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Abstract

This paper aims to investigate the association between exporting and performance in the agricultural sector of some Mediterranean countries involved in the process of global market liberalization. The causality pattern flowing from exporting to efficiency and quality improvement is explored through the joint estimation of the performance equations and a dynamic probit model for the export decision over a set of thirty six crop products in a panel of nine South Mediterranean Countries and five European Union Countries for the period 1990 to 2005. Product quality measures are inferred from trade data using a discrete choice demand model, and technical efficiency scores are appraised using a stochastic production frontier approach. The empirical findings lend a strong support for the self-selection hypothesis. Exporting appears to help quality upgrading that incites the efficient use of resources.

ملخص

تهدف الدراسة إلى البحث في الترابط بين التصدير والأداء في القطاع الزراعي في بعض دول البحر الأبيض المتوسط التي تنضم إلى عملية تحرير السوق العالمي. فان النمط السببي بدءا من التصدير إلى تحسين الجودة والكفاءة يتم اكتشافه من خلال التقدير المشترك لمعادلات الأداء والنموذج الحركي والمستقيم لقرار التصدير على مجموعة من ستة وثلاثين منتجا زراعيا ويتكون هذا التقدير بلجنة من تسعة دول من جنوب البحر الأبيض المتوسط بالإضافة إلى خمسة دول من الاتحاد الأوروبي وذلك بين في الفترة من 1990 إلى 2005. أما عن معايير جودة المنتج، فيتم استنتاجها من البيانات التجارية باستخدام نموذج ممتاز عن حق الاختيار ويتم أيضا تحسين نتائج الكفاءة التقنية باتباع اتجاه حدود الإنتاج. بالإضافة إلى ذلك، تساند النتائج التجريبية وتدعم بشدة نظرية الاختيار الفردي في حين يقوم التصدير بتحسين الجودة بتعزيز كل ما يحفز الاستخدام الكفء للمصادر.

1. Introduction

The Barcelona Conference, held in November 1995, has marked the start of the "Euro-Mediterranean Partnership" launched between the European Union (EU) and several South Mediterranean Countries (SMC). The partnership contemplates the establishment of a Euro-Mediterranean free trade area by 2010. The free trade agreements, currently covering industrial products, are expected to be gradually enlarged to agricultural commodities.

Agricultural markets are presently highly protected by various trade barriers that severely distort the international flow of the commodities considered as a potential source of strong competition in the Mediterranean basin. Reducing the distorting policies for further market liberalization offers interesting perspectives and ambitious challenges for the South Mediterranean farming sector.

Opportunities for SMC producers could lie in the trade of fresh fruits and vegetables, in which these countries enjoy a relatively high production potential. Challenges stem from the environmental and natural resources constraints and the prevalence of small traditional farmers with inadequate technological skills and structural inefficiencies. SMC, with very few exceptions, face a mounting pressure on their limited land and water resources. Important development projects and agricultural structural adjustment policies were carried, with various degrees of extensiveness and speed, in the different South economies during the last decades. The policy reforms targeted the reduction of the State intervention, the modernization of the farming sector and the enhancement of efficiency and quality in the vegetable production. The development measures focused essentially on the establishment of hydro-agricultural projects for mobilizing water, the expansion of irrigated areas and the promotion of export crops. A marked progress has been registered in fruit and vegetable productions with the development of irrigation schemes. This progress has been achieved primarily by medium-sized and large farms producing for exportation which were generally more privileged in terms of access to fertile land and to water resources. This gradually accentuated the dualistic agriculture structure where a modern export-oriented agriculture, in which the irrigation system prevails, co-exists with traditional agriculture that predominates in the rural areas where rain-fed farming is the main livelihood source. While modern market-integrated farms are in a position to cope with trade liberalization; small traditional producers, under equipped, badly organized and displaying weak productivity and quality levels may have severe difficulties to sustain the stiffer international competition (Correns et al., 2004; CIHEAM, 2002, 2005).

The underlying idea in the Barcelona process is that trade may play a key role in encouraging rural development and enhancing economic integration in the Mediterranean region. The increasing competition resulting from trade barriers reduction may bring a push to promote product quality and export diversification towards high value markets which may contribute to efficiency and productivity growth in the farming sector. A less optimistic view cannot however deny the challenges facing the most vulnerable SMC producers.

This paper aims to analyze the causal relationship between exporting, technical efficiency and product quality in the Mediterranean countries agricultural sector. The study paricularly focuses on investigating the influence of exporting on product quality and technical efficiency of the aggregate farming sector, using a panel of EU and SMC involved in the process of global market liberalization. The analysis may help to reveal the potential for each country to reap the benefits of a free trade policy. Positive feedback from exporting to agricultural production efficiency and product quality may foretell possible improvements of the agricultural performance particularly in the traditional sector, enhanced by the learning effects resulting from the interaction among Mediterranean farmers and more advanced trading partners. Otherwise, agricultural liberalization would present a serious threat for the small farmers from the South Mediterranean side.

The association between trade openness and economic performance has been vigorously debated in the economic literature. Many analysts believe that trade liberalization helps to expand productivity growth (Krugman, 1987; Grossman and Helpman, 1991). The higher economic performance of exporters relative to domestically oriented producers has been recognized in a number of advanced and developing countries (Haddad, 1993; Harrison, 1994; Bernard and Jensen, 1995; Aw and Hwang, 1995; Tybout and Westbrook, 1995; Isgut, 2001). Most studies that attempted to disentangle the direction of causality between exports and performance, found however, little evidence of performance improvements through exporting experience (Clerides et al., 1998; Bernard and Jensen, 1999; Aw et al., 2000; Delgado et al., 2002; Fafchamps et al., 2002). These analyses suggest that a more plausible explanation for the link between exporting and performance might simply reflect the self-selection of the most productive firms into the foreign market. Only some studies provided empirical support for the view that trading causes better performance (Kraay, 1999; Bigsten et al., 2004; Biesebroeck, 2005).

The association between exporting and economic performance has been investigated, in the empirical literature, using aggregate cross-country data or microeconomic observations. Most existing analyses proxy the performance measures with labor productivity, total factor productivity and unit costs. Despite the relevance of product quality in international trade patterns underlined in a growing body of empirical analysis (Hallak, (2003, 2005); Hummels and Klenow, 2004; Hallak and Schott, 2005) and the positive link between product quality and productivity growth invoked in the literature (Feenstra and Kee, 2004)[1], little attention has been devoted to incorporate the quality dimension in the performance measures[2]. When the learning from exporting process leads to quality upgrading rather than productivity gains, abstracting from the former component is likely to yield misleading results since the entire exporting effect may be missed, opening the door to omitted variable bias.

The distinguishing aspect of this study is the attempt to isolate the causal effects of exporting on farming performance in the dimensions of production efficiency and product quality in the Mediterranean agricultural sector. We use a dynamic discrete choice panel specification to determine whether exporting helps to achieve higher efficiency and quality levels and whether improvements in one dimension are complemented by changes in the other. The analysis is conducted over a set of thirty six agricultural products in a panel of nine South Mediterranean Countries: Algeria, Tunisia, Morocco, Lebanon, Turkey, Jordan, Syria, Egypt and Israel; and five European Union Countries: France, Spain, Italy, Greece and Portugal for the period 1990 to 2005.

We start our analysis by evaluating product quality and efficiency scores across the considered range of countries, products and years. Product quality measures are inferred from market shares and unit-value trade data using the discrete choice framework proposed by Berry (1994). Efficiency scores are assessed using the stochastic production frontier models.

To test whether exporting helps efficiency and quality improvements, we follow a somewhat similar approach to that of Kraay et al. (2002) and Bigsten et al. (2004), in estimating the performance equations jointly with a dynamic discrete choice equation of export decision.

[1] The authors argued that outputs differentiation lead to the use of different factor intensities and then to productivity gains.

