 7,000 firms operating in various industries. Although some evolution has been recorded in the structure of the manufacturing sector since mid-eighties, it has not led to any significant transformation. Three industries continue to dominate the sector either in terms of employment, exports or value added; agro-food, textile and garments and chemical and par chemical industries.

Metallic and metallurgic industries are less important in terms of their contribution to output and exports, and their sales are mainly domestic. Over the last two decades, these industries witnessed a dramatic decline in state capital ownership. Electric and electronic industries' still remain of limited importance in terms of production and employment; however their their share in foreign markets is dynamically increasing. Foreign ownership is high in these industries, representing more than 40 percent of their total capital.

For a long time, Morocco's manufacturing sector has been characterized by its high specialization, its economic and geographic concentration, its limited domestic competition and its low exposure to international competition. Where size distribution is concerned, the manufacturing sector in Morocco appears to be highly concentrated with few dominating firms. More than 90 percent of manufacturing firms are small and medium enterprises (SMEs) with less than 200 employees. Although large firms do not represent more than eight percent in terms of their number, their sales amount to 63 percent of total manufacturing sales, their value added amounts to 70 percent and their exports to 72 percent. Even in terms of employment, large firms contribute by roughly 58 percent to total manufacturing employment. Overall, large firms appear to be more stable as indicated by their older age, higher labor productivity, tendency to pay higher wages and generation of higher profits compared to SMEs. Finally, large firms are foreign or state-owned. Conversely, SMEs seem to be largely owned by Moroccan private capital.

The manufacturing sector in Morocco, similarly to other countries in the MENA region, developed in the sixties and seventies under the import substitution strategy. Most industries benefited from protection through tariff and non-tariff barriers such as import licenses, quotas and exchange rate restrictions. Since the early eighties, the Moroccan authorities have decided to switch from a closed import substitution economy with a relatively large public sector to a market oriented economy with liberalized trade. The country speeded up the process of economic reforms in the nineties with the aim of increasing efficiency to withstand competition and foster growth and development.

In that context, the restructuring policy—more commonly referred to as upgrading programs—emerged in the mid nineties following the signature of the Free Trade Agreement (FTA) with the EU. The main features of the agreement are (1) progressive elimination of all tariffs on industrial goods over 12 years leading Morocco to dismantle the protection on the industrial goods imported from EU, since its industrial exports already received preferential customs treatment, (2) gradual and limited liberalization for agricultural products, (3) adoption of a wide range of trade-related regulations such as harmonization of rules and regulations in the fields of competition, intellectual property, and industrial standards. Upgrading was perceived as a necessary step to prepare the Moroccan economy for competition challenges induced by the FTA. However, there was some confusion on who will fund the upgrading strategy (EU resources versus local resources) and who will lead it (state leadership versus private sector leadership).

In Morocco, unlike Tunisia, the process of upgrading known as *Programme de Mise à Niveau* (PMN) has been mainly a private sector initiative backed by EU funding. Only recently has the Moroccan government started being proactive towards the restructuring of firms. In the early stages of the upgrading process, the government restricted its action to correcting market frictions to ensure that firms get access to finance, regardless of their size. The government's underlying assumption was that financial constraints impeded the firms' restructuring efforts. However, the state's approach has gradually evolved over the last decade. Between 1997 and 2002 no specific institution was dedicated to firms' upgrading issues and progress results were disappointing. In 2002, a national agency in charge of SMEs was created with the main task of managing upgrading resources under MEDA program. In

2003, the National Upgrading Fund (FOMAN) was created with funds from the EU and the Moroccan government.

The upgrading policy in Morocco is made of a collection of initiatives and programs with different contents and targeted firms depending on the founders' preferences. The upgrading guide had a list of 30 upgrading services by the end of 2007. They included programs of technical assistance, provision of guarantees to get access to banking resources and programs supporting firms' equity and incentives to upgrade equipments. Eligibility criteria differed from one program to the other.

The main upgrading program in Morocco was designed with the specific objective of modernizing SMEs. It benefited from EU funding and has been endowed with 13 million Euros since its initiation. The program provides 90 percent of the cost of technical assistance for eligible applicant firms and the rest is paid by the firm itself. Eligibility criteria are as follows. First, the firm has to be created under the Moroccan law, which means the branches of multinational firms are not excluded. Second, the firm needs to exist on the market for at least two years before it can apply for assistance. Third, the firm should provide jobs for at least 20 employees with an annual turnover of at least 2.5 million DH[1] with at least 50 percent originating from manufacturing activity. For firms providing support services to the industry, the number of employees should be at least 10 with at least three executives, and its turnover should be at least 1 million DH. This second program also benefited from FOMAN; in addition to technical assistance, FOMAN provided funds for material investments.

