

ISO 9000 Norm as a Club Good: Network Effect Evidence from the French Employer Survey

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The objective of this article is to provide empirical evidence supporting the claim of ISO certification as a Club Good. To this purpose, we use two French cross-sectional surveys called the “Changement Organisationnel et Informatisation” (COI 1997) and the “Enquête Annuelle d’Entreprises” (EAE 1997) and we show that there is a positive relationship between the hierarchical’s position inside the ISO network and the effect on productivity.

Key words: ISO certification; Club Goods; Network

JEL classification: L15, H41, D62

1. Introduction

Club Goods are type of goods in Economics classified as a subtype of public goods that are excludable but non rivalrous. It is well-known in the literature that voluntary standards like *ISO* can be conceptualized as a Club Good (Prakash and Potoski, 2007; Kollman and Prakash, 2000). One of the reasons for this is the impossibility to price the discrete units of goodwill benefits that *ISO* generates, on the other side firms only have to pay an incentive as a membership fee if the excludable benefits are seen to outweigh the costs. Hence, Club’s excludable benefits that stem from a membership of *ISO 9000* will provide an important signal to the market of company’s engagement with a policy for quality.

Even though there is a number of studies implying *ISO* norms as a Club Good, there is, to the best of our knowledge, no true analysis of *ISO* norms in terms of a network in which firms are certified or not and in which the ties (between the firms) represent an economic relationship. From our point of view an approach in terms of network is important because as shown by Bramoullé and Kranton (2007), the production of Public Goods fundamentally induces a network of relationships between different

participants. In our case, the advantage of network analysis is that it makes the empirical analysis of ISO as a Club Good more definitive. Indeed, if from empirical analysis one can show that the payoff (for instance, the profit) of a firm varies according to its relative position in the network (network effect) then one can argue that the ISO standard is a Club Good. In this paper, we aim to provide empirical evidence of this network effect.

The rationale for our approach is that a costly process of ISO certification, as an obstacle for many firms, influence firms to choose between different positions inside the network. Hence some firms may try to be indirectly certified, through their suppliers, to gain advantage of ISO certification, but at the same time try to avoid a difficult and costly process of ISO certification. Using two French microeconomic surveys called the “Changement Organisationnel et Informatisation¹” (COI 1997), “Enquête Annuelle d’Entreprises²” (EAE 1997), we distinguish four types of firms³. The first category of firms called Direct Complete Adopters includes companies that have ISO 9000 certification and whose suppliers are also ISO 9000 certified. The second category named Direct Non Complete Adopters, presents those firms that are certified with ISO 9000 certification although their suppliers are not. The third category called Indirect Adopters includes firms which are not ISO certified but their suppliers have ISO certification. The fourth category named Non Adopters includes firms that are not ISO certified and their suppliers also do not have ISO certification. This categorisation allows us to empirically construct a network of relationships between firms (certified/non certified)⁴. For instance, Direct Complete Adopter firms are those which are certified and deal only with certified firms.

The objective of this paper is not to show the impact of ISO certification on firms’ economic performance as this has already been shown by studies of Terlaak and King, 2006 and Corbett et al., 2005. Rather, it is to provide empirical evidence (through network analyses) that ISO certification represents a Club Good. After controlling for the endogeneity of ISO 9000 certification variables, with switching endogenous regression models, we found that the productivity of Direct Complete Adopters is higher than that of Direct Non Complete Adopters, which is higher than the one of Indirect Adopters

¹The COI survey includes information about firms’ organizational change and computerization, <http://www.enquetecoi.net>.

²The EAE is a survey covering basic firm-level variables such as employment, sales, capital stock etc...

³We worked with a sample of 4577 companies with more than 20 employees.

⁴Being Direct Complete Adopter, Direct Non Complete Adopter, Indirect Adopter or Non Adopter therefore represents in some sense the position of the firms inside the network.

which itself is higher than that of Non Adopters. Consequently, the network empirical analysis shows that firms which are not certified gain more when they deal with certified companies.

The remainder of the paper is organized as follows: section 2 introduces the ISO 9000 standard; section 3 develops the main issue of the paper; section 4 presents the data sets and some descriptive statistics; section 5 introduces our econometric analysis and result, finally section 6 concludes.

2. Brief description of ISO 9000 standard

The first ISO 9000 certificates attesting that firms were adhering to standards were issued in 1987 (ISO, 1998). The ISO's goal is to facilitate worldwide trade through development of international standards that add value to the products and services in the context of globalisation.

According to International Organisation for Standardisation (ISO, 1998), "*The ISO 9000 international standards are a set of written guidelines that make up a non-specific quality management system that can be applied to any organization regardless of the product or service being provided*". ISO 9000 provides a framework without a need to change how the organization operates so as to "*ensure that nothing important is left out and that everyone is clear about who is responsible for doing what, when, how, why and where*". Therefore, the certification only recommends the basic elements of a proper quality assurance system, without imposing the ways to apply them (ISO, 1998).

Establishing quality standards and documenting the company's quality systems require a considerable managerial time and effort. Nonetheless, the ISO 9000 certification is not a risk-free undertaking. The cost of certification (Anderson et al., 1999) can be very high (ranging from \$10 000 to \$300 000 per company). The time required for a company to become certified depends on many factors, including a firm's size and complexity, current level of work quality, extent of current documentation, and the degree of management commitment and it usually takes between six to twelve months.

Benefits of ISO certification could be distinguished on internal and external levels. Internal advantages include increased customer demand, improved company quality image and competitiveness on the market, compliance with customer requirements. On the other side external advantages include streamlined procedures and documentation, increased awareness of preventive and

corrective actions, and provision of foundation for TQM (Total Quality Management). The literature suggests that the most prominent reason for implementing the ISO 9000 certification is that customers prefer to buy from firms that are ISO certified (Rao et al., 1997). In addition, it is identified that firms that have directly adopted the ISO certification often require their suppliers to obtain this kind of certification.

3. Methodology

We will use the network based analysis (Jackson, 2005). Let us recall that the network is considered as a collection of nodes (the members of the network) and ties (relationships between members in term of diffusion of quality improvement information).

3.1. Relative position inside the network

In the ISO network, being certified is a positive signal concerning quality improvement (Terlaak and King, 2006), and dealing with (i.e. having as a supplier) a certified firm amplifies this positive signal. On the contrary, dealing with (i.e. having as a supplier) a non-certified firm when certified reduces the positive signal concerning quality improvement. However dealing with (i.e. having as a supplier) a certified firm while being non-certified improves the signal concerning quality improvement.

As a consequence, the relationships between firms will determine their position inside the network. The fact that both actors in the relationship (firm and supplier) of Direct Complete Adopters⁵ are members of the ISO Club creates a very strong relationship in terms of two-way diffusion of quality improvement information. Moreover, even if we do not find both actors in the relationship of Direct Non Complete Adopters as members of the ISO Club, the firm's certification permits this group to still have a strong relationship in one-way diffusion of quality improvement information. Although the actors of this group lost on their link's strength, they still have a strong position inside the ISO Club. Furthermore, in the case of Indirect Adopters, although the principal beneficiary of ISO advantages (firm) does not directly belong to the ISO Club, firms in this group indirectly benefit from ISO advantages through its suppliers which are certified (indirect membership). We define this relationship as a fairly weak relationship in terms of diffusion of quality improvement information. Finally, firms

which belong to Non Adopters category are not members of the ISO Club so the signal in terms of quality information is therefore very weak as the ties between firms in terms of diffusion of quality improvement information.