[2] To our knowledge, the only study analyzing the impact of international technology diffusion on production efficiency and product quality is that developed by Kraay et al. (2002) for manufacturing firms in Colombia, Mexico and Morocco.

This approach enables us to control for unobserved heterogeneity in the form of country specific effects that are correlated across the different equations.

The paper is organized as follow: section 2 outlines the mechanism by which trade may interact with performance and exposes the procedures used to infer quality and efficiency measures. Section 3 presents the empirical model and the estimation method. Section 4 provides an overview of the data used. Section 5 reports the main econometric results. Section 6 summarizes the essential findings and conclusions.

2. Trade, Efficiency and Quality

The question of causation between openness and economic performance has been widely investigated in the empirical literature using a dynamic discrete choice panel specification (Roberts and Tybout, 1995; Clerides et al., 1998; Kraay et al., 2002; Bigsten et al., 2004; Biesebroeck, 2005). This section examines the relationship between exporting and performance in the Mediterranean agricultural sector relying on a similar approach. We begin our analysis by outlining the mechanism by which trade may interact with countries farming performance in the dimensions of productive efficiency and product quality. In a theoretical setting with product differentiation, increases in the country's exposure to international competition enhance the farmers' incentive to export higher quality goods and to reduce the inefficiency in employing scarce resources. The competitive pressures may push inefficient agriculturists to restructure, freeing resources for better quality products and more productive uses (Pilat, 1996; Melitz, 2003; Bernard and Jensen, 2004). Producing higher-quality goods without substantially increasing production costs might, on the other hand, ensure productivity promoting (Melitz, 2003). Furthermore, international trade enables farmers to benefit from the technical expertise of their buyers and facilitates process improvements transmission that may enhance their productive efficiency and help their quality upgrading (Kraay, 1999; Elsass, 1999; Liu et al., 2001).

The positive association between trade and economic performance may also be due to the self-selection of the more efficient producers into the export market for which they produce better quality goods, rather than learning (Clerides et al., 1998; Verhoogen, 2004).

To assess the causal linkage between exporting, efficiency and quality, we begin by combining productive efficiency (TE_{it}) and product quality (q_{it}) to form the performance vector $\Psi_{it} = (TE_{it}, q_{it})$ of the country *i(i:1,…,I)* at time *t(t:1,…,T)*. Following Kraay et al. (2002), we assume that the country's performance depends on its own history, on the exporting decision and on exogenous country characteristics:

$$\Psi_{it} = g_{\Psi}\left(\Psi_{it-1}^{[-]}, EXP_{it-1}^{[-]}, s_{it}\right) \tag{1}$$

where $\Psi_{it}^{[-]} = (\Psi_{it}, \Psi_{it-1}, \Psi_{it-2}, ...)$, $EXP_{i,t}^{[-]} = (EXP_{it}, EXP_{it-1}, EXP_{it-2}, ...)$ with EXP_{it} a binary variable indicating whether country i is exporting at time t or not, and s_{it} a vector of exogenous country characteristics. The decision to export is defined by:

$$EXP_{it} = \begin{cases} 1 & if \quad EXP_{it}^{*} \geq 0 \\ 0 & otherwise \end{cases} \tag{2}$$

where EXP_{it}^{*} is a latent variable represented by:

$$EXP_{it}^{*} = h\left(\Psi_{it-1}, EXP_{it-1}, W_{it}\right) \tag{3}$$

with W_{it} is a set of exogenous variables explaining export.

To distinguish the learning hypothesis from the self selection alternative we need to quantify the relationships in (1) and (3). A significant association between EXP_{it-1} and Ψ_{it} in (1) suggests that export Granger-cause performance. In the same way, a positive influence of Ψ_{it-1} on EXP^{*}_{it} can be viewed as performance Granger-causing export (Kraay at al., 2002). The empirical investigation of equations (1) and (2) requires the measurement of quality and efficiency. The procedure used to evaluate these variables is presented below.

2.1. Quality Measurement

A growing body of empirical studies has underlined the relevance of product quality in international trade patterns and economic development. Product quality is a complex notion and may have several usages. Lack of adequate data has forced trade economists to adopt a quality definition that uses export prices to proxy for unobserved quality (Brooks, 2003; Hallak, (2003, 2005)). These models assume that the cross-country variation in export prices, even within similar product categories, reflects differences in products quality. This proxy assumption allows mainly for vertical product differentiation, and any price dispersion is considered as being owed to differences in product quality. A more general approach using a discrete choice framework relating country's product quality to market shares have been applied in recent works (Kraay et al., 2002; Verhoogen, 2004; Khandelwal, 2005). According to this approach product quality is defined as all observable characteristics plus an intangible attribute that influences the consumer's valuation of the good. Given the vector of prices for all available goods, products with larger market shares are considered as having higher quality. The quality estimates are recovered from prices and market shares using a discrete choice model of product differentiation[3]. The model allows for heterogeneous preferences through the interaction of consumer and product characteristics in a nested logit demand system (Berry, 1994; Manez and Waterson, 2001; Kraay et al., 2002; Katayama et al., 2003).

Our procedure to infer quality estimates rely on a similar discrete choice methodology. In a nested logit model, prior to the estimation, products are grouped in sets of goods of similar characteristics and products within the same group are considered as closer substitutes than those belonging to different groups (Manez and Waterson, 2001; Kraay et al., 2002).

Each product set g: 1…G is comprised of several varieties denoted by j : 1….J_g. We consider I trading countries, indexed by i:1..I, producing and exporting product j. Consumers have heterogeneous tastes indexed by n. Each chooses a single unit of the variety that gives him the highest utility. As is standard in logit specifications, we consider an outside option (g = 0) where the consumer does not purchase any of those products. Ignoring time subscripts, the indirect utility of consumer *n* from buying product *j* belonging to group *g* is:

$$u_{nij} = \delta_{ij} + \zeta_{nig} + \varepsilon_{nij} \qquad (4)$$

$$\delta_{ij} = \xi_{ij} - \alpha p_{ij} \qquad (5)$$

$$u_{n0} = \xi_0 + \zeta_{n0} + \varepsilon_{n0} \qquad (6)$$

[3] The resulting model combines horizontal and vertical product differentiation (Verhoogen, 2004; Khandelwal, 2005).

the utility specification in (4) is composed into a mean utility component, denoted by δ_{ij} and two unobserved error components that capture individual taste differences. ζ_{nig} represents consumer *n*'s idiosyncratic taste for products in group g, which varies only across the nests. ε_{nij} is consumer's idiosyncratic taste for good j, which varies only within product sets. $(\zeta + \varepsilon)$ and ε are assumed to have type-I extreme value distribution with variances $(\pi\mu_1)^2 / 3$ and $(\pi\mu_2)^2 / 3$, we normalize $\mu_1 = 1$ and define $\sigma = 1 - \mu_2 / \mu_1$ (0< σ <1) a substitution parameter among, versus within, the groups[4] (Kraay et al., 2002 ; Ackerberg and Rysman, 2002).

The mean utility component in (5) contains p_{ij} the variety's price and ξ_{ij} the unobservable component of utility that can be understood as the consumer's valuation of product characteristics and then be used as a proxy for quality. α is an unknown parameter to be estimated. Equation (6) represents the utility of the outside option which is normalized to 0.