3. Literature Review

There is an economic consensus on the impacts of free trade on the composition of industrial sectors and their performance when the free trade area covers unequally developed countries. Industries of Less Developed Countries (LCDs) perform better within free trade. Tybout et al., (1991), Haddad (1993), Haddad and Harrisson (1993), Tybout and Westbrook (1995), and Harrisson (1996) show that free trade practiced by LDCs has an impact on the efficiency of their firms. From a theoretical point of view, Navaretti and Tarr (2000) show that this improvement is due to three complementary channels: importation of new machinery and intermediate goods, exportation of services and goods more adapted to consumers' preferences and industrial alliances between Northern and Southern firms.[2] The development of East Asian countries and ex-communist countries during last decades has given empirical evidence on this thesis.

In all cases, transition periods are often observed, and LCDs are recommended to upgrade their firms prior to a "full" free trade regime. Upgrading policies were recommended and pursued in different areas (Latin America, Asia, Central and Eastern Europe, and more recently in MENA countries). These policies are viewed as industrial and commercial policies seeking to improve the performance of LCDs' firms to be able to compete in a more open context (free trade). In actuality, upgrading policies are industrial policies since they affect the structure, behavior and performance of firms. At the same time, they seem very close to a temporary protectionist policy (infant industry argument). They include temporary protection policies for the domestic firms in order to consolidate their advantages.

An emerging industry cannot operate at an optimum least-cost output until it has reached a sufficient size to benefit from significant economies of scale (Hill, 1988). A new industry, especially one in a developing country, will always be in a competitively vulnerable position

[1] The Moroccan currency is the Dirham (1 DH=0.124$ currently).

[2] Linked to this dynamic, Navaretti and Carraro (1999) point to the increasing number of multinationals that transfer their R&D centers to Southern countries.

compared with an established industry in a developed country. The protection of these infants has been interpreted by Weiss (1988) as an investment by a society that demands short-term costs, for the long-term benefits that emerge when the infants mature and become internationally competitive.

Without this intervention and protection, the probability of surviving is very low. In the context of FTAs, most developing countries have negotiated laps of time for their firms to adapt to this new context. But this opportunity seems to be diminishing.[3]

Upgrading policies in developing countries are at the heart of three economic debates at least. The first one relies on industrial dynamics and tries to define upgrading policies and their content; the second one is concerned with the channels by which upgrading policies affect firms' performances; and the last one is related to empirical evidence of these industrial policies' impacts on economic performances.

(a) Are upgrading policies industrial policies?

Upgrading policies is an overused concept and a poorly defined one in economic literature. From a theoretical point of view, industrial upgrading refers to different processes which include increasing the skill of local production, moving into market niches that are relatively insulated from competition on global markets, and expanding the range of activities in a given value chain carried out within a firm or cluster of firms (Humphrey and Schmitz, 2002). In conclusion, this policy seeks to increase efficiency, competitiveness and profitability. Humphrey and Schmitz (2002) also mention that private institutions are capable of conducting these policies without needing public agencies.

For Mathews (2006), upgrading policies have at least ten objectives: "Changing industrial structure, insertion in regional and global value chains, institutional and economic learning, firm and industry creation, export orientation and import substitution, firm formation and selection, formation of development blocks and clusters, internationalization and globalization of firms, and closing the gap and maintaining the development perspective."

Cammett (2007) thinks that we can separate the upgrading policies into two levels. "In its earlier stages, upgrading focuses more on expanding the range of activities carried out within the chain value and moving into market niches rather than on boosting the skill content of local production." More complex programs for increasing the quality and the value added are pursued afterwards.

According to these definitions, it seems clear that upgrading policies are industrial policies affecting the structure, the behavior and the performance of the firms.

(b) The impacts and the channels of upgrading policies

Mathews (2006) suggests "economists tend to focus more on aggregate outcomes of industrial development and treat policy influences on firms as a 'black box'. To examine the effectiveness of industrial policy, it is essential to peer into the box to understand how government policy causes performance differentials by changing firm behavior." In addition, both the course and the outcome of an industrial policy implementation process are affected by a great variety of factors, and the effects of these separate factors cannot be isolated (Hung, 1999).