According to the strength of the links between firms, we can classify our four types of firms: Direct Complete Adopters are on the top of the classification followed by Direct Non Complete Adopters, then Indirect Adopters and finally Non Adopters, respectively.

3.2. Hierarchical Positioning by Cost-Benefit Analysis

Does the hierarchy inside the ISO network imply a similar hierarchy in terms of monetary gains? Taking into account the level of costs and benefits, what are the real advantages of each member inside the network ?, what correlations do exist between the strength of the links and economic value inside the network ?.

In order to understand the logic of these questions, we state the following Figure 1.

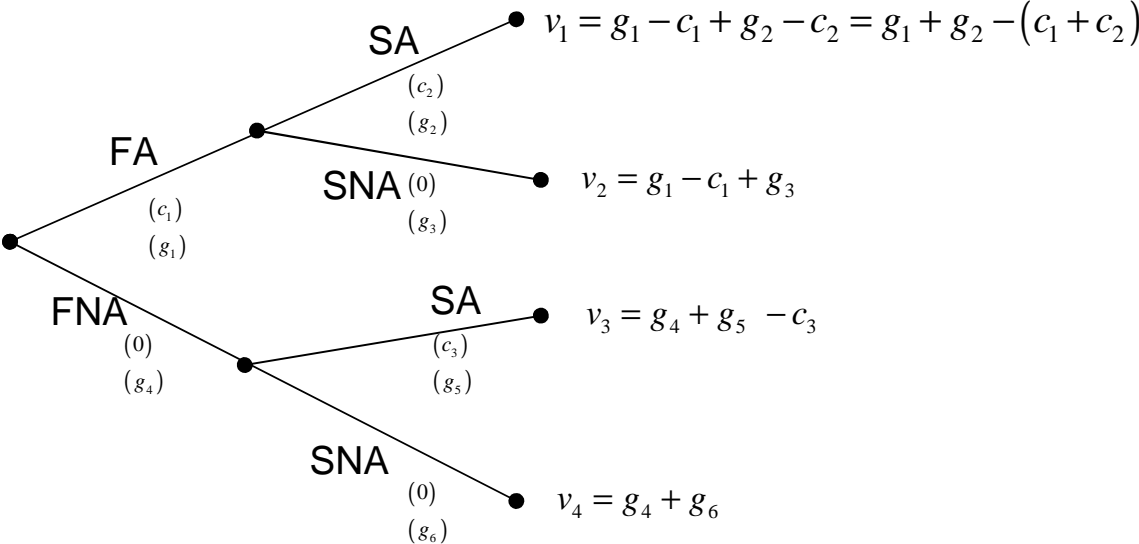


Figure 1 : Net monetary gains of the ISO adopters and Non adopters.

- where:
- FA, FNA, SA and SNA respectively mean “ISO Adopter Firms”, “non ISO Adopter Firms”, “ISO Adopter Suppliers” and “non ISO Adopter Supplier”.
 - $c_1, c_2,$ and c_3 are respectively the cost of ISO certification, the additional cost of having suppliers that are certified with ISO when the company is certified with ISO and the additional cost of having suppliers that are certified with ISO when the company is not certified ISO.
 - $g_1 + g_2$ is the gain of company that is certified with ISO when its suppliers are also certified with ISO.

- $g_1 + g_3$ is the gain of company that is certified with ISO when its suppliers are not certified with ISO.
- $g_4 + g_5$ is the gain of company that is not certified with ISO when its suppliers are certified with ISO.
- $g_4 + g_6$ is the gain of company that is not certified with ISO when its suppliers are not certified with ISO⁶.
- $v_j, j \in \{1, 2, 3, 4\}$, is the net monetary gain that company could receive or not from the implementation/non-implementation of ISO certification.

Obviously⁷ v_1, v_2, v_3, v_4 are respectively the values of Direct Complete Adopter firms, Direct Non Complete Adopter firms, Indirect Adopter firms and Non Adopters firms.

The main remark from Figure 1 is that Indirect Adopters do not act as “free riders” in this network because they pay additional costs of having certified suppliers. Thus, it seems that for a firm to become Direct Complete Adopter, Direct Non Complete Adopter, Indirect Adopter or Non Adopter, it is a rational decision because the other alternatives lead to a weaker net monetary gain. In other words, the decision of a firm to become a Direct Complete Adopter, Direct Non Complete Adopter, Indirect Adopter or Non Adopter is always optimal.

As a consequence, the ordering inside the ISO network does not necessarily imply a similar ordering ($v_1 > v_2 > v_3 > v_4$) in terms of monetary gains. If we take four different firms which are respectively Direct Complete Adopter, Direct Non Complete Adopter, Indirect Adopter and Non Adopter, it is a *priori* impossible to say whether the net monetary gains (v_1) for the Direct Complete Adopter firm are higher than the net monetary gains (v_2) for the Direct Non Complete Adopter firm which are higher than the net monetary gains (v_3) for the Indirect Adopter firm which are higher than the net monetary gains (v_4) for the Non Adopter firm. Hence the question of the relationship between the ordering inside the ISO network and the ordering in terms of monetary gains is not trivial.

3.3 Econometric Strategy

We aim in this paper to show that from an empirical standpoint the net monetary gain (v_j) of a firm varies according to its relative position in the network (network effect). Therefore, we want to provide an empirical answer to the question whether the ordering inside the ISO network (the position inside the network) is positively correlated with the ordering in terms of net monetary gains (v_j).

⁶ Of course, it seems reasonable to state that $g_1 > g_4$, $g_2 > g_3 > g_5 > g_6$; and $c_1 > c_3 > c_2$.

⁷ The notation could be confusing, indeed roughly speaking, we have to put an index to v_j . For instance v_j^k where $j \in \{1, 2, 3, 4\}$, and $k \in \{\text{Direct Complete Adopters, Direct Non Complete Adopters, Indirect Adopters and Non Adopters}\}$.

If the answer to this question is positive, it demonstrates the real existence of a network that we presented in Figure 1 and it also shows that the application of our analysis using the concept of ISO as a Club Good is pertinent.

From an empirical standpoint, we will either look at the ordering $v_1 > v_2 > v_3 > v_4$ or at the ordering $v_{1,2} > v_3 > v_4$ where $v_{1,2}$ ⁸ is the net monetary gains of Direct Complete Adopters and Direct Non Complete Adopters considered as one category. More precisely, v represents economic performance's gain. Let "y" be the economic performance variable, in our case defined as productivity.

y_i is therefore the productivity variable of firm i . y_i writes:

$y_i = Z_{1i} + Z_{2i}$ (1), where Z_{1i} is the productivity due to all other factors but the position inside the ISO network, and Z_{2i} is the productivity due to the position inside the ISO network.

Let : $Z_{1i} = \beta_0 + \beta_1 X_{1i} + \dots + \beta_p X_{pi} + u_{1i}$ (2), where the X_1, \dots, X_p are variables which explained Z_1 and $Z_{2i} = v_1 \chi_{1i} + v_2 \chi_{2i} + v_3 \chi_{3i} + v_4 \chi_{4i} + u_{2i}$ (3) if we look at the ordering $v_1 > v_2 > v_3 > v_4$ or $Z_{2i} = v_{1,2} \chi_{1,2i} + v_3 \chi_{3i} + v_4 \chi_{4i} + \epsilon_{2i}$ (4), if we look at the ordering $v_{1,2} > v_3 > v_4$.

Of course, the $\chi_{1i}, \chi_{1,2i}, \chi_{2i}, \chi_{3i}, \chi_{4i}$ are the characteristic functions equal to 1 if firm i belongs to the corresponding category and 0 if otherwise; and u_{1i}, u_{2i} are error terms.