Each agent chooses the product that confers him the highest utility. Integrating over consumers yields the standard nested logit expression for the conditioned market share of the product ij within group g:

$$s_{ij/g} = \frac{exp(\delta_{ij} / (1-\sigma))}{\sum_{h,k} exp(\delta_{hk} / (1-\sigma))} \quad j,k \in g \text{ and } i,h\text{: } 1 \ldots I \qquad (7)$$

Similarly, the demand for group g varieties as a share of total demand is:

$$s_{ig} = \frac{D_{ig}^{1-\sigma}}{1 + \sum_{h,g} D_{hg}^{1-\sigma}} \qquad g:,1,\ldots,G \qquad (8)$$

where $D_{ig} = \sum_{k \in g} exp(\delta_{ik} / (1-\sigma))$, and the outside good share:

$$s_0 = \frac{1}{1 + \sum_{h,g} D_{hg}^{1-\sigma}} \qquad (9)$$

the demand of the variety ij as a fraction of total demand is:

$$s_{ij} = s_{ij/g} s_{ig} \qquad (10)$$

Combining expressions (7) to (10) and taking logs gives the following linear estimating equation:

$$Log(s_{ij}) - Log(s_0) = -\alpha p_{ij} + \sigma Log(s_{ij/g}) + \xi_{ij} \qquad (11)$$

We expect unobserved product characteristics to be correlated with varieties prices since equilibrium prices are determined by observed and unobserved product attributes. Within market shares are also expected to be correlated with ξ_{ij}. If we consider ξ_{ij} as an error term we can estimate α and σ by instrumental variables. We use the parameter estimates to back out product quality from (11).

[4] Higher values of σ imply stronger within group substitution relative to across group substitution (Ackerberg and Rysman, 2002).

2.2. Efficiency Measures

This section aims to estimate technical efficiency at aggregate level in Mediterranean agricultural production. The measurement of technical efficiency has become commonplace with the development of the Stochastic Production Frontier models (SPF) by Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977). Our approach uses the general form of the panel data version of Aigner, Lovell and Schmidt's (1977) production frontier extended to include producer's characteristics following Battese and Coelli (1995).

The SPF model is based on a parametric specification of the technology with inefficiency effects. The disturbance term in a regression of output-input relationship is considered as composed of two elements: a symmetrical error term (ν) that accounts for random effects and assumed to be independently and identically distributed as $N(0,\sigma_{\nu}^{2})$; and a one-sided non-negative random disturbance (u) which represents systematic effects that are not explained by the production function and therefore considered as technical inefficiency. By decomposing the error term, the stochastic frontier production function for panel data can be expressed as[5]:

$$y_{it} = f(x_{it};\beta)exp(\nu_{it} - u_{it}) \qquad (12)$$

where y_{it} is the observed output for the i^{th} country (i:1…I) at time *t* (t: 1,…,T); x_{it} is a (1xk) vector of input quantities employed to produce *y*; and β a (kx1) vector of unknown parameters to be estimated.

To make the model suitable for econometric analysis, it is convenient to approximate the frontier production base $f(.)$ by a Cobb-Douglas functional form. Notwithstanding the inherent restrictive properties of the C-D form, it has been widely used in the empirical estimation of frontier models since more flexible forms such as the Translog function consumes more degrees of freedom and reduces the precision of the estimated parameters (Seymoun et al., 1998).

The C-D technology is described by the subsequent log-linear form:

$$\begin{aligned} Log(y_{it}) = \beta_0 + \beta_1 Log(Land_{it}) + \beta_2 Log(Water_{it}) + \beta_3 Log(Lab_{it}) + \\ \beta_4 Log(Fert_{it}) + \beta_5 Log(Cap_{it}) + \nu_{it} - u_{it} \end{aligned} \qquad (13)$$

Where *Land* is cropland use, *Water* is irrigation water, *Lab* is labor, *Fert* is fertilizers and *Cap* is tractors use.

Following Battese and Coelli (1995), we assume the technical inefficiency effects u_{it} to be independently distributed as truncations at zero of the $N(\mu_{it},\sigma_{u}^{2})$ distribution. The mean of technical inefficiency effect, μ_{it}, is approximated by a multiple linear regression with country characteristics as independent regressors. Specifically:

$$u_{it} = z_{it}\delta + \omega_{it} \qquad (14)$$

where z_{it} is a (1xm) vector of country's specific variables associated with technical inefficiencies (with z_1:water resources, z_2:land degradation, z_3: land fragmentation and z_4 : average precipitations); δ a (mx1) vector of parameters to be estimated, and ω_i a

[5] (Battese and Coelli, 1993 ; Battese and Coelli, 1995)

random variable with zero mean and finite variance σ_{ω}^{2} defined by the truncation of the normal distribution such that the point of truncation is $-z_{it}\delta$, ($\omega_{it\geq} -z_{it}\delta$).

An estimated measure of technical efficiency for the i^{th} country at time *t*, may be obtained by the ratio of the observed output to the corresponding frontier output, conditional on observed allocation of factor inputs:

$$TE_{it} = exp(-u_{it}) = exp(-z_{it}\delta - \omega_{it}) \quad (15)$$

The prediction of technical efficiencies relies upon the conditional expectation of u_{it} given the observable value of $(v_{it} - u_{it})$ (Jondrow et al., 1982; Battese and Coelli, 1988).

The maximum likelihood method is used for simultaneous estimation of the parameters (β) of the stochastic frontier in (13) and those for the technical inefficiency model (δ) in (14). The likelihood function is expressed in terms of the variance parameters $\sigma^2 \equiv \sigma_v^2 + \sigma_u^2$ and $\gamma \equiv \sigma_u^2 / \sigma^2$, where γ varies between zero and one (Battese and Coelli, 1995). The parameter γ determines whether a stochastic frontier is suitable as opposed to an average response production function, the closer the estimated value of γ to one, the higher is the probability of the relevance of stochastic parametric production function and maximum likelihood estimation.

This and several other hypotheses concerning the presence of inefficiency effects and the significance of the explanatory variables in the inefficiency model can be tested using the generalized likelihood-ratio statistic $\lambda = -2\{Log(L(H_0)) - Log(L(H_1))\}$ where $L(H_0)$ and $L(H_1)$ denote the values of the likelihood function under the null and the alternative hypothesis respectively.

3. The Empirical Model and Estimation Method

3.1. The Empirical Model

Our empirical framework follows Kraay et al. (2002) and Bigsten et al. (2004) specifications. We assume product quality and technical efficiency to depend on previous export participation, as learning is unlikely to be instantaneous, on lagged country performance and a set of observable country's characteristics influencing efficiency and quality in the agricultural sector. Equation (1) is expressed by the following linear system:

$$TE_{it} = a_0 + \sum_{l:1}^{L} a_l^e TE_{it-l} + \sum_{l}^{L} a_l^q q_{it-1} + a^x EXP_{it-1} + a^d LD_{it} + a^f LF_{it} + a^l AL_{it} + a^r R_{it} + a^k K_{it} + \vartheta_{it}^1 \quad (16)$$

$$q_{it} = b_0 + \sum_{l:1}^{L} b_l^e TE_{it-l} + \sum_{l}^{L} b_l^q q_{it-1} + b^x EXP_{it-1} + b^d LD_{it} + b^f LF_{it} + b^l AL_{it} + b^r R_{it} + b^k K_{it} + \vartheta_{it}^2 \quad (17)$$

where q_{it} is product quality approximated by the product characteristics[6], $(q_{it} \equiv \xi_{it})$, in (11), LD_{it} is land degradation, LF_{it} is land fragmentation, AL_{it} is total agricultural land, R_{it} the part of agricultural irrigated area and K_{it} is agricultural capital equipment.

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[6] See (Kraay et al., 2002 ; Katayama et al., 2003, Khandelwal, 2005).

The export participation equation is assumed to depend on previous export decisions, on previous country performance and on a set of variables explaining export such as product diversification and trade costs, to respectively capture fixed costs of exporting, self-selection into the export market, the production structure and the inequalities of access of the different countries to foreign markets. The export market participation decision evolves according the following dynamic discrete process:

$$EXP_{it} = \begin{cases} 1 \ \ if \quad c_1 EXP_{it-1} + c_2 TE_{it-1} + c_3 q_{it-1} + c_4 Spread_{it} + c_5 tariff_{it} + c_6 \tau_{it} + \vartheta_{it}^3 \geq 0 \\ 0 \quad \text{otherwise} \end{cases}$$

(18)

where $Spread_{it}$ is product diversification, $tariff_{it}$ is customs duties and τ_{it} is transportation and transaction costs.