[3] Wade (2003) thinks that "the 'development space' for diversification and upgrading policies in developing countries is being shrunk behind the rhetorical commitment to universal liberalization and privatization. The rules being written into multilateral and bilateral agreements actively prevent developing countries from pursuing the kinds of industrial and technology policies adopted by the newly developed countries of East Asia, and by the older developed countries when they were developing, policies aimed at accelerating the 'internal' articulation of the economy".

Upgrading policies impact the firms' production efficiency through three complementary channels:

(i) Upgrading policies help firms to reach the necessary size to benefit from scale economies (Tybout, 2000). In fact, most of LDCs' firms are small or medium sized, making them unable to compete in terms of pricing, since their costs are high. Hence, they need protection in order to increase their size and to benefit from scale economies. Yet, it may be more about rationalizing production and cost-cutting and less about size of the firm. Concentration of the industry may play a key role in achieving better returns (Kaplinsky et al., 2002). In any case, by achieving scale economies firms' efficiency is expected to increase.

(ii) Upgrading policies aim at improving the technological capabilities of the firm and encouraging the use of more efficient technologies. LDCs' firms are under using the technological possibilities open to them nowadays. They are under using both general purpose technologies and the more advanced and appropriate technologies (Bellon et al., 2007). The cost of these technologies, the intellectual propriety rights and the lack of trained and well-educated workers are among the most known arguments. Starting from these considerations, upgrading policies seek to improve the technological capabilities of the local firms and to help them acquire more advanced machinery and promote innovative activities. Innovation and using advanced technologies impact the firms' efficiency.

(iii) Upgrading policies prepare LDCs' firms for the more competitive contexts (open economy). Firms move from protected positions and soft competition to a dynamic process of competition. This process impacts their attitudes and their efficiency. Imitation of best practices in terms of marketing, pricing, distribution and innovation is expected.

Using the value chain analysis to understand the impacts of upgrading policies, Humphrey and Schmitz (2001) suggest three main areas of upgrading: products, processes and functional, which is the capacity to change the performance mix. Across a number of sectors we can observe a growing confluence between value added (and the resulting incomes which are sustained) and the degree of intangibles (particularly design, branding and marketing) for which producers are responsible.

(c) Empirical studies on upgrading policies impacts on firms' performance in the MENA region

There is a plethora of empirical literature on upgrading policies in Latin America, Asia and South Africa[4] (Kaplinsky et al., 2002). However, only a few studies have addressed the impact of upgrading policies in North Africa. From an institutional perspective, Cammett (2007) concluded that the impact of these programs was very limited, especially in the Moroccan case. In their recent report, Achy et al., (2007) demonstrate a positive effect between upgrading policies pursued by North African countries and employment, sales and debt. However, these effects are less important in terms of investment, productivity and exportation. The upgrading policies in Morocco have not followed the traditional trend in relation to rationalizing costs and increasing efficiency and productivity. The firms tried to benefit from their temporary protection to raise their sales in the domestic market. Little attention was given to the future context of liberalization. More recently, Goaïed and Jendoubi (2007) have calculated the efficiency frontier in the case of Tunisia for 1,440 firms

[4] Kaplinsky et al., (2002) suggest that the buyers and especially the *"donneurs d'ordre"* have a critical role in upgrading LDCs' firms. The standards help them to achieve these goals. In the case of South African furniture industry, they found that the upgrading policies had achieved their objectives. However, they mentioned that this sector was concentrated, which may have played a major role in the upgrading process.

that followed upgrading policies and found little impact. The technical efficiency of Tunisian firms calculated through the non-parametric method was relatively low at about 53 percent.

4. Econometric Modeling and Data Description

In order to examine the effect of upgrading programs on the efficiency of small and medium manufacturing firms in Morocco, the stochastic frontier approach is adopted. The methodology developed by Battese and Coelli (1995)[5] in the context of panel datasets is adjusted for the case of Morocco. The model provides estimates of inefficiency levels in an appropriate manner, and explains inefficiencies in terms of potential explanatory factors. In fact, from a theoretical point of view, several studies shed some light on the concept of inefficiency in production. The gap between an optimum to be reached and the effective realization could have a damaging and negative impact on both economic and financial performance of firms. Some factors directly related to the firm[6] or to its external environment[7] are conceived to be responsible of variations in the firm's performance.

Since it is very difficult for an analyst to quantify the producer's real potential, as well as his capability to achieve that potential, the stochastic frontier approach was developed in order to take this uncertain behavior of firm managers into account.