Testing $v_1 > v_2 > v_3 > v_4$ in the model $y_i = \beta_0 + \beta_1 X_{1i} + \dots + \beta_p X_{pi} + v_1 \chi_{1i} + v_2 \chi_{2i} + v_3 \chi_{3i} + v_4 \chi_{4i} + \epsilon_i$ (5), is equivalent to testing $0 > v'_2 > v'_3 > v'_4$ in the model $y_i = \gamma_0 + \beta_1 X_{1i} + \dots + \beta_p X_{pi} + v'_2 \chi_{2i} + v'_3 \chi_{3i} + v'_4 \chi_{4i} + \epsilon_i$ (6). Likewise testing $v_{1,2} > v_3 > v_4$ in the model $y_i = \beta_0 + \beta_1 X_{1i} + \dots + \beta_p X_{pi} + v_{1,2} \chi_{1,2i} + v_3 \chi_{3i} + v_4 \chi_{4i} + \epsilon_i$ (7), is equivalent to testing $0 > v'_3 > v'_4$ in the model $y_i = \gamma_0 + \beta_1 X_{1i} + \dots + \beta_p X_{pi} + v'_3 \chi_{3i} + v'_4 \chi_{4i} + \epsilon_i$ (8).

However, this model considers ISO 9000 adopters as exogenous. More precisely, the position inside the ISO certification network may not be random as it may depend on the firms' individual characteristics. Some unobserved characteristics that influence the choice of a particular position

⁸ We consider this case (in which we do not directly compare the Direct Non Complete Adopters with the other categories) because as shown by the descriptive statistics (see section 4.3), the category of Direct Non Complete Adopters includes very few firms (only 183).

inside ISO network could also influence the productivity. Furthermore, given the participation decision, firms have to decide among ISO 9000 categories. Hence, the switching regression model controls for the endogenous effect by estimating simultaneously the selection equation and the productivity equations, for the two regimes (superior or inferior position inside ISO network).

The switching model structure is defined by two states: state 1 and state 0, corresponding respectively to certain type of ISO adopters (for instance state 1 may correspond to Direct Complete Adopters and state 0 to Indirect Adopters; likewise concerning Direct Complete Adopters vs Non Adopters; Indirect Adopters vs Non Adopters; Direct Complete Adopters and Direct Non Complete Adopter vs Indirect Adopters; Direct Complete Adopters and Direct Non Complete Adopter vs Non Adopters).

Hence, the model is composed of the following system of three equations that are estimated simultaneously:

$$\log(y_{1i}) = \beta'_1 X_i + \varepsilon_{1i} \quad (9)$$

$$\log(y_{0i}) = \beta'_0 X_i + \varepsilon_{0i} \quad (10)$$

$$ISO^*_i = \gamma' M_i + \mu_i > 0 \quad (11)$$

Equations (9) and (10) are the structural equations that describe the productivity of firms in the alternative regimes. More precisely, as we define previously, y_{1i} and y_{0i} represent respectively the productivity of firm i in state 1 and state 0. Furthermore, X_i is a vector of explanatory variables (features of the company's strategy, external market's constraints, logarithm of the capital per employee, logarithm of the labour,...), β'_1 and β'_0 are vectors of slope coefficients to be estimated. Finally ε_1 and ε_0 are the disturbance terms for the two equations respectively, with null mean and variances equal to σ^2_1 and σ^2_0 .

Equation (11) is the selection equation that determines a firm's "propensity" of belonging in one of ISO's categories that depends on differences between monetary gains associated with each category (being Direct Complete Adopters, Direct Non Complete Adopters, Indirect Adopters or Non Adopters). More precisely, ISO^*_i is the monetary gain for firm i of belonging to one of ISO categories and a firm i will choose one of the categories if its monetary gain of belonging to this category is

strictly positive. In equation (11), M_i is a vector of explanatory factors of being in one of the ISO categories and μ is an error term which follows a normal law with mean and variance respectively equal to zero and one.

Here ISO_i^* is a latent variable measuring the tendency or the firm's likelihood of being in the first or the second regime and has following form:

$$ISO_i = 1 \quad \text{if} \quad ISO_i^* > 0$$

$$ISO_i = 0 \quad \text{otherwise.}$$

Finally, we observe $\log(y_{1i})$ if $ISO_i = 1$ and $\log(y_{0i})$ if $ISO_i = 0$, with Σ the variance-covariance matrix which writes:

$$\Sigma = \begin{pmatrix} \sigma_1^2 & \rho_{10} & \rho_{1\mu} \\ \rho_{10} & \sigma_0^2 & \rho_{0\mu} \\ \rho_{1\mu} & \rho_{0\mu} & 1 \end{pmatrix}$$

Besides, the variance-covariance matrix Σ can be estimated in one step. Finally, we have endogenous switching models if $\rho_{1\mu}$ or $\rho_{0\mu}$ are significantly different from zero, i.e. if errors of the productivity equations and error of the choice equation are correlated. ρ_{10} is not defined since the two regimes are never observed simultaneously.

Switching models are then based on the analysis of three variables but each of them is partly observed (Maddala, 1983). The selection variable, ISO_i^* , is not directly observed but only through a dummy ISO_i . Moreover, the probability of observing y_{1i} or y_{0i} depends on the outcome of the selection variable ISO_i . The expected productivity, conditionally on being state 1 can be calculated as follows,

$$E[\log(y_{1i}) \mid ISO_i = 1] = \beta_1' X_i + \sigma_1 \rho_{1\mu} \frac{-\phi(\gamma' M_i)}{1 - \Phi(\gamma' M_i)} \quad (12)$$

In the same way, the expected productivity, conditionally on being in state 0 is given by

$$E[\log(y_{0i}) | ISO_i = 0] = \beta_0' X_i + \sigma_0 \rho_{0\mu} \frac{-\phi(\gamma' M_i)}{1 - \Phi(\gamma' M_i)} \quad (13)$$

The model is estimated by the method of Maximum Likelihood. Although we do not observe the tendency of a firm being in one or the other productivity regime, we know that if $ISO_i = 1$ the firm's productivity is determined by (9), and if $ISO_i = 0$, the firm's productivity is determined by (10). The likelihood function for each observation is thus given by:

$$\log L = \sum_{i=1}^n \text{prob}(ISO_i = 1) f[\log(y_{1i}) | ISO_i = 1] \text{prob}(ISO_i = 0) f[\log(y_{0i}) | ISO_i = 0], \quad (14).$$

with

$$\text{prob}(ISO_i = 1) = \Phi(\gamma' M_i)$$

$$\text{prob}(ISO_i = 0) = 1 - \Phi(\gamma' M_i)$$

$$f[\log(y_{1i}) | ISO_i = 1] = [\Phi(\gamma' M_i)]^{-1} \sigma_1^{-1} \phi\left\{\sigma_1^{-1} [\log(y_{1i}) - \beta_1' X_{1i}]\right\} \times \Phi\left\{\left(1 - \frac{\rho_{1\mu}^2}{\sigma_1^2}\right)^{-1/2} \left[\gamma' M_i - \frac{\rho_{1\mu}}{\sigma_1^2} (\log(y_{1i}) - \beta_1' X_{1i})\right]\right\} \quad (15).$$

$$f[\log(y_{0i}) | ISO_i = 0] = [\Phi(\gamma' M_i)]^{-1} \sigma_0^{-1} \phi\left\{\sigma_0^{-1} [\log(y_{0i}) - \beta_0' X_{0i}]\right\} \times \Phi\left\{\left(1 - \frac{\rho_{0\mu}^2}{\sigma_0^2}\right)^{-1/2} \left[\gamma' M_i - \frac{\rho_{0\mu}}{\sigma_0^2} (\log(y_{0i}) - \beta_0' X_{0i})\right]\right\} \quad (16).$$

The maximization of log likelihood permits us to define following parameters:

- a) γ' the vector of coefficients of the factors explaining the choice of the position inside the ISO network.
- b) β'_1 and β'_0 the vectors of coefficients of the factors explaining productivity, conditioned on utilization of superior or inferior position inside ISO network, respectively.