The estimation of equations (16) to (18) as a system should reveal whether there is support for self-selection into exporting, in which case c_2 and c_3 would be positive; whether exporting helps to improve the productive efficiency and/or the product quality in the agricultural sector, in which case a^x and/or b^x would be positive; and if countries tend to continue exporting due to the fixed costs associated with exporting, in which case c_1 would be positive (Roberts and Tybout, 1995).

3.2. Estimation Method

The joint estimation of the performance and participation equations may yield misleading results unless we control for the unobserved heterogeneity between countries. While the set of exogenous regressors, s_{it} and W_{it}, control for heterogeneity in certain observable variables, presence of unobserved characteristics, regarding managerial expertise for example, that affect both performance and exports may induce serial correlation in the error terms, ϑ_{it}^1, ϑ_{it}^2 and ϑ_{it}^3. Failure to control for unmeasured variables in models containing lagged dependant variables may lead to upward biased estimates reflecting "spurious" state dependence (Heckman, 1981a, 1981b).

Following Heckman (1981a, 1981b), we model each disturbance as composed of an unobserved country-specific effect and a white-noise component: $\vartheta_{it}^1 = \eta_i^1 + \varpi_{it}^1$, $\vartheta_{it}^2 = \eta_i^2 + \varpi_{it}^2$ and $\vartheta_{it}^3 = \eta_i^3 + \varpi_{it}^3$. Where: $var(\eta_i^k) = \sigma_{\eta,k}^2$, $var(\varpi_{it}^k) = \sigma_{\varpi,k}^2$, $cov(\eta_i^k, \eta_{i'}^k) = 0$ and $cov(\varpi_{it}^k, \varpi_{it'}^k) = 0$, $\forall k : 1,2,3$, $\forall i \neq i'$ and $\forall t \neq t'$. We allow the unobserved effects and the white noises to be correlated across equations[7]: $cov(\eta_i^k, \eta_i^{k'}) = \sigma_{\eta,kk'}$, $cov(\varpi_{it}^k, \eta_{it}^{k'}) = \sigma_{\varpi,kk'}$ and $cov(\eta_i^k, \eta_{i'}^{k'}) = 0$, $\forall k,k' : 1,2,3$ and $\forall i \neq i'$. $\varpi_{it}^1, \varpi_{it}^2$ and ϖ_{it}^3 are assumed to follow a trivariate normal distribution with the variance of ϖ_{it}^3 normalized to one.

The presence of lagged dependant variables among the explanatory variables creates an initial conditions problem in the performance equations and in the export probit, in that the lagged variables will be correlated with the unobservable specific effects if TE_{it}, q_{it} and EXP_{it} have been determined by the same model as (16) to (18) when $t \leq L$. Ignoring the initial

[7] See Clerides et al. (1998) ; Kraay et al. (2002) and Bigsten et al. (2004).

conditions problem gives rise to inconsistent estimates (Heckman, 1981a, 1981b). We use the Wooldrige's (2002) technique to deal with this problem. We express $\eta_i = (\eta_i^1, \eta_i^2, \eta_i^3)$ as a linear projection on $TE_{i1}, q_{i1}, EXP_{i1}$ and the temporal mean of s_i and W_i, plus a residual effect :

$$\eta_i = d_0 + d_1 TE_{i1} + d_2 q_{i1} + d_3 EXP_{i1} + d_4 \bar{s}_i + d_5 \overline{W_i} + \eta_i^* \qquad (19)$$

where η_i^* is independent of $\left(TE_{i1}, q_{i1}, EXP_{i1}, \bar{s}_i, \overline{W_i}\right)$ and distributed as Normal$\left(0, \sigma^2_{\eta^*}\right)$. Substituting expression (19) into the joint density function of $TE_{it}, q_{it}, EXP_{it}$ and η_i conditioned on $TE_{i1}, q_{i1}, EXP_{i1}, s_i$ and W_i, and integrating out the unobserved effects $\eta_i^* = \left(\eta_i^{*1}, \eta_i^{*2} \eta_i^{*3}\right)$ eliminates the initial conditions problem. We estimate the system (16), (17), (18) and (19) by the Full Information Maximum Likelihood approach assuming that all disturbances are normally distributed.

4. Data and Summary Statistics

The empirical application in this study considers panel data at the national level for agricultural productions in nine south Mediterranean countries involved in the partnership agreements with the EU such as: Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Syria, Tunisia and Turkey; and five EU Mediterranean countries presenting a strong potential in agricultural production as: France, Greece, Italy, Portugal and Spain for the period 1990-2005. The data used comes from the FAO (FAOSTAT), World Bank, AOAD, Eurostat, CEPII and AMAD databases as well as from the different reports of the FEMISE and the ESCWA. Our data set include observations on the main crops grown in these countries, inputs use, determinants of market competition and country characteristics. The model includes some non observable explanatory variables. We approximate these variables by available proxies. The variables used in the empirical analysis are summarized as follows:

- Outputs and inputs: we consider thirty six agricultural products belonging to six categories: fruits (apricots, dates, figs, olives, peaches and nectarines, pears, apples, plums, grapes), shell-fruits (almonds, peanuts, hazelnuts, pistachios), citrus fruits (lemons, oranges, tangerines, grapefruits, other citrus fruits), vegetables (artichokes, carrots, cucumbers and pickles, strawberries, watermelons and melons, pepper, potatoes, tomatoes), cereals (rice, wheat, maize, barley) and pulses (beans, peas, chick-peas, lentils, vetches). Inputs are classified into five groups: cropland, irrigation water, fertilizers, labor and machines. The data for the input use by crop for each country are constructed according to the information collected from recently published reports by FAO, FEMISE, ESCWA and the Ministries of Agricultural in the considered countries. Table 1 presents summary statistics on the sample.
- Determinants of market competition: these variables include products quality, products diversification and trade barriers. Product quality measures are obtained from equation (11) in section 2.1, using the trade data from the FAO database. Export unit-values (prices) are computed by dividing export values by export quantities. In order to calculate the market shares for each product and for the outside option, a market size has to be defined. The market size is assumed to equal a weighted average of the agricultural imports of the main destination markets. Market shares for each product (s_{ij}) are computed as the exported quantity divided by the market size, the remaining share is assigned to the outside option (s_0). The within group shares ($s_{ij/g}$) are computed in a

similar way by dividing the exported quantity by the total exports of the group they belong.

Product diversification is approximated by: $spread_{ki} = \left[\frac{\sqrt{\sum_{j=1}^{cl} (X_{ij} - \overline{X}_{ig})^2}}{N(\overline{X}_{ig})} \right]$ which captures for each country the distribution of export products compared to the average export value. Where X_{ij} is the country's i exports of product j, $\overline{X}_{ig}$: the country i average exports in the group g and N the number of products in group g.

Trade barriers are evaluated by trade costs and custom duties. Trade costs are approximated by the weighted average of the geographic distance between the exporting country and destination markets. Tariff barriers represent an aggregate measure of ad valorem tariffs and entry prices imposed on each product category and exporting country. The data used come from the FEMISE and the ESCWA reports and the CEPII and AMAD databases.

- Country characteristics: we use variables on the agricultural productive capacity of each country such as: agricultural land, part of irrigated agricultural area, water resources and agricultural capital equipment measured by the total number of wheeled and crawler tractors used; environmental variables as: average precipitations, part of agricultural area incurring severe and very severe degradation; and land fragmentation evaluated by the part of exploitations having an area under five ha. Country statistics are summarized in table 2.

5. Estimation Results

This section summarizes the main estimation results of the demand equation (11), the stochastic frontier model (13) and (14), and the simultaneous system of performance and participation equations (16) to (19).