A stochastic frontier production function could be defined as follows:

$$\log Y_{it} = \log(f(X_{it}, \beta)) + \upsilon_{it} - u_{it} \qquad (1)$$

Y_{it} is the observed level of production of firm i at time t. Indeed, this observed level of output is obtained firstly with a given technology according to a well known fundamental relationship written as follows:

$$\log Y_{it} \leq \log(f(X_{it}, \beta)) + \upsilon_{it} \qquad (2)$$

X is the vector of explanatory variables (inputs and outputs prices and firm-specific variables, etc.). β is the vector of unknown parameters to be estimated. υ is a two-sided normally distributed error term with zero mean and variance σ_{υ}^2, while u is a positive half-normal error term capturing inefficiency effects. It is assumed also that υ and u are independent over time and across firms. Finally, f(.) denotes a production function with usual forms such as Cobb-Douglas or Translog functional forms. It corresponds to the deterministic production frontier. The inequality in expression (2) shows that observed output Y_{it} is bounded above by the stochastic production frontier $\log(f(X_{it}, \beta)) + \upsilon_{it}$ where the error term υ is included in order to capture the effects of statistical noise on observed output that are errors of observations and measurement. Within this context of stochastic production frontiers, one is able to distinguish between what is possible (the deterministic production frontier f(.)) and what is influenced by external events beyond the control of firms (error term υ). Next, from inequality (2), we move directly to equation (1) through the introduction of the second disturbance term u which is positive. It captures the effect of technical and economic

[5] The first formulations for the cross-sectional case is due to Aigner et al., (1977) and Meeusen and van den Broeck (1977), while Pitt and Lee (1981) were the first to develop estimation techniques used for stochastic frontier production functions in the panel data context.

[6] Greene (2008) speaks about two sources of inefficiency: technical inefficiency when the chosen inputs (levels and possible combinations) lead to a level of output which falls short of the optimum, and allocative inefficiency which reflects initial suboptimal input choices given prices and a desired level of output.

[7] These external factors are considered as random. They reflect random variation in the behavior across firms or over time for the same firm. So we are in the context of stochastic frontier as opposed to the deterministic approach where inefficiency is solely due to the firm's production strategy.

inefficiency on observed output. The term $\exp(u_{it}) \geq 1$ is defined as the technical efficiency and has to be estimated.[8]

Simultaneously, Battese and Coelli (1995) assume that the non-negative technical inefficiency effects vary over time and depend on other firm-specific variables. The question of variability or invariance of inefficiency over time was debated in earlier studies in a cross-sectional or panel data context. Pitt and Lee (1981) note that the case where firm inefficiency is time invariant only provides a measure of average efficiency for the used sample. In addition, the authors initiate a way to conduct tests of time variability against time-invariance, the former situation being nested in the latter. Panel data analysis especially offers the possibility to investigate whether the inefficiency of firms varies over time or is time invariant. In case of variability over time, one can also verify whether the inefficiency of a firm varies randomly or not. Here, we can observe the behavior of firms over time, which is not possible in the cross-sectional case. The time-invariance assumption was relaxed for the first time by Cornwell et al., (1990) and Kumbhakar (1990) by specifying the positive error term u_{it} as a function of time. In addition, Schmidt and Sickles (1984) confirmed the opinion according to which it may be incorrect to assume that inefficiency is independent of some explanatory variables.[9] Battese and Coelli (1995) created what they call the inefficiency model which defined as follows:

$$u_{it} = Z_{it}\gamma + \omega_{it} \qquad (3)$$

Error terms reflecting inefficiency u_{it} are considered independently and are identically distributed and obtained by truncation at zero of the normal distribution with mean $Z_{it}\gamma$ and variance σ_u^2. Z is the vector of explanatory variables associated with technical inefficiency of firms' production over time. γ is the appropriate vector of unknown parameters to be estimated. The random variable ω_{it} is defined by the truncation of the normal distribution with zero mean and variance σ_u^2 since the point of truncation is $-Z_{it}\gamma$. They need not be independently and identically distributed nor are they required to be non-negative.