- c) $\rho_{1\mu}$ and $\rho_{0\mu}$ the correlation terms between the ISO category's choice equation and productivity equations.
- d) σ_1^2 and σ_0^2 the productivity variances in the two states.

Finally, we implicitly use a Cobb-Douglas production function in which ISO standard is a production factor. That is, our productivity variable is actually $\log(Y/L)$ is the logarithm of value added per employee. Among our explanatory variables, we have $\log(K/L)$ the logarithm of capital per employee, $\log(L)$ the logarithm of number of employees and of course the ISO 9000 categories.

4. The database and the variable

4.1 The database

The research presented here is based on two microeconomic surveys from the French National Institute of Statistics (INSEE), the “Changement Organisationnel et Informatisation” (the Organizational Changes and Computerisation COI 1997) and “Enquête Annuelle d’Entreprises” (the Annual Survey of Industry EAE 1997). The COI survey was created by researchers and statisticians within the economic administration. This collaboration gathered a great deal of knowledge, which made it possible to put together the surveys of different companies and the surveys concerning employees section (“labour force”). In this survey, we can find the manufacturing industry, the agro-food industry, branches of the service industry (i.e. accountancy), and branches of the commercial industry. The COI survey has been used by several researchers (see for instance the special issue by Greenan and Mairesse (2006); see also Acemoglu et al. (2007) or Aubert et al. (2006)). The Annual Survey of Industry (EAE) is the principal source of economic data regarding companies’ activities, structure and performance. The choice of companies is based on the files of companies in the Annual Survey of Industry (EAE). We restricted our empirical analysis to the manufacturing industry and we worked with a sample of 4577 companies which have at least more than 20 employees.

4.2. The variables

Our four different categories of adopters (Direct Complete Adopters, Direct Non Complete Adopters, Indirect Adopters, and Non Adopters) are constructed using two variables from the COI survey: whether firm is ISO 9000 certified in 1997 (yes/no) and whether firm has ISO 9000 certified suppliers in 1997 (yes/no).

Using our four categories of ISO adopters, we construct 5 dummies of ISO adopters and for each we evaluate the impact on productivity.

To resume, we consider five models:

- *In Model 1, the dummy variable is 1 if the firm is a Direct Complete Adopter and is 0 if the firm is an Indirect Adopter.*
- *In Model 2, the dummy variable is 1 if the firm is a Direct Complete Adopter and is 0 if the firm is a Non Adopter.*
- *In Model 3, the dummy variable is 1 if the firm is an Indirect Adopter and is 0 if the firm is a Non Adopter.*
- *In Model 4, the dummy variable is 1 if the firm is a Direct Complete Adopter or a Direct Non Complete Adopter and is 0 if the firm is an Indirect Adopter.*
- *In Model 5, the dummy variable is 1 if the firm is a Direct Complete Adopter or a Direct Non Complete Adopter and is 0 if the firm is a Non Adopter.*

For instance, when we compare Direct Complete Adopters to Indirect Adopters, y_1 will be the logarithm of the productivity per employee of Direct Complete Adopter firms and y_0 will be the logarithm of the productivity per employee of Indirect Adopter firms.

Furthermore variables (from the COI survey) used for descriptive statistics and switching regression model are:

- importance (not important/quite important/important/very important) of the feature of the companies strategy: quality improvement, cost reduction and new process,
- influence of external market constraints: competitive pressure (yes/no), uncertainty on the market (yes/no), clients conditioned (yes/no), suppliers conditioned (yes/no), stockholders conditioned (yes/no),
- whether firm has another type of certification measure or total quality management in 1997 (yes/no),
- whether there is a full time quality manager in 1994 (yes/no),
- whether there is an outsource manager for quality in 1994 (yes/no),
- the export by company's turnover,
- logarithm of capital per employee,
- and logarithm of labour,
- the sector of activity (17 sectors).

4.3. Descriptive Statistics

Firm distribution for each category of adopters (Direct complete Adopters, Direct non complete adopters, Indirect adopters, Non adopters) is respectively 1949 firms, 183 firms, 960 firms and 1485 firms. From the table 1 we can see that the proportion of uncertified companies that have certified suppliers is significant: 22% firms (from a total of 64% non certified companies) are part of this group, or approximately 40% of non certified companies. In comparison, only 4% companies certified with ISO (from a total of 36% certified companies) have suppliers that are not certified with ISO which suggests that ISO certified companies avoided having relationships with suppliers that are not certified with ISO. This suggests, as we expected, that being certified (i.e. inside the network) gives a positive signal concerning quality information, and having as a supplier a certified firm amplifies this positive signal. Our data suggests several important first-order differences between four types of ISO firms. In particular, we can observe that there are more companies that are certified with ISO since 1994 under

category Direct Non Complete Adopters than Direct Complete Adopters. We noticed that there is a positive correlation between company's size and the position inside the network so that highest percentage of larger companies make up Direct Complete Adopters (23%) whilst the highest percentage of smaller companies belong to Non adopters (4%). Furthermore, although the full time quality manager is present in each category of adopters, the percentage of concentration is positively related to the group position inside the network with the highest percentage being present in the category of Direct Complete Adopters (74%). Interestingly, there exist a small percentage of companies (in each category) that utilize quality service from outsource managers.

Investment in the quality norms can at the same time be a function of improvement of the company's competence and can also make a positive signal on the market, especially for companies that export abroad. Companies might view ISO certification as an export requirement, especially if they operate a majority of their business abroad (Terlaak and King, 2006). The international marketing aspects of ISO 9000 certification have been regarded as one of the most important reasons to seek certification. We noticed that the percentage of export is positively correlated with the position inside the network, the highest export being for the category of Direct Complete Adopters which descends in the following pattern: Direct Complete Adopters > Direct Non Complete Adopters > Indirect Adopters > Non Adopters. Finally we observed that firms which are not ISO certified do not tend to substitute ISO certification for another type of certification (QA, ISO 14000, QS ...). On the other hand, as we can see from Table 1, 15% of Direct Complete Adopters have other types of certification or total quality management. In contrast, only 8% of Non Adopters have another kind of certification. It seems therefore that there is no strategy of substitution among Non Adopter companies relating to the quality norms. Other kinds of adopters such as Direct Complete Adopters may view the ISO certification as being complementary to other kinds of certifications. Interestingly, the category Indirect Adopters has the highest percentage of firms (25%) that have other type of certification or total quality management. Possible reason for this is that Indirect Adopters firms want throughout previous experience with similar standards to lower additional costs of ISO 9000 implementation (*e.g.*, through the overlap of documentation requirements) because of learning by doing and scale economies.