5.1 The Demand Equation

The model that is taken to the data is given by (11). This equation represents a static panel data model, where we need to control for unobserved individual heterogeneity and simultaneity. To alleviate endogeneity biases we use the Instrumental Variable estimator of Hausman and Taylor (1980). Table 3 show results from the OLS estimation and the IV specification.

The coefficient of prices is significantly negative in both models, as desired. The IV results show a larger prices coefficient (in absolute value) than the OLS counterpart, being consistent with the expected correlation between prices and unobserved product quality that biases the OLS estimates towards zero. The coefficient for conditional market shares is significantly positive, and also larger for IV estimates. This shows a relatively important variability of the consumer indirect utilities across the different groups of product.

5.2 The Stochastic Frontier Model

The general model of the stochastic frontier (13) along with the technical inefficiency effects (14) are simultaneously estimated by maximum likelihood method using the computer program FRONTIER 4.1 (Coelli, 1996). Table 4 reports the estimation results for the EU countries and for the SMC panels separately as well as for the pooled data.

It appears from the results that technical inefficiency effects are significantly present in the model. The variance ratio $\gamma \equiv \sigma_u^2 / (\sigma_u^2 + \sigma_v^2)$ exceeds 60% in the different panels, suggesting that Mediterranean countries farmers operate beneath the frontier function and inefficiencies in production are the dominant source of random errors since they explain more than 60% variation in the Mediterranean crop yields. The generalised likelihood ratio test confirms the presence of one-sided error component in the specified model at the 1% level, supporting the relevance of stochastic parametric production function. The traditional average production function would then be inadequate representation of the data. The hypothesis that inefficiency effects have half normal distribution ($\delta_m = 0 \quad \forall m$) is also strongly rejected.

The estimation results of the production function show that input elasticities are positive and globally significant at the 1% level. Water and cropland have the largest elasticity, indicating that the increase of Mediterranean agricultural productions depends mainly on these inputs. Water appears as the most important production factor being consistent with the fact that Mediterranean crops are highly water intensive and water is the most limiting and precious production factor in this region. Fertilizers, while significant, have a limited effect in the SMC production. This may be explained by the fact that farmers in these regions tend to use fertilizers as complementary factor to organic manure which is much less expensive. It appears also from the results that SMC crops are labor intensive while EU products are capital intensive.

The estimated coefficients of the inefficiency function provide some explanations for the efficiency differentials among the selected countries. All the variables proved significant at the 1% level and have globally the expected signs. Average precipitations and water availability have a positive impact on the efficiency of resources use while land degradation and land fragmentation enhance inefficient behavior. The availability of water resources may encourage irrigation and reduce yield variability when rainfall is inadequate; the results show however that this effect is relatively limited. The important positive impact of precipitations on efficiency in SMC can be explained by the fact that a relatively important part of the crops grown in these regions are produced in rain fed areas. These commodities are particularly sensitive to weather conditions and to the lack of rainfall characterizing their climate. An increase in rainfall can then contribute to a substantial increase in productivity and efficiency. Land degradation seems to have a pronounced role in efficiency reduction in SMC. Land fragmentation is also negatively correlated with efficiency. Land fragmentation may lead to sub-optimal usage of factor inputs due to inadequate monitoring, the inability to use certain types of machines, and wasted space among borders[8]. A high percentage of land fragmentation may also reflect the existence of an important number of small farms with limited financial resources, low skills and inefficient traditional production methods.

Once the model was estimated, we evaluated technical efficiency scores for each country, product and year. Table 5 reports average efficiency scores for the EU countries, the SMC and the pooled panel over the sample period for export and non-export products.

The results indicate the presence of important inefficiencies in the Mediterranean agricultural production. Farmers in the selected countries could achieve the same level of production and reduce their inputs use by around 33% through the improvement of their technical efficiency. For the SMC region the average efficiency score is about 0.656 indicating considerable room

[8] A recent study conducted by Raghbendra, Nagarajan and Prasanna (2005), in southern India, showed that land fragmentation had a significant negative impact on production efficiency.

for enhancing the management of the resources in these regions. EU countries exhibit slightly better efficiency levels with an average score of 0.691.

As is commonly observed in the previous studies[9], export products enjoy relatively higher efficiency levels than the non-export ones. This result may be explained by the exposure of the producers to the international competitiveness which incites efficient production process, or may simply reflect the self-selection of the most productive crops to the export market.

5.3 The Performance and Export Participation System

The effect of exporting on Mediterranean countries agricultural performance is appraised through the simultaneous estimation of the performance equations and the export decision in the system (16) to (19) using the FIML method and controlling for countries heterogeneity. Countries' product quality measures are inferred from (11) and technical efficiency scores are appraised using (15). Table 6 summarizes the mean values and standard deviations of technical efficiency and quality measures for the different considered countries and products.

We achieved different groups of estimations: the system of equations is first fitted separately to each group of products in the panel of the considered countries; the different groups are then stacked in one model which is estimated for the EU countries, for the SMC and for the pooled panel. Tables 7 and 8 summarize the main estimations results.

In the efficiency equation lagged efficiency and lagged quality proved highly significant; whereas lagged export rarely affect efficiency levels significantly, providing no evidence of a learning process. Table 7 reveals that quality enhances efficiency for vegetables, fruits and citrus productions. The impact of quality on cereals and pulses is however non significant. This result may be explained by the agricultural strategy adopted in SMC which is mainly oriented towards promoting vegetables, citrus and fruits productions considered as high value goods and which mobilize an important fraction of fertile lands and irrigation water, whereas pulses and cereals are mostly planted in rain-fed areas and use traditional production methods.

Concerning the quality equation, the results show a significant effect of lagged quality and lagged export on quality, the effect of lagged efficiency is rather small and rarely significant. Country characteristics appear to have a determinant effect on efficiency and quality. Land degradation and land fragmentation appear to have a negative impact on product quality and increase inefficient behavior. Wider irrigated areas affect efficiency and quality favorably, since irrigation is considered as a land quality augmenting input that increases crops yields. Agricultural land has a positive but limited impact on efficiency, this result may be explained by the fact that countries with higher agricultural areas, by exploring scale economies, tend to be more efficient than those suffering from narrow farming areas.

In the export probit equation, the coefficient of the lagged export variable is quite important and strongly significant, indicating great persistence in the export decision and suggesting the presence of large exporting fixed costs. Consistent with previous studies we find large evidence of self-selection by relatively more effective products into exporting, as lagged efficiency and lagged quality significantly affect the probability of exporting.

The exporting decision seems on the other hand to be highly constrained by the trade barriers and the product diversification. Increasing the crops varieties limits the country's dependence on a small number of products but may impede the market penetration of the different goods. The custom duties and trade costs hinder the Mediterranean countries possibilities, in particular those of the south strand, to achieve their full potential of trade expansion. SMC

[9] These studies are however mostly applied on the manufacturing sector.

products and mainly fruits and vegetables are currently submitted to high custom duties especially during the growing season of their main destination markets, it appears from tables 7 and 8 that tariff removals may substantially enhance exporting incentives for agricultural products and mainly for vegetables, citrus and fruits. The negative effect of the distance on the exporting probability ensues from the fact that agricultural products are strongly perishable and require an important conditioning and developed structures of merchandising and transport guaranteeing the preservation of the product quality and the speed of deliveries. This generates costs as much elevated as the distance with markets of destination is important, which therefore affect export negatively.

The analysis reveals strong country-level persistence in efficiency, quality and exporting and lends support to the learning hypothesis for product quality. The effect of exporting on efficiency appears indirectly through quality. The results suggest that exposure to international competition enhances the Mediterranean countries incentive to improve the quality of their agricultural exports. Producing higher-quality crops seems on the other to encourage efficient resource usage. The self-selection assumption is verified by the model since products enjoying better quality and efficiency levels appear o more likely enter the export market.