The whole model (the stochastic frontier production function (1) and the inefficiency equation (3)) is estimated simultaneously using maximum likelihood since normality is attributed to error terms.[10] Such procedure leads to consistent and asymptotically efficient estimators especially when the number of firms is high and regardless the number of time observations. The log-likelihood function as presented in Battese and Coelli (1993) is defined as follows:[11]

$$\log L(\beta, \gamma, \sigma_\upsilon^2, \sigma_u^2; Y_{it}) = -\frac{NT}{2}\left(\log 2\pi + \log \sigma_S^2\right)$$
$$-\frac{1}{2}\sum_{i=1}^{N}\sum_{t=1}^{T}\left(\frac{(\log Y_{it} - \log(f(X_{it}, \beta)) + Z_{it}\gamma)^2}{\sigma_S^2}\right) - \sum_{i=1}^{N}\sum_{t=1}^{T}\left(\log(\Phi(d_{it})) - \log(\Phi(d_{it}^*))\right) \qquad (4)$$

[8] Here we adopt the definition of Debreu (1951) and Farrell (1957) giving technical efficiency as the ratio of maximum possible output over actual or observed output. Note that the reciprocal could be also used.

[9] Some of them could come from the production function or are associated with the technical inefficiency of firms' production over time.

[10] The distribution function of the sum of a normal variable and a truncated normal one was derived by Weinstein (1964).

[11] This log-likelihood is written for a balanced panel. The case of unbalanced panel could also be considered.

were $\Phi(.)$ is the cumulative distribution function of a standard normal distribution and:

$$\sigma_S^2 = \sigma_\upsilon^2 + \sigma_u^2 \tag{5}$$

$$d_{it} = \frac{Z_{it}\gamma}{\left(\lambda\sigma_S^2\right)^{1/2}} \tag{6}$$

$$d_{it}^* = \frac{(1-\lambda)Z_{it}\gamma - \lambda\left(\log Y_{it} - \log\left(f\left(X_{it},\beta\right)\right)\right)}{\left(\lambda(1-\lambda)\sigma_S^2\right)^{1/2}} \tag{7}$$

$$\lambda = \frac{\sigma_u^2}{\sigma_S^2} \tag{8}$$

The technical efficiency of production for each firm i at each period t is defined by the following equation:[12]

$$TE_{it} = \exp\left(u_{it}\right) = \exp\left(Z_{it}\gamma + \omega_{it}\right) \tag{9}$$

The prediction of these technical efficiencies is based on the conditional expectation of $\exp\left(u_{it}\right)$ given $\upsilon_{it} - u_{it}$. This expression is also found in Battese and Coelli (1993) and it is defined by the following expression:

$$E\left(\exp\left(-u_{it}\right)/\varepsilon = \upsilon_{it} - u_{it}\right) = \left(\exp\left(-\mu_{it}^* + \frac{1}{2}\sigma_*^2\right)\right)\left(\frac{\Phi\left(\left(\frac{\mu_{it}^*}{\sigma_*}\right) - \sigma_*\right)}{\Phi\left(\frac{\mu_{it}^*}{\sigma_*}\right)}\right) \tag{10}$$

where:

$$\mu_{it}^* = \frac{\sigma_\upsilon^2 Z_{it}\gamma - \sigma_u^2\left(\upsilon_{it} - u_{it}\right)}{\sigma_\upsilon^2 + \sigma_u^2} \tag{11}$$

$$\sigma_*^2 = \frac{\sigma_u^2\sigma_\upsilon^2}{\sigma_u^2 + \sigma_\upsilon^2} \tag{12}$$

In order to examine inefficiency improvement following the upgrading, we refer to some studies suggesting that existing environmental factors could affect firms' performance.[13] These factors could reflect differences in ownership type or structure, regulatory constraints, business environment, competition, etc. between firms in the sample. So, in a second step and within the panel data context, we regress the estimated technical efficiency measure (equation (9)) on an available set of environmental variables to account for exogenous factors that

[12] Initial studies involved the estimation of the parameters of the stochastic frontier production function and the mean technical efficiencies for the firms in the sample. It was claimed that technical efficiencies for individual sample firms could not be predicted. Individual predictions of technical efficiency were advanced at first time by Jondrow et al., (1982) for the cross-sectional case and Schmidt and Sickles (1984) for the panel data context.

[13] Several specific factors are discussed in Aigner and Chu (1968), Timmer (1971), Pustay (1978), Gumbau-Albert (2000), Salinas-Jiménez (2003), and Wu et al., (2003).

might affect the firms' performance.[14] In the same way, we could also appreciate any improvement due to subscription to the upgrading program.