Table 1. Descriptive Statistics

	Direct Complete Adopters	Direct Non Complete Adopters	Indirect Adopters	Non Adopters
	Year of ISO Certification			
1994	38%	47%	0%	0%
	Company's Size			
20 to 49 employees	39% (a)	54%	62%	69%
50 to 199 employees	38%	34%	30%	27%
200 employees and more	23%	12%	8%	4%
	Quality department in 1997			
Full time quality manager	74%	56%	43%	21%
	Quality outsourcing in 1997			
Outsource quality manager	18%	22%	14%	6%
	Previous certification			
Other certification or total quality management	15%	12%	25%	8%
	Mean export by firm's turnover			
Mean of export	0.22	0.19	0.17	0.16
Total	32%	4%	22%	42%

Source: Survey COI, sample 4577 companies, weighted by the number of employees.

Field: manufacturing industries of more than 20 employees.

Lecture: (a) 39% of "direct complete adopters" are companies that have from 20 to 49 employees (category-small company).

5. Switching Endogenous Estimates Results

Table 2 (determinants of ISO categories), table 3 (determinants of productivity of superior position inside ISO network) and table 4 (determinants of productivity of superior inferior inside ISO network) report results of from the estimates of Model 1, Model 2 and Model 3. The results obtained from the estimates of Model 4 and Model 5 are presented in table 6 (determinants of ISO categories), table 7 (determinants of productivity of superior position inside ISO network) and table 8 (determinants of productivity of superior inferior inside ISO network). From table 4 and table 8, we can note that the correlation coefficients between selection equations (choice of ISO 9000 adopters) and productivity equations ($\rho_{0\mu}$ and $\rho_{1\mu}$) are significantly different from zero, (at least one of them). This result indicates that the ISO 9000 adopters is endogenous and that our econometric model is appropriate.

The estimation results regarding the factors that may impact on adoption of different ISO 9000 categories are presented in table 2 and table 6. The estimation of the selection equation includes all variables which will later be also included in the estimation of the productivity equations. Additionally, two instrument variables that explain the ISO 9000 categories, but have no impact on productivity, are included for identification.

The first group of variables that we have utilized is sector of activity. We have used 17 sectors of different company's activities and as a reference the sector of textile industry. As in the literature, we found that the probability to be ISO certified is higher in certain industries such as the manufacture of mechanical equipment, machines for general utilization, electric and electronic equipment and etc.

Concerning the features of the company's strategy, we can see from table 2 and table 6 that for our five regressions and for the three variables (quality improvement, cost reduction, new procedure), the coefficients, when significant, are positive. When quality improvement, cost reduction and new procedure are important or very important for the company's strategy, they will increase the company's probability of being ISO certified and to become a Direct Complete Adopter (as compared to being a Non Adopter). It is interesting to note that when comparing Direct Complete Adopters to Indirect Adopters, only the new procedure variable plays a role in a decision to be a Direct Complete

Adopter. When comparing Indirect Adopters to Non Adopters, only the quality improvement variable plays a role (at a 5% level of significance) in the decision to be an Indirect Adopter.

Concerning the external market's constraints, one can remark that the variable "uncertainty on the market" seems to play no role in determining the firm's probability to be ISO certified or the firm's position inside the ISO network. Indeed, this variable is not significant in all four regressions (out of five). It is only significant (only at a 10% level) when comparing Direct Complete Adopters + Direct Non Complete Adopters with Indirect Adopters. It could therefore be interpreted that the market uncertainty increases the probability that a non ISO certified firms opt to have ISO certified firms as suppliers. If we look at the other variables (competitive pressure, clients-conditioned, suppliers-conditioned and stockholders-conditioned), the coefficients, when significant, are positive. For instance, the variable clients-conditioned is significant (at a 1% level) for all three regressions (out of five). This tells us that when clients' condition is an important external constraint, firms will adopt ISO certification either directly or indirectly through their suppliers. The same explanation can be used in the case of stockholders whereby companies are more driven to become ISO certified by stockholders' conditions. Another interesting result is that only those firms in the category of Direct Complete Adopters vs Non Adopters are more cautious about the conditions imposed by suppliers. Finally, it is quite surprising that the variable "competitive pressure" is significant (at a 10% level) only when comparing Indirect Adopters with Non Adopters. This result implies that the competitive pressures increase both the probability that a non-certified firm wants to have a certified firm as supplier and the probability that a certified firm wants be a supplier of a non-certified firm.

Having other type of certification or total quality management has positive effect only when we compare Indirect Adopters vs Non Adopters. On the other hand, when we compare Direct Complete Adopters vs Indirect Adopters or Direct Complete Adopters +Direct Non Complete Adopters vs Indirect Adopters, the other type of certification or total quality management will impact adoption negatively.

Concerning the quality department and outsourcing, it is important to mention that “full time quality management “ and “outsource quality manager” variables are included in the regression and not in the productivity equations, hence it can be consider as an instrument. We can notice that variable “full time quality manager” impacts positively ISO 9000 adoption for all five regressions. Furthermore, outsource quality manager has positive impact on ISO 9000 adoption, indeed as we can see the variable is positive and significant for four regressions (out of five).

Finally logarithm of capital per employee or logarithm per labour has positive impact on ISO 9000 adoption. As we can see, logarithm of capital per employee is positive and significant for four regressions. Moreover, we found the same results as in the literature relating to the effects of number of employees on the adoption of ISO certification (Anderson et al., 1999; Terlaak and King, 2006). Generally, the firm’s size mainly determines the firm’s possibility (in a sense of financial resources) to choose one of the categories of ISO adopters.

The second stage results define factors that may impact on logarithm of added value per employee for ISO adopters of superior level inside the network (tables 3 and 6). The first group of variables that we have utilized is sector of activity as in previous stage. The findings indicate that majority of sectors have positive and significant impact on the dependent variable.

Concerning the features of the company’s strategy, we can see from Tables 3 and 6 that for our five regressions only variable “cost reduction” is significant, but with negative sign. This indicates that when cost reduction is important or very important company’s strategy, it impact negatively added value.

Concerning the external market’s constraints we notice that for our four regressions only competitive pressure and uncertainty on the market impact added value, but negatively.

Concerning the variable “other type of certification or total quality management” seems to impact negatively logarithm of value added per employee (for firm belonging to superior position inside ISO network). Indeed, this variable is negative for two regressions (out of five).

Finally, the variables “logarithm of capital per employee” and “logarithm of the labour have positive and significant impact on logarithm of added value per employee for ISO adopters of superior level inside the network for four regressions.

The third stage results define factors that may impact on logarithm of added value per employee for ISO adopters of inferior level inside the network. Concerning the variable sector of activity, as we can see from the Tables 4 and 8 results are similar as in second stage.

Concerning variables of features of the company’s strategy, we notice that only quality improvement has positive and significant impact on choice of ISO adopters for thee regression. Furthermore, as in previous regime, the variable cost reduction when significant is negative, when comparing Direct Complete Adopters vs Non Adopters, Indirect Adopters vs Non Adopters and Direct Complete Adopters +Direct Non Adopters vs Non Adopters. The variable new process has negative impact on logarithm of added value per employee for ISO adopters of inferior level inside the network when comparing Direct Complete Adopters vs Non Adopters and Direct Adopters +Non Adopters vs Non Adopters.

Concerning the external market’s constraints, we can see from table 4 and table 7 that, the coefficients, when significant, are negative. We can conclude that competitive pressure has negative impact on our dependent variable for four regressions. Similarly the variable uncertainty on the market also has negative impact for three regressions. Furthermore, the findings suggest that clients conditioned has negative impact when we compare for Direct Complete Adopters vs Non Adopters and Direct Complete Adopters+ Direct Non Adopters vs Non Adopters.

