"...We argue that certification with a management standard may represent an attempt to communicate about desirable organizational attributes to parties that cannot observe directly. This aspect of certified management standards is inherent in their design and may be critical to their function, yet it remains little explored..."

(Terlaak and King, 2006, p. 580)

1. Introduction

Club Goods are type of goods in Economics classified as a subtype of public goods that are excludable but non rivalrous, at least until reaching a point where congestion occurs. 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 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 membership of *ISO 9000* will provide an important signal to the market a of company's engagement with a policy for quality.

Even if there are many studies concerning 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 (remember that Club Goods are a specific case of Public Goods) fundamentally induces a network of relationship between the different actors. In our case, the advantage of network analysis is that it makes the empirical analysis of ISO as a Club Good, easier. 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 it must be the case that the ISO standard is a Club Good. In this paper, we want to provide empirical evidence of this network effect.

The rationale for our approach is that a costly process, 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 the advantages of ISO certification, but at the same time to avoid the difficult and costly process of certification. Using two French microeconomic surveys called the "Enquête Annuelle d'Entreprises[1]" (EAE 1997) and the "Changement Organisationnel et Informatisation[2]" (COI 1997), we distinguish four types of firms[3]. The first category of firms called

[1]The EAE is a survey covering basic firm-level variables such as employment, sales, capital stock etc…

[2]The COI survey includes information about firms' organizational change and computerization, www.enquetecoi.net.

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 the firms that are certified with ISO 9000 certification but 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 whose suppliers also do not have ISO certification.

This categorisation allows to empirically construct the network of relationships between the firms (certified/non certified)[4]. For instance, Direct Complete Adopters firms are those which are certified and deal only with certified firms. The analysis of the network will give us some information about the relative position of each firm inside the network.

We find out for instance that firms certified with ISO prefer on average to be supplied by ISO certified firms. Moreover even if the suppliers of firms which are not certified with ISO are also, in general, not ISO certified the proportion of firms which are not certified but which have certified companies as suppliers is important. Indeed, 40% of non certified companies (983 firms from 2505 non certified firms) are part of this group. In comparison, only 194 ISO certified firms (from the 2194 companies which are certified) have for suppliers firms which are not ISO certified. Hence, it seems that for firms which are certified, dealing with non certified represents negative signal while we have opposite for firms when suppliers are certified.

Our objective in this paper is not to show the impact of ISO certification on firms' economic performance (this has already done for instance by Terlaak and King, 2006, or Corbett et al., 2005) it is rather to provide an empirical evidence of ISO certification as a Club Good (through a network analysis).

Using the OLS we arrived to conclusion that the economic performance of the Direct Complete Adopters is higher than Direct Non Complete Adopters which is higher than the Indirect Adopters which is higher than the Non Adopters. The result is robust after controlling selection bias (through propensity score estimates), since the economic performance of the Direct Complete Adopters firms is better than the economic performance of the Indirect Adopters firms which is higher than the economic performance of the Non Adopters firms. We did not include the Direct Non Complete Adopters when we control for selection bias (because there is no sufficient number of individuals in this category). Hence, network analysis shows that firms which are not certified gain more when they deal with certified companies (comparing to non certified companies).

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[3]We worked with a sample of 4699 companies with more than 20 employees.

[4] Being 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.

The remainder of the paper is organized as follows. Section 2 describes the ISO 9000. In Section 3, we develop the main issue of the paper. Section 4 presents the data sets and the results of our econometric analyses. Finally section 5 concludes.

2. Brief description of ISO 9000 standard

The ISO's goal is to facilitate worldwide trade trough the development of international standards that add value to products and services.

According to 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"*. According to its design, ISO 9000 only 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", but 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 requires 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 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, but usually it takes between six to twelve months.

Benefits of ISO certification include: increased customer preference, improved company quality image and competitiveness in the market, compliance with customer requirements, streamlined procedures and documentation, increased awareness of preventive and corrective actions, and provision of foundation for TQM. 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, they identified that firms that have directly adopted the ISO certification also ask their suppliers to have this kind of certification.

3. Methodology

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

3.1. Relative position inside the network

In this 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 non-certified improves your signals concerning quality improvement.

As a consequence, the relationship between firms (see Appendix A) will determine their position inside the network. The fact that both two actors (firm and supplier) of Direct Complete Adopters[5] are members of the ISO Club creates a very strong relationship in both ways of diffusion of quality improvement information (presented in Appendix A as link "a"). Even