6. Conclusion

Great attention has been devoted to investigating the relationship between international trade and economic performance in the recent empirical literature. Building on the evidence of the superior economic performance of exporters relative to domestically oriented producers, several studies tempted to explore the causal linkages between exporting and efficiency. The self-selection hypothesis has been widely established by the different analyses; however, little support was lent to the learning process. Despite the relevance of product quality in international competitiveness, underlined in recent works, most of the studies proxy performance measures with productivity and unit costs. Moreover the existing analyses restricted their attention to the manufacturing sector; little research has been applied to agriculture.

The analysis performed in this paper set out to investigate the association between exporting and Mediterranean agricultural performance in the dimension of technical efficiency and product quality. The analysis basically focused on exploring the causality pattern flowing from exporting to efficiency and quality improvement for a panel of advanced and developing Mediterranean countries involved in the process of global market liberalization.

Countries' product quality measures are inferred from trade data using a discrete choice demand model, and technical efficiency scores are appraised using a stochastic production frontier approach. The test for the learning and self selection effects is conducted through the simultaneous estimation of the efficiency and quality equations and the export probit decision using the FIML method and controlling for countries heterogeneity. Like the previous studies, the self selection hypothesis is highly supported by the data, as the coefficient for efficiency and quality is positive and strongly significant in the export equation. The learning process is less evident. Lagged export appears to have a significant positive impact on quality and is rarely significant in the efficiency equation. Quality seems on the other hand to enhance the efficient use of resources, suggesting an indirect impact of exporting on productive efficiency through quality.

The analysis also highlighted the negative impact of trade barriers on the exporting probability. The important custom duties imposed on the SMC agricultural exports and the substantial transport costs supported by the producers, seems to hinder the competitiveness of their high value exports such as fruits and vegetables. Opening the agricultural sector to the international trade, through dropping the tariff barriers and improving the merchandising structures and the distribution chains in view of reducing the transport costs, may provide a significant contribution to exporting growth that would help quality upgrading and therefore inefficiencies reduction.

The empirical findings indicate that the openness process should be carried out with accompanying policies for restructuring the Mediterranean agricultural sector to cope with the fierce international competition, as the crops enjoying better performance levels appear more likely to be selected into the export market. In line with the results of the study, the restructuring policies would focus on enhancing quality expansion and efficiency incentives, through expanding irrigated areas, encouraging the mechanization of the farmers and combating the land fragmentation by re-parceling actions. Some SMC like Tunisia, Jordan, Israel and Lebanon may not, however, have adequate resources to manage such restructuring measures. One way for these countries to compete with those offering similar products like Spain, Turkey, France and Morocco rests on them promoting their comparative advantage in their product quality through specialization in high quality goods.

The present study sheds some light on the effects of agricultural liberalization on the Mediterranean farming sector. It is important to underline that without trying to quantify the effects of trade openness that would require a deep investigation of the economic situation of the concerned countries, our analysis attempts to give some indications to identify the potential of these countries to reap the benefits of a free trade policy. It appears from the analysis that exposure to international trade may be profitable in terms of performance improvement. Cooperation programs between the advanced and developing countries involved in the partnership association and enabling SMC with limited resources to survive the competitive process, should however be reinforced prior to the opening of the agricultural markets.

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Table 1: Summary Statistics by Country

Production 1000 Mt	Fruits		Citrus		Shell Fruits		Vegetables		Cereals		Pulses	
	Mean	**S. Dev**	**Mean**	**S. Dev**	**Mean**	**S. Dev**	**Mean**	**S. Dev**	**Mean**	**S. Dev**	**Mean**	**S. Dev**
Algeria	1129	223	418	94	28	7	2779	526	2490	1297	46	13
Spain	12473	2633	5305	537	271	51	10030	527	17992	3608	335	133
France	10644	1006	28	3	10	2	7933	641	58823	5401	2746	705
Greece	4692	450	1216	135	66	9	3923	260	4793	396	43	4
Italy	16917	1366	2985	381	218	21	10495	825	19572	1369	154	43
Portual	1785	293	278	51	17	7	2429	158	1333	154	30	9
Israel	367	41	811	275	28	3	1338	274	255	70	11	3
Jordan	347	360	146	30	2	1	663	94	91	35	6	2
Lebanon	617	111	352	54	32	7	844	119	107	28	25	11
Morocco	1424	153	1249	173	94	24	2923	577	5576	2750	235	93
Syria	1465	259	589	151	120	56	1586	405	4993	1199	222	68
Tunisia	1262	416	266	33	47	11	1596	323	1618	697	77	19
Turkey	8516	627	2005	378	631	99	19699	2654	30131	2080	1691	233
Egypt	2925	805	2399	280	123	69	10501	2808	16835	2764	488	53

Cropland 1000 ha	Fruits		Citrus		Shell Fruits		Vegetables		Cereals		Pulses	
	Mean	**S. Dev**	**Mean**	**S. Dev**	**Mean**	**S. Dev**	**Mean**	**S. Dev**	**Mean**	**S. Dev**	**Mean**	**S. Dev**
Algeria	453	74	44	7	31	9	197	18	2374	837	85	17
Spain	3508	363	272	23	648	28	315	70	6195	427	464	140
France	1040	36	2	0	4	0	211	14	8422	334	580	115
Greece	965	22	66	28	45	9	119	5	1265	72	27	3
Italy	2273	62	177	4	169	13	319	17	3984	164	97	27
Portual	733	23	27	1	41	2	159	177	461	79	53	17
Israel	37	6	27	5	6	0	36	4	92	12	7	1
Jordan	69	10	7	1	0	0	18	2	73	34	7	3
Lebanon	96	2	15	2	7	2	30	4	46	13	14	5
Morocco	639	72	76	2	148	14	117	9	5265	509	397	52
Syria	592	41	26	2	38	7	82	12	3369	316	260	38
Tunisia	1578	121	23	3	237	55	100	9	1195	419	111	25
Turkey	1438	29	84	8	416	25	797	477	13582	185	1771	246
Egypt	199	40	135	7	45	18	370	50	2478	156	172	16

Source: FAOSTAT.

Table 2: Country Characteristics

	Water Res.[1]	Agr.[2]	Capital[3]	Precipitations[4]	Irrigation[5]	Degradation[6]	Fragmentation[7]
Algeria	14.3	39.5	1.2	211.5	1.4%	21.0%	48.0%
Spain	111.5	30.1	7.2	321.7	12.0%	38.0%	42.0%
France	203.7	30.0	5.7	478.0	8.3%	9.0%	17.0%
Greece	74.3	8.9	8.4	86.1	15.5%	48.0%	48.0%
Italy	191.3	15.7	18.2	250.8	17.3%	28.0%	56.0%
Portual	68.7	3.9	7.3	78.6	16.6%	21.0%	49.0%
Israel	1.7	0.6	7.4	9.2	33.9%	6.0%	58.0%
Jordan	0.9	1.2	2.3	9.9	6.2%	31.0%	56.0%
Lebanon	4.4	0.3	2.9	6.9	30.5%	25.0%	53.0%
Morocco	29.0	30.6	0.5	154.7	4.3%	14.0%	71.0%
Syria	26.3	13.7	1.8	46.7	8.0%	60.0%	43.0%
Tunisia	4.6	9.4	1.1	33.9	4.0%	79.0%	53.0%
Turkey	229.3	39.5	3.3	459.5	11.3%	89.0%	39.0%
Egypt	58.3	3.2	2.9	51.4	99.7%	9.0%	45.0%

Source: FAOSTAT and World Bank databases.

1 Water Resources in km3.

2 Total Agricultural area in Million Ha.

3 Agricultural capital equipment per 100 hectares of arable land.

4 Average precipitations (1961-1990) in km^3/year.

5 Part of Irrigated Area in %.

6 Part of agricultural area incurring severe and very severe degradation in %.

7 Part of exploitations having an area under five hectares in %.

Table 3: Demand Equation

VARIABLES	OLS	IV
Price	-0.135**	-0.254**
	(-3.55)	(-4.26)
Sj/g	0.158**	0.326**
	(12.87)	(13.28)
Constant	-1.237**	-1.15**
	(-6.83)	(-6.7)
Number of Observations	6944	6944
R^2	0.93	0.95

Numbers in (.) are t-statistics. The significance at the 10% and 1% levels is indicated by * and ** respectively.