Having other type of certification or total quality management has positive effect when we compare Direct Complete Adopters vs Indirect Adopters and Direct Complete Adopters +Direct Non Complete Adopters vs Indirect Adopters. On the other hand, the variable “other type of certification or total quality management” impact negatively logarithm of value added per employee (for firms belonging to inferior position inside ISO 9000 network) when we compare Indirect Adopters vs Non Adopters.

Finally, the logarithm of the capital per employee is positive for all five regressions. However, the partial elasticity for capital is slightly higher for certain regression in the regime with superior position

inside the ISO network for model. On other hand, the logarithm of the labor is significant and negative for all five regressions.

Furthermore, we compare observed and predicted productivity's mean of our five ISO dummies (see able 5 and table 9). Switching model ensure us to predict productivity, conditionally on the position inside ISO network. For this, we use equations (5) and (6). With this method, predicted productivity include the correlation parameters between the ISO adopter's position equation and the productivity equations. This endogenous bias correction allowed by switching regression leads us to following conclusions⁹.

The comparison between Direct Complete Adopters and Indirect Adopters shows positive results concerning the effects on the productivity (table 5). This result confirms the prediction given by the graphic in Figure 1: Indirect Adopters have a link that permits them to enter into the ISO Club and thus differentiate themselves from Non Adopters. One can also remark that the coefficient of significance in Models 1 and 2 are same to those in Models 4 and 5 despite the fact that Direct Complete Adopters and Direct Non Complete Adopters have been merged.

This leads us to conclude that Direct Non Complete Adopters are in a more advantageous position inside the network as compared to Indirect Adopters or Non Adopters. Moreover, since both actors (firm and suppliers) within Direct Complete Adopters are certified, it permits this group to have the highest impact on the productivity. Furthermore, although the suppliers of Direct Non Complete Adopters are not certified, the firms' certification still gives them a possibility to have a high impact as evidenced by their second position inside the network hierarchy.

The case of Indirect Adopters proves that firms can also indirectly profit form the ISO certification (via suppliers) and that firms inside this group differ from Non Adopters. Indeed, Indirect Adopters take up the third position in regards to the strength of impact effects, while Non Adopters occupy the lowest position. We also observed that the difference for our dependent variable, productivity,

⁹ A classical test for the equality of predicted productivity shows that this difference is statistically significant.

between firms within Indirect Adopters and Non Adopters which shows us that Indirect Adopter firms gain from ISO certification via their certified suppliers. In Model 5, merging Direct Complete Adopters with Direct Non Complete Adopters decreased the value of the predicted value (when it is compared with Non Adopters). This could mean that the ISO certified firms dealing with the non ISO certified suppliers have some negative signal on the market.

There is a positive correlation between the hierarchy in the network and the impact on productivity. The productivity of Direct Complete Adopter firms is higher than those of Direct Non Complete Adopter firms which are higher than those of Indirect Adopter firms which are higher than those of Non Adopter firms. These findings suggest that being a certified firm amplifies a positive effect on the productivity of firms. In addition, owing to the network effect, a non-certified firm dealing with certified suppliers (Indirect Adopters) can also improve their productivity.

6. Conclusions

The main contribution of this article is the provision, through a network analysis, of empirical evidence demonstrating the ISO norms as Club Goods. We show that companies which are not ISO certified will, if they have ISO certified firms as suppliers, profit from this network generating the positive signal on the market through their certified suppliers.

Moreover, our *empirical paper* poses the important *theoretical question* as to whether the number of firms which are ISO certified is equal to the Pareto optimal number of ISO certified firms. This question is not trivial. At the first glance, due to the existence of external factors, the answer could be a negative one (i.e. the number of firms which are ISO certified is lower than the Pareto optimal number of ISO certified firms). However, since there is no 'poaching effect' (i.e. the companies which are not ISO certified also have to pay an additional cost in order to have ISO certified suppliers), the firms which are not ISO certified directly have in some sense internalised the external effects in their behaviour. Hence, it may be the case that a number of firms which are ISO certified is equal to the Pareto optimal number of ISO certified firms.

Acknowledgments

We thank the participants of seminars held at the Centre d'Etudes de l'Emploi and at the University of Evry, especially Oana Calavrezo. We thank also Richard Duhautois and Dominique Redor. This paper has been presented at the Applied Econometrics Association Conference in Strasbourg, France (June 2007), at the "Antitrust for Networks" summer school at the University of Verona, Italy (June 2007), at the "Public Economics and the Provision of Global Public Goods" INFER workshop in Galway City, Ireland (September 2007), at the conference on Applied Infrastructure Research (INFRADAY) held in Berlin, Germany (October 2007), at the conference "Les Journées Doctorales de l'ADRES ", Toulouse (January, 2008) and at conference "25èmes Journées de Microéconomie Appliquée", Saint-Denis, La Réunion (May, 2008).

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Table 2. Switching regression (part 1)
Equation 1: Determinants of choosing one of the ISO categories

	Direct Complete Adopters vs Indirect Adopters (ref)	Direct Complete Adopters vs Non Adopters (ref)	Indirect Adopters vs Non Adopters (ref)
Constant	-2.35***	-4.40***	-2.34***
	Features of the company's strategy <i>Ref = Less Important and Not Important</i>		
Quality improvement	-0.00	0.22***	0.17**
Cost reduction	0.05	0.09	0.08
New process	0.13**	0.15***	0.02
	External market's constraints		
Competitive pressure-yes	0.00	0.05	0.14**
Uncertainty on the market-yes	-0.08	-0.05	0.04
Clients conditioned- yes	0.08	0.28***	0.16***
Suppliers conditioned-yes	-0.03	0.11*	0.12*
Stockholders conditioned-yes	0.02	0.18**	0.06
	-0.39***	-0.02	0.54***
	Quality department and outsourcing in 1994		
Full time quality manager-yes	0.31***	0.62***	0.23***
Outsource quality manager-yes	0.30***	0.38***	0.06
	Capital and Labor		
Logarithm of the capital per employee	0.22***	0.20***	0.03
Logarithm of the labor	0.28***	0.51***	0.21***
	Sector of Activity <i>Ref = textile industry</i>		
Agro-Food Industry	-0.19	0.35***	0.61***
Industry of wearing, leather and shoes	-0.67***	-0.87*	-0.25**
Industry of edition, printing and reproduction	-0.14	-0.32*	-0.06
Manufacture of soap, perfumes and care products and Pharmaceutical industry	-0.73***	0.41**	0.94***
Manufacture of household equipments	-0.11	0.16	0.34**
Manufacture of automobiles	0.78***	1.22***	0.50*
Manufacture of naval, aeronautical and railroad materials	0.24	1.13***	0.96***
Manufacture of boilers, manufacture of metallic tank, mechanical equipment and machines for general utilisation	0.62***	1.14***	0.71***
Manufacture of machines for agro-culture, machines-tools of others specific machines and weapon and munitions	0.19	0.74***	0.72***
Manufacture of electric and electronic equipment	0.87***	1.42***	0.72***
Eextractives industries/ Manufacture of glass and other product glass and ceramic products and construction equipments	0.22	0.22	0.13
Manufacture wood and paper	0.19	0.48***	0.35**
Industry of artificial fiber , synthetic products and plastic materials	0.72***	1.13***	0.53***
Industry of mineral, organic and parchemical products	0.54***	1.09***	0.41**
Metallurgies and Transformation of materials	0.92***	1.42***	0.73***
Manufacture of electric and electronic components	0.91***	1.57***	0.84***

Table 3. Switching regression (part 2)

Equation 2: Determinants of logarithm of added value per employee (superior position inside ISO network)