The data we use is extracted from a global Moroccan dataset. For the purpose of this study we use a panel of 282 firms observed over the period [1998–2005]. Such firms are classified into four sectors of industrial activities: Agro-Food Industries (AFI), Textile Industry and Leather Clothing (TILC), Chemical Industries (CI), and Mechanical and Electrical Industries (MEI). Table 1 presents the distribution of firms across these categories. We observe the preponderance of firms belonging to TILC sector with a high proportion of about 64.5 percent. Morocco, like Tunisia in the MENA region, has been specialized since several decades in this worker-oriented industrial activity. Therefore, it is important for Moroccan authorities to encourage these firms to benefit from any upgrading process. AFI firms are also important since they are present about 13.1 percent of the sample followed by CI and MEI firms with around 12.8 and 9.6 percent, respectively. Of our sample, 59 firms (or 21 percent) are involved in upgrading programs. Yet Table 1 also shows an opposite sectoral trend in terms of benefitting from upgrading programs. Some 44.5 percent of MEI firms benefit directly from the programs followed by 27, 22.2 and 15.9 percent of AFI, CI and TILC firms, respectively. It seems that TICL firms, although largely present in the sample, are of a small size which is likely to prevent them from integrating the upgrading process.

For the estimation purpose and for the stochastic frontier model, the dependent variable is the level of output in logarithmic form while the inputs are the level of investment as a proxy for the flow of capital during a period and the yearly staff costs also expressed in logarithmic form. For the inefficiency model, the dependent variable is the technical efficiency measure resulting from the first stage of estimation. The explanatory variables are considered to explain any improvement in the efficiency of firms. Surely, such impacts should be highlighted through the event of upgrading programs. For this reason, we consider a dummy variable (PMN) which indicates whether the observer firms in the sample were subscribed in the upgrading process. The coefficient associated to this variable have to be positive if the upgrading process contributes directly or indirectly in improving firms' performance. If such coefficient is positive, then firms integrating the process become more efficient than the others. On the other hand, it is recognized that the structure of ownership could improve efficiency especially in the case of foreign ownership. We constitute a dummy variable named OWNER which takes value of one for foreign-owned firms and zero otherwise. The associated coefficient has also to be positive since improvement in performance is due to managerial restructuring in comparison to domestic firms. The size of the firm is considered important since big firms have more willingness to improve their performance than smaller ones. We consider the number of workers in logarithmic form (WORKER variable) as a proxy for size. Such variable have a positive impact on the considered technical efficiency measure. In addition, Gumbau-Albert (2000) suggests a quadratic effect of this variable as well as for the capital intensity defined by the capital-labor ratio in logarithmic form (K/L variable) and which might also exhibit a positive effect on efficiency. Another variable which is expected to have a positive impact on efficiency is the per capita income (wL variable) defined by the annual staff costs divided by the total number of workers. Finally, this variable is crossed with the dummy OWNER to detect eventual combined effect of foreign ownership and per capita income.

5. Empirical Results and Policy Implications

Estimation of the stochastic frontier model was conducted on STATA10 software. A specific command (xtfrontier) permits the estimation of the stochastic frontier model and provides the

[14] See Table 2 for a complete list of variables used in so called inefficiency model.

technical efficiency measure for each firm observed each year. Table 3 presents the estimation results for the complete model where translog specification is considered for the stochastic frontier model.[15] First, calculus of factors' elasticity in the sample's means shows the preponderance of labor as an input in the production process, which is typical of developing economies. We obtain 6.5 percent for capital elasticity and about 24 percent for labor elasticity.

Concerning the estimation of technical efficiency, we note that figures obtained from this sample are very low. Table 4 shows that the global mean of Moroccan firms' technical efficiency measure during the period [1998–2005] does not exceed 13.3 percent. It also shows that MEI are slightly more efficient than the other industries. Adopting upgrading programs clearly differentiates upgraded firms from others. Looking at Table 5 for the period under study, we observe that the technical efficiency mean is 13.73 percent for upgraded firms versus 13.16 percent for those who are not. In terms of technical efficiency, the difference is very small. This negligible difference was recorded for years prior to implementing the upgrading program and remains the same throughout the period under study. It is surprising that technical efficiency is stable over the years for both types of firms (upgraded and non-upgraded). These findings could explain why the upgrading program was not attractive for some firms and why they have chosen to forgo the opportunity for an upgrade. The trade-off between the constraints imposed by the government on firms' eligibility to enter the program and the small technical efficiency gains was not worth it for most firms (Achy et al., 2007). Three alternative explanations may be invoked here. First, subsidies received by subscribed firms were so small that they did not impact technical efficiency in any direction. Firms needed a considerable impact on their production in order to shift to a more efficient path, whether by adopting a new technology or by becoming more capital intensive. Yet, Moroccan authorities distributed subsidies equally among all firms without targeting. Obviously, the amount received by each firm was so small that no change in efficiency was observed.