Table 4: Stochastic Frontier Model

	EU Countries	South Medit. Countries	Total Panel
		Stochastic Frontier Model	
Constant	0.217**	0.439**	0.923**
	(28.2)	(9.22)	(25.11)
Land	0.265**	0.276**	0.237**
	(12.6)	(15.8)	(17.62)
Water	0.594*	0.503**	0.514**
	(16.84)	(22.4)	(39.28)
Labor	0.087	0.255**	0.114**
	(1.31)	(22.1)	(13.37)
Fertilizer	0.142*	0.018**	0.081**
	(1.71)	(8.75)	(8.17)
Capital	0.23**	0.009*	0.039**
	(6.36)	(1.91)	(4.71)
		Inefficiency Model	
Resources	-0.18**	-0.053**	-0.039**
	(-12.7)	(-6.41)	(-9.85)
Land degradation	0.155**	0.53**	0.38**
	(18.2)	(11.7)	(12.43)
Land Fragmentation	0.104*	0.27**	0.72**
	(2.22)	(12.22)	(19.33)
Precipitations	-0.22**	-0.74**	-0.41**
	(-9.74)	(12.22)	(-4.72)
		Diagnosis Statistics	
σ^2	0.439**	0.213**	0.37**
	(27.4)	(34.4)	(27.9)
γ	0.656**	0.602**	0.648**
	(37.4)	(31.2)	(40.9)
Log likelihood	-426.6	-694.3	-117.14
LR test	44.6	29.72	60.9
Number of observations	2480	4464	6944

Note: the variables are in natural logarithm. Numbers in (.) are t-statistics. The significance at the 10% and 1% levels is indicated by * and ** respectively. A negative sign in the inefficiency model means that the associated variable has a positive effect on technical efficiency.

Table 5: Efficiency Scores by Export Status

	European Union Countries	South Mediterranean Countries	Total Panel
Export products			
Mean	0.724	0.689	0.693
Std. Deviation	0.09	0.1	0.099
Non Export products			
Mean	0.544	0.592	0.581
Std. Deviation	0.203	0.114	0.12
Total			
Mean	0.691	0.656	0.669
Std. Deviation	0.104	0.106	0.105

Averages are for the period : 1990 to 2005

Table 6: Technical Efficiency and Quality

	Fruits		Citrus		Shell Fruits		Vegetables		Cereals		Pulses	
	TE	Quality	TE	Quality	TE	Quality	TE	Quality	TE	Quality	TE	Quality
Algeria	0.675[a]	3.93	0.652	3.56	0.57	1.16	0.637	4.25	0.527	2.55	0.59	2.79
	(0.09)[b]	(0.18)	(0.12)	(0.18)	(0.09)	(0.21)	(0.13)	(0.31)	(0.08)	(0.57)	(0.17)	(0.8)
Spain	0.681	3.92	0.693	**4.19**	0.618	3.63	0.656	**4.1**	0.699	**4.4**	0.684	**4.13**
	(0.11)	(0.2)	(0.08)	(0.13)	(0.11)	(0.49)	(0.10)	(0.07)	(0.06)	(0.37)	(0.07)	(0.66)
France	**0.829**	3.75	**0.723**	3.71	**0.76**	3.97	**0.83**	**4.1**	**0.79**	**4.48**	**0.81**	**4.83**
	(0.12)	(0.17)	(0.09)	(0.16)	(0.08)	(0.08)	(0.13)	(0.08)	(0.12)	(0.31)	(0.07)	(0.46)
Greece	0.67	3.73	0.66	**4.06**	0.62	2.79	0.697	**4.21**	0.65	**4.23**	**0.81**	3.75
	(0.1)	(0.26)	(0.2)	(0.11)	(0.13)	(0.85)	(0.11)	(0.24)	(0.09)	(0.49)	(0.04)	(0.56)
Italy	**0.77**	3.83	**0.78**	**4.32**	0.69	3.55	**0.78**	3.86	0.69	**4.28**	0.65	**4.61**
	(0.11)	(0.15)	(0.09)	(0.14)	(0.07)	(0.34)	(0.11)	(0.13)	(0.09)	(0.41)	(0.13)	(0.6)
Portugal	0.58	3.22	0.69	3.7	0.69	3.26	0.67	3.95	0.58	3.15	0.61	3.6
	(0.11)	(0.15)	(0.07)	(0.24)	(0.13)	(0.95)	(0.09)	(0.28)	(0.11)	(0.62)	(0.15)	(0.63)
Israel	0.67	3.92	**0.71**	3.82	0.64	3.15	0.66	4.1	0.532	3.52	0.53	3.1
	(0.08)	(0.26)	(0.11)	(0.14)	(0.08)	(0.91)	(0.1)	(0.27)	(0.12)	(0.47)	(0.06)	(0.76)
Jordan	0.537	**4.12**	0.595	**4.42**	0.583	**4.77**	0.611	**4.11**	0.57	3.65	0.51	3.4
	(0.09)	(0.45)	(0.14)	(0.25)	(0.09)	(0.95)	(0.54)	(0.15)	(0.1)	(0.47)	(0.07)	(0.52)
Lebanon	0.64	3.94	0.54	**4.47**	0.51	**5.1**	0.55	**4.12**	0.64	3.82	0.51	0.31
	(0.12)	(0.2)	(0.09)	(0.15)	(0.08)	(1.2)	(0.1)	(0.33)	(0.06)	(0.48)	(0.07)	(0.63)
Morocco	0.684	**4.09**	0.697	**4.05**	0.684	3.25	0.698	3.93	0.693	3.94	0.63	3.41
	(0.12)	(0.4)	(0.08)	(0.26)	(0.11)	(0.91)	(0.08)	(0.24)	(0.12)	(0.7)	(0.09)	(0.46)
Syria	0.669	**5.16**	0.66	**5.07**	0.631	**5.2**	0.704	**4.95**	0.59	**5.16**	**0.81**	**4.1**
	(0.09)	(0.7)	(0.12)	(0.67)	(0.08)	(1.41)	(0.9)	(0.8)	(0.07)	(0.95)	(0.04)	(0.53)
Tunisia	0.54	**5.12**	0.58	**4.95**	0.64	**4.42**	0.55	**5.12**	0.49	3.95	0.49	2.11
	(0.11)	(0.76)	(0.1)	(0.79)	(0.07)	(1.76)	(0.1)	(0.62)	(0.12)	(0.8)	(0.07)	(0.52)
Turkey	**0.87**	**4.57**	**0.87**	**4.86**	**0.79**	**5.63**	**0.81**	**5.18**	0.67	**4.57**	0.63	**4.32**
	(0.13)	(0.56)	(0.07)	(0.72)	(0.12)	(0.6)	(0.09)	(0.8)	(0.15)	(0.7)	(0.15)	(0.89)
Egypt	0.55	3.35	0.55	2.93	0.54	3.11	0.57	3.88	0.55	5.06	0.59	2.15
	(0.11)	(0.6)	(0.12)	(0.79)	(0.08)	(1.64)	(0.12)	(0.7)	(0.14)	(0.9)	(0.17)	(0.75)