	Direct Complete Adopters vs Indirect Adopters (ref)	Direct Complete Adopters vs Non Adopters (ref)	Indirect Adopters vs Non Adopters (ref)
Constant	2.63***	2.99***	3.03***
Features of the company's strategy <i>Ref = Less Important and Not Important</i>			
Quality improvement	0.03	0.03	-0.00
Cost reduction	-0.07**	-0.08**	0.00
New process	0.02	0.01	-0.02
External market's constraints			
Competitive pressure-yes	-0.05*	-0.05**	-0.09**
Uncertainty on the market-yes	-0.05**	-0.05**	-0.02
Clients conditioned- yes	-0.00	-0.01	-0.04
Suppliers conditioned-yes	-0.02	-0.01	-0.04
Stockholders conditioned-yes	0.02	0.02	0.01
	-0.06***	-0.02	0.03
Quality department and outsourcing in 1994			
Full time quality manager-yes	-	-	-
Outsource quality manager-yes	-	-	-
Capital and Labor			
Logarithm of the capital per employee	0.18***	0.16***	0.15***
Logarithm of the labor	0.05***	0.02***	0.01
Sector of Activity <i>Ref = textile industry</i>			
Agro-Food Industry	0.19**	0.21***	0.10
Industry of wearing, leather and shoes	-0.07	0.01	-0.07
Industry of edition, printing and reproduction	0.21**	0.23**	0.35***
Manufacture of soap, perfumes and care products and Pharmaceutical industry	0.42***	0.50**	0.94***
Manufacture of household equipments	0.08	0.09	0.15*
Manufacture of automobiles	0.23***	0.17**	0.15
Manufacture of naval, aeronautical and railroad materials	0.26***	0.24***	0.20***
Manufacture of boilers, manufacture of metallic tank, mechanical equipment and machines for general utilisation	0.28***	0.22***	0.24***
Manufacture of machines for agro-culture, machines-tools of others specific machines and weapon and munitions	0.34***	0.32***	0.36***
Manufacture of electric and electronic equipment	0.43***	0.36***	0.36***
Eextractives industries/ Manufacture of glass and other product glass and ceramic products and construction equipments	0.24***	0.22***	0.21***
Manufacture wood and paper	0.21***	0.18***	0.09
Industry of artificial fiber , synthetic products and plastic materials	0.23***	0.16**	0.12
Industry of mineral, organic and parchemical products	0.65***	0.60***	0.81***
Metallurgies and Transformation of materials	0.20***	0.12**	0.08
Manufacture of electric and electronic components	0.25***	0.17***	0.11

Table 4. Switching regression (part 3)

Equation 3: Determinants of logarithm of added value per employee (inferior position inside ISO network)

	Direct Complete Adopters vs Indirect Adopters (ref)		Direct Complete Adopters vs Non Adopters (ref)		Indirect Adopters vs Non Adopters (ref)	
Constant	3.13***		3.13***		3.03***	
	Features of the company's strategy <i>Ref = Less Important and Not Important</i>					
Quality improvement	-0.01		0.09***		0.08**	
Cost reduction	0.00		-0.07**		-0.08**	
New process	-0.04		-0.04*		-0.03	
	External market's constraints					
Competitive pressure-yes	-0.08*		-0.05*		-0.07**	
Uncertainty on the market-yes	0.00		-0.07**		-0.07***	
Clients conditioned- yes	-0.05		-0.07***		-0.07**	
Suppliers conditioned-yes	-0.02		-0.02		-0.03	
Stockholders conditioned-yes	-0.01		-0.00		-0.01	
	0.11***		-0.05		-0.16***	
	Quality department and outsourcing in 1994					
Full time quality manager	-		-		-	
Outsource quality manager	-		-		-	
	Capital and Labor					
Logarithm of the capital per employee	0.12***		0.17***		0.18***	
Logarithm of the labor	-0.05***		-0.05***		-0.04**	
	Sector of Activity <i>Ref = textile industry</i>					
Agro-Food Industry	0.15*		0.14**		0.08	
Industry of wearing, leather and shoes	0.04		0.02		0.02	
Industry of edition, printing and reproduction	0.40***		0.57***		0.56***	
Manufacture of soap, perfumes and care products and Pharmaceutical industry	1.08***		0.55***		0.41***	
Manufacture of household equipments	0.21**		0.10		0.07	
Manufacture of automobiles	0.01		0.18		0.22**	
Manufacture of naval, aeronautical and railroad materials	0.18*		-0.08		-0.14	
Manufacture of boilers, manufacture of metallic tank, mechanical equipment and machines for general utilisation	0.15*		0.31***		0.30***	
Manufacture of machines for agro-culture, machines-tools of others specific machines and weapon and munitions	0.37***		0.22**		0.17**	
Manufacture of electric and electronic equipment	0.22***		0.29***		0.31***	
Eextractives industries/ Manufacture of glass and other product glass and ceramic products and construction equipments	0.18*		0.19***		0.21***	
Manufacture wood and paper	0.07		0.04		0.04	
Industry of artificial fiber , synthetic products and plastic materials	-0.01		0.07		0.10	
Industry of mineral, organic and parchemical products	0.62***		0.42***		0.48***	
Metallurgies and Transformation of materials	-0.07		0.14*		0.17***	
Manufacture of electric and electronic components	-0.04		-0.01		0.02	
$\sigma_j^2 (j = 0,1)$	0.51	0.44	0.45	0.43	0.49	0.45
$\rho_{j\mu}^2 (j = 0,1)$	-0.62 ***	0.45***	-0.39**	0.02	-0.63***	-0.06

Source: Survey COI merges to the EAE, sample of 2909, 3434 and 2445 companies, respectively.

Field: manufacturing industries of more than 20 employees.

Notes: (*), (**), and (***) indicate parameter significance at the 10, 5 and 1 percent level respectively

Table 5. Observed and predicted productivity

Model 1	Direct Complete Adopters		Indirect Adopters	
	<i>Observed Productivity</i>	<i>Predicted Productivity (a)</i>	<i>Observed Productivity</i>	<i>Predicted Productivity (a)</i>
Means	3.82	3.84	3.66	3.41
SD	0.49	0.24	0.56	0.24

Model 2	Direct Complete Adopters		Non Adopters	
	<i>Observed Productivity</i>	<i>Predicted Productivity</i>	<i>Observed Productivity</i>	<i>Predicted Productivity</i>
Means	3.82	3.84	3.56	3.64
SD	0.49	0.25	0.54	0.26

Model 3	Indirect Adopters		Non Adopters	
	<i>Observed Productivity</i>	<i>Predicted Productivity</i>	<i>Observed Productivity</i>	<i>Predicted Productivity</i>
Means	3.66	3.69	3.56	3.64
SD	0.56	0.32	0.54	0.30

Source: Survey COI merges to the EAE, sample of 2909, 3434 and 2445 companies, respectively.

(a) : Predicted productivity comes from the switching model

Table 6. Switching regression (part 1)
Equation 1: Determinants of choosing one of the ISO categories

	Direct Complete and Direct Non Complete Adopters vs Indirect Adopters (ref)	Direct Complete and Direct Non Complete Adopters vs Non Adopters (ref)
Constant	-1.98***	-4.02***
	Features of the company's strategy <i>Ref = Less Important and Not Important</i>	
Quality improvement	-0.04	0.18**
Cost reduction	0.03	0.07
New process	0.12**	0.12**
	External market's constraints	
Competitive pressure-yes	0.02	0.08
Uncertainty on the market-yes	-0.10*	-0.07
Clients conditioned- yes	0.03	0.23***
Suppliers conditioned-yes	-0.06	0.07
Stockholders conditioned-yes	0.04	0.19***
	-0.38***	0.01
	Quality department and outsourcing in 1994	
Full time quality manager	0.28***	0.58***
Outsource quality manager	0.27***	0.40***
	Capital and Labor	
Logarithm of the capital per employee	0.20***	0.19***
Logarithm of the labor	0.28***	0.48***
	Sector of Activity <i>Ref = textile industry</i>	
Agro-Food Industry	-0.16	0.37***
Industry of wearing, leather and shoes	-0.51**	-0.74***
Industry of edition, printing and reproduction	-0.11	-0.28*
Manufacture of soap, perfumes and care products and Pharmaceutical industry	-0.75***	0.36**
Manufacture of household equipments	-0.07	0.20
Manufacture of automobiles	0.73***	1.17***
Manufacture of naval, aeronautical and railroad materials	0.17	1.05***
Manufacture of boilers, manufacture of metallic tank, mechanical equipment and machines for general utilisation	0.56***	1.08***
Manufacture of machines for agro-culture, machines- tools of others specific machines and weapon and munitions	0.19	0.72***
Manufacture of electric and electronic equipment	0.77***	1.31***
Eextractives industries/ Manufacture of glass and other product glass and ceramic products and construction equipments	0.18	0.16***
Manufacture wood and paper	0.14	0.42***
Industry of artificial fiber , synthetic products and plastic materials	0.70***	1.12***
Industry of mineral, organic and parchemical products	0.48***	1.00***
Metallurgies and Transformation of materials	0.85***	1.36***
Manufacture of electric and electronic components	0.81***	1.47***

Table 7. Switching regression (part 2)

Equation 2: Determinants of logarithm of added value per employee (superior position inside ISO network)

	Direct Complete and Direct Non Complete Adopters vs Indirect Adopters (ref)	Direct Complete and Direct Non Complete Adopters vs Non Adopters (ref)
Constant	2.64***	2.95***
	Features of the company's strategy <i>Ref = Less Important and Not Important</i>	
Quality improvement	0.01	0.02
Cost reduction	-0.08**	-0.09**
New process	0.02	0.01
	External market's constraints	
Competitive pressure-yes	-0.05*	-0.06**
Uncertainty on the market-yes	-0.06**	-0.06***
Clients conditioned- yes	0.01	0.00
Suppliers conditioned-yes	-0.01	0.00
Stockholders conditioned-yes	0.02	0.02
	-0.06**	-0.02
	Quality department and outsourcing in 1994	
Full time quality manager	-	-
Outsource quality manager	-	-
	Capital and Labor	
Logarithm of the capital per employee	0.18***	0.17***
Logarithm of the labor	0.05***	0.03***
	Sector of Activity <i>Ref = textile industry</i>	
Agro-Food Industry	0.20***	0.21***
Industry of wearing, leather and shoes	0.02	0.09
Industry of edition, printing and reproduction	0.20**	0.21**
Manufacture of soap, perfumes and care products and Pharmaceutical industry	0.40***	0.47***
Manufacture of household equipments	0.11	0.12
Manufacture of automobiles	0.21***	0.16**
Manufacture of naval, aeronautical and railroad materials	0.25***	0.24***
Manufacture of boilers, manufacture of metallic tank, mechanical equipment and machines for general utilisation	0.26***	0.21***
Manufacture of machines for agro-culture, machines-tools of others specific machines and weapon and munitions	0.36***	0.34***
Manufacture of electric and electronic equipment	0.42***	0.35***
Eextractives industries/ Manufacture of glass and other product glass and ceramic products and construction equipments	0.22***	0.20***
Manufacture wood and paper	0.19***	0.17**
Industry of artificial fiber , synthetic products and plastic materials	0.23***	0.16**
Industry of mineral, organic and parchemical products	0.61***	0.56***
Metallurgies and Transformation of materials	0.19***	0.11*
Manufacture of electric and electronic components	0.24***	0.17***

Table 8. Switching regression (part 3)

Equation 3: Determinants of logarithm of added value per employee (inferior position inside ISO network)

	Direct Complete and Direct Non Complete Adopters vs Indirect Adopters (ref)		Direct Complete and Direct Non Complete Adopters vs Non Adopters (ref)	
Constant	3.07***		3.17***	
	Features of the company's strategy <i>Ref = Less Important and Not Important</i>			
Quality improvement	-0.00		0.09***	
Cost reduction	0.00		-0.07**	
New process	-0.04		-0.04*	
	External market's constraints			
Competitive pressure-yes	-0.08**		-0.06*	
Uncertainty on the market-yes	0.01		-0.06**	
Clients conditioned- yes	-0.04		-0.07***	
Suppliers conditioned-yes	-0.02		-0.02	
Stockholders conditioned-yes	-0.02		-0.01	
	0.12***		-0.06	
	Quality department and outsourcing in 1994			
Full time quality manager	-		-	
Outsource quality manager	-		-	
	Capital and Labor			
Logarithm of the capital per employee	0.12***		0.16***	
Logarithm of the labor	-0.05***		-0.06***	
	Sector of Activity <i>Ref = textile industry</i>			
Agro-Food Industry	0.15**		0.13***	
Industry of wearing, leather and shoes	0.02		0.03	
Industry of edition, printing and reproduction	0.39***		0.58***	
Manufacture of soap, perfumes and care products and Pharmaceutical industry	1.10***		0.54***	
Manufacture of household equipments	0.20**		0.09	
Manufacture of automobiles	0.02		0.16*	
Manufacture of naval, aeronautical and railroad materials	0.19**		-0.10	
Manufacture of boilers, manufacture of metallic tank, mechanical equipment and machines for general utilisation	0.16**		0.28***	
Manufacture of machines for agro-culture, machines-tools of others specific machines and weapon and munitions	0.37***		0.20***	
Manufacture of electric and electronic equipment	0.23***		0.27***	
Eextractives industries/ Manufacture of glass and other product glass and ceramic products and construction equipments	0.19**		0.20***	
Manufacture wood and paper	0.08		0.04	
Industry of artificial fiber , synthetic products and plastic materials	-0.01		0.05	
Industry of mineral, organic and parchemical products	0.62***		0.41***	
Metallurgies and Transformation of materials	-0.06		0.11	
Manufacture of electric and electronic components	-0.04		-0.04	
$\sigma_j^2 (j = 0,1)$	0.45	0.52	0.46	0.43
$\rho_{j\mu}^2 (j = 0,1)$	-0.64 ***	0.46***	-0.46***	0.01

Source: Survey COI merges to the EAE, sample of 3092 and 3617 companies, respectively.

Field: manufacturing industries of more than 20 employees.

Notes: (*), (**) and (***) indicate parameter significance at the 10, 5 and 1 percent level respectively

Table 9. Observed and predicted productivity

Model 4	Direct Complete +Direct Non Complete Adopters		Indirect Adopters	
	<i>Observed Productivity</i>	<i>Predicted Productivity</i> (a)	<i>Observed Productivity</i>	<i>Predicted Productivity</i> (a)
Means	3.82	3.84	3.66	3.41
SD	0.50	0.25	0.56	0.24

Model 5	Direct Complete +Direct Non Complete Adopters		Non Adopters	
	<i>Observed Productivity</i>	<i>Predicted Productivity</i>	<i>Observed Productivity</i>	<i>Predicted Productivity</i>
Means	3.82	3.84	3.56	3.66
SD	0.50	0.25	0.54	0.25

Source: Survey COI merges to the EAE, sample of 3092 and 3617 companies, respectively.

(a) : Predicted productivity comes from the switching model