The second explanation relates to external factors impacting technical efficiency such as the firms' environment and the factors' markets (capital and labor). Observing such weak technical efficiency gains may lead to a conclusion that technical efficiency is more related to factors' markets than it is to the behavior of firms, which was the case for Morocco. A change in the environment and deep changes in the factors' markets are needed to improve technical efficiency. Other countries like Tunisia have considered such variables while formulating their upgrading program and dedicated part of the subsidies for upgrading the environment. In addition, Tunisia's upgrading program targeted a set of enterprises before expanding it to include others. This explanation is also corroborated by the relative stability of technical efficiency between different sectors. There is no evidence why different sectors with different capital intensities and different technologies have the same technical efficiency except the fact that they share the same environment and the same factor markets conditions. Hence one can assume external factors to be important determinants of technical efficiency.

The last explanation is linked to the profile of the Moroccan entrepreneur. Several studies like Bellon and Ben Youssef (2003) and Bellon et al., (2006, 2007) show that the performance of firms in the Mediterranean area greatly depends on the profile of

[15] Cobb-Douglas specification was also considered. Yet performing a likelihood ratio test lead to the rejection of such specification in favor of the translog . The statistic of the test is defined by $LR = -2(\log L_0 - \log L_1)$ where L_0 and L_1 are the values of the likelihood functions obtained when running estimations for Cobb-Douglas and translog specifications, respectively. LR follows a Chi-squared distribution with three degrees of freedom under the null hypothesis. The estimated statistic takes the value 34.581 while the critical value is 7.81 at the 5 percent level of significance.

Mediterranean entrepreneurs. They seem to apply a "wait and see" attitude vis-à-vis upgrading policies and the Euro-Med free trade area in general. Their approach is more reactive than proactive and they appear to be reluctant to act until the last minute, which might be too late.

On the policy maker's side, the state aid was not offered in an incentivizing method. Apparently, technical efficiency was not taken into account when handing out subsidies and the eligibility criteria for getting aid was not linked to the performance of the firm and its improvement. To get better results, this approach needs to be changed (Cammett, 2007). This seems to be the case nowadays, but the available data does not allow us to verify this fact.

Finally, we turn to the second part of the estimation procedure. The results related to the inefficiency model reported in Table 3 are interesting, since the estimated coefficients are statistically significant with the expected sign, except for the influence of the foreign-ownership variable. Results verify that that the upgrading program exhibits an increasingly significant effect on technical efficiency. In addition, firm size, as measured by the total number of workers, relates to pure technical efficiency in the expected quadratic manner. A similar result is observed for the capital intensity measure K/L. Finally, the quality of labor is positively correlated with technical efficiency, which means that the higher the levels of labor productivity as measured by a higher level of per capita income, the higher are the pure technical efficiency scores.

6. Concluding Remarks

This paper aims to analyze the impacts of the upgrading policies adopted by Morocco for almost ten years. The study was conducted following the stochastic frontier approach on a panel of 282 Moroccan firms during the period [1998–2005].

Our results, which are similar to the findings of Goaïed and Jendoubi (2007) for the Tunisian case, show that the technical efficiency of Moroccan firms is still very low (not exceeding the 13.3 percent level). Surprisingly, the average technical efficiency of firms that have officially enrolled in the upgrading program is only slightly higher than that of firms which have not, which suggests that upgrading policies have no substantial impact on technical efficiency. One possible explanation is that the upgrading program was implemented to improve the short-term performance of the firm and its profitability rather than its long-term performance and technical efficiency. Achy et al., (2007) demonstrate similar results and record some paradoxes linked to the upgrading programs. While expecting upgrading programs to promote investment and enhance export performance of firms, empirical results show a decrease in investment and a decline in export performance. These surprising findings provide a more comprehensive picture and compel researchers to scrutinize the usage of these policies.

We believe that such poor performance is linked to the profile of the Moroccan entrepreneur. Several studies like Bellon and Ben Youssef, (2003) and Bellon et al., (2006, 2007) show that the performance of firms in the Mediterranean area still depends hugely on the profile of the Mediterranean entrepreneurs. They seem to apply a "wait and see" attitude vis-à-vis upgrading policies and the Euro-Med free trade area in general. Their approach is more reactive than proactive and they appear to be reluctant to act until the last minute, which might be too late.