a: Mean, b: Std. Dev. Averages are for the period : 1990 to 2005

Table 7: Technical Efficiency, Quality and Export: Desegregated Groups

	Fruits	Citrus	Shell Fruits	Vegetables	Cereals	Pulses
			Efficiency Equation			
TE_{t-1}	0.659**	0.765**	0.479**	0.594**	0.715**	0.603**
	(30.7)	(24.65)	(15.01)	(25.85)	(15.39)	(11.42)
TE_{t-2}	0.34**	0.232**	0.519**	0.404**	0.283**	0.183**
	(15.8)	(7.45)	(16.24)	(17.6)	(6.1)	(5.23)
$Quality_{t-1}$	0.014**	0.011*	0.026*	0.378**	0.169	0.121
	(2.89)	(1.77)	(1.85)	(3.76)	(0.971)	(1.27)
$Quality_{t-2}$	0.009	0.007	0.044*	0.019*	-	-
	(1.15)	(0.9)	(1.67)	(1.76)		
$Export_{t-1}$	0.015	0.03	0.026	0.05*	0.044	0.014
	(0.38)	(1.35)	(1.12)	(2.09)	(0.78)	(0.57)
Land Degradation	-0.18**	-0.021*	-0.066	-0.01**	-0.92*	-0.32*
	(-4.7)	(-2.34)	(-0.78)	(-3.4)	(-1.81)	(-1.93)
Land Fragmentation	-0.09**	-0.074*	0.068	-0.077**	-0.095**	-0.035*
	(-4.79)	(-1.81)	(0.218)	(-3.86)	(-2.77)	(-2.17)
Part of irrigation area	0.025**	0.0236**	0.195**	0.168**	0.013**	0.011*
	(7.52)	(4.54)	(4.49)	(9.19)	(2.75)	(1.75)
Agricultural. capital equipment	0.0146**	0.0135*	0.082*	0.0127**	0.104	0.201
	(3.9)	(1.7)	(1.75)	(3.22)	(0.95)	(0.83)
			Quality Equation			
TE_{t-1}	0.32	0.026	0.162	0.22	2.32	1.41
	(1.18)	(0.87)	(1.12)	(0.55)	(0.79)	(1.29)
TE_{t-2}	0.14	-	-	-	0.812	0.11
	(1.5)				(1.11)	(0.91)
$Quality_{t-1}$	0.619**	0.722**	0.723**	0.61**	0.609**	0.521**
	(28.05)	(24.01)	(21.13)	(25.89)	(20.08)	(17.12)
$Quality_{t-2}$	0.236**	0.153**	0.044**	0.252**	0.199**	0.151**
	(10.7)	(5.11)	(3.15)	(11.02)	(6.9)	(7.21)
$Export_{t-1}$	0.06**	0.03**	0.859**	0.37**	0.23**	0.151*
	(3.15)	(4.26)	(5.19)	(2.97)	(3.31)	(2.11)
Land Degradation	-0.021*	-0.048*	-0.26*	-0.087**	-0.03	-0.061
	(-1.89)	(1.91)	(-2.1)	(-2.66)	(-1.18)	(-1.36)
Land Fragmentation	-0.19*	-0.038*	0.29	-0.196*	0.045*	0.025*
	(-1.7)	(-1.95)	(0.53)	(-1.95)	(-1.76)	(-1.69)
Part of irrigation. area	0.015	0.027*	0.04	0.011*	0.09	0.012
	(1.12)	(1.73)	(0.83)	(1.89)	(0.72)	(1.33)
Agricultural. capital equipment	-	0.022	-	-0.035	0.023*	0.018*
		(1.56)		(-1.18)	(1.74)	(1.84)
			Export Equation			
TE_{t-1}	0.087*	3.97*	3.75*	2.43*	2.95*	1.25*
	(1.96)	(1.94)	(2.02)	(1.86)	(1.68)	(1.74)
$Quality_{t-1}$	0.167*	0.579**	0.251**	0.388**	0.033*	0.018*
	(2.12)	(3.07)	(2.58)	(2.62)	(2.48)	(1.84)
$Export_{t-1}$	0.97**	0.836**	2.17**	1.92**	2.03**	1.37**
	(7.2)	(4.82)	(4.55)	(11.04)	(9.16)	(3.11)
Spread	-1.15**	-0.564**	-0.139**	-0.037	-0.17**	-0.13**
	(-4.26)	(-3.89)	(-4.45)	(-0.56)	(-3.79)	(-3.41)
Distance	-0.754*	-0.174**	-0.063*	-0.87*	0.39	-0.03*
	(-1.81)	(-3.5)	(-1.81)	(-2.21)	(1.15)	(1.65)
Taxes	-0.39**	-0.812**	-0.12*	-3.37**	-0.33**	-0.25*
	(-4.02)	(-4.87)	(-2.05)	(-3.29)	(-3.35)	(-2.14)
Log Likelihood	-388.67	-159.44	-219.907	-256.28	-171.98	-168.14
N. of observations	1764	1050	840	1680	840	630

Numbers in (.) are t-statistics. The significance at the 10% and 1% levels is indicated by * and ** respectively.

Table 8: Technical Efficiency, Quality and Export: Stacked Data

	EU Countries	South Medit. Countries	Total Panel
		Efficiency Equation	
TE_{t-1}	0.437**	0.76**	0.79**
	(18.4)	(41.52)	(25.01)
TE_{t-2}	0.538**	0.239**	0.321**
	(22.7)	(13.11)	(18.32)
$Quality_{t-1}$	0.043*	0.051*	0.064**
	(1.78)	(2.29)	(8.27)
$Quality_{t-2}$	--	0.017	0.027*
		(1.61)	(1.72)
$Export_{t-1}$	0.097*	0.028	0.062
	(1.68)	(1.47)	(0.92)
Land Degradation	-0.17**	-0.048*	-0.096**
	(-3.6)	(-1.71)	(-3.08)
Land Fragmentation	-0.05**	-0.029**	-0.085**
	(-3.63)	(-3.28)	(-4.05)
Agricultural Land	0.002**	0.0129**	0.085**
	(3.66)	(12.7)	(4.27)
Part of irrigation area	0.11**	0.121*	0.12*
	(3.7)	(1.69)	(1.68)
Agricultural capital equipment	0.15**	0.09*	0.12*
	(4.51)	(2.07)	(1.98)
		Quality Equation	
TE_{t-1}	1.07*	0.03	0.023
	(2.02)	(0.67)	(0.72)
TE_{t-2}	0.24	-	-
	(1.45)		
$Quality_{t-1}$	0.4**	0.648**	0.788**
	19.05)	(36.86)	(10.3)
$Quality_{t-2}$	0.14**	0.227**	0.41**
	(8.13)	(13.06)	(13.2)
$Export_{t-1}$	0.06**	0.03*	0.65**
	(3.15)	(2.08)	(3.29)
Land Degradation	-0.021*	-0.04*	-0.077**
	(-1.89)	(1.78)	(-3.22)
Land Fragmentation	-0.19*	-0.025*	0.19
	(-1.7)	(-1.75)	(0.76)
Agricultural Land	-	0.019	0.012
		(1.15)	(1.23)
Part of irrigation area	0.17**	0.12**	0.15**
	(3.56)	(4.33)	(3.07)
Agricultural capital equipment	0.21*	0.19**	0.17**
	(1.86)	(2.96)	(3.21)
		Export Equation	
TE_{t-1}	1.066*	2.55**	0.66*
	(1.88)	(2.91)	(30.7)
$Quality_{t-1}$	0.025**	0.497**	0.056**
	(3.64)	(4.97)	(3.78)
$Export_{t-1}$	0.81**	1.32**	0.79**
	(21.2)	(13.4)	(14.7)
Spread	-0.72*	-0.35**	-0.089**
	(-2.37)	(-3.04)	(-3.85)
Distance	-0.124*	-0.14**	-0.037*
	(-1.71)	(-4.75)	(-1.95)
Taxes	-0.39**	-0.79**	-0.31*
	(-4.02)	(-3.89)	(-4.95)
Log Likelihood	-104.13	-754.94	-369.12
N. of observations	2170	4774	6944

Numbers in (.) are t-statistics. The significance at the 10% and 1% levels is indicated by * and ** respectively.