On the policy maker's side, the state aid was not offered in a proper manner. Apparently, technical efficiency was not taken into account when handing out subsidies and the eligibility criteria for getting aid was not linked to the performance of the firm and its improvement. To get better results, this approach needs to be changed (Cammett, 2007). While this seems to be the case nowadays, the available data does not allow us to verify this fact.

Our work needs to be extended in two ways. First, Moroccan politicians and the European Commission seem to be aware of the inefficiency of the Moroccan upgrading programs during the considered period and have changed their approach since 2006. Obviously, we need to verify, possibly by using the same methodology, whether this change has impacted the technical efficiency of the firms. Second, we have focused more on internal variables— than on external variables— that influence technical efficiency in this paper. We need to refine our model in a following paper to focus on external variables and how they may be contributing to the low levels of technical efficiency.

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Table 1: Distribution of Firms across Activities

Sectors	Firms (number)	Firms (%)	Upgrading	Upgrading (%)
Agro-Food Industries	37	13.12	10	27.02
Textile Industry and Leather	182	64.54	29	15.93
Clothing	36	12.76	8	22.22
Chemical Industries	27	9.58	12	44.44
Mechanical and Electrical Industries				
Total	282	100	59	20.92

Table 2: List of Variables

Variables	Definition
a) Stochastic frontier model	
Log Y	Level of production (in logarithms)
Log K	Capital flow (in logarithms)
Log L	Staff costs (in logarithms)
b) Inefficiency model	
PMN	= 1 if the firm adopted the upgrading program = 0 otherwise
OWNER	= 1 if the firm is foreign-owned one = 0 otherwise
WORKER	Number of workers (in logarithms)
K/L	Capital-Labor ratio = Capital flow divided by total number of workers (in logarithms)
wL	Per capita income = Staff costs divided by total number of workers

Table 3: Estimation Results of the Stochastic Frontier and the Inefficiency Models

Variable	Estimate	Standard error
a) Stochastic frontier model		
Constant	10.303***	0.939
Log K	0.0757*	0.0435
Log L	-0.0639	0.124
0.5(Log K)²	-0.0112**	0.00463
0.5(Log L)²	0.0782***	0.0174
(Log K)(Log L)	0.00607	0.00664
Log likelihood	-972.184	
σ_u^2	0.65	0.0631
	0.111	0.00451
σ_υ^2	0.761	0.0628
σ_s^2	0.854	0.0135
λ	3.176	0.872
μ		
b) Inefficiency model		
Constant	10.5***	0.1
PMN	0.092***	0.0291
WORKER	0.217***	0.0432
WORKER²	0.0454***	0.00464
K/L	0.0417***	0.0031
(K/L)²	-0.00419***	0.000824
wL	0.00218***	0.000425
OWNER	0.0147	0.0138
OWNER*wL	-0.00034	0.000312
Statistic F	7054.97***	
Number of observations	1549	
Number of firms	278	

Note: Estimation results were obtained using the STATA10 software. It was run in two stages. For the first stage, xtfrontier command permits estimation of the stochastic frontier model where the translog specification is chosen. We also obtain the technical efficiency measure which will be introduced as a dependent variable in the inefficiency model. Such model is estimated in random-effects manner.

Table 4: Mean Technical Efficiency

	AFI	TILC	CI	MEI	Mean
1998	13.29	13.17	13.33	13.58	13.25
1999	13.23	13.2	13.31	13.9	13.29
2000	13.24	13.13	13.46	13.82	13.26
2001	13.05	13.09	13.65	13.68	13.25
2002	13.16	13.02	13.61	13.67	13.19
2003	13.24	13.13	13.72	13.87	13.31
2004	13.28	13.1	13.9	13.79	13.3
2005	13.31	13.11	13.74	13.78	13.31
Mean	13.24	13.12	13.63	13.78	13.28

Table 5: The Impact of Upgrading Program

	Upgraded firms	Non upgraded firms	Total
1998	13.59	13.16	13.25
1999	13.76	13.18	13.29
2000	13.77	13.13	13.26
2001	13.79	13.1	13.25
2002	13.64	13.14	13.26
2003	13.77	13.18	13.31
2004	13.75	13.17	13.3
2005	13.71	13.18	13.31
Mean	13.73	13.16	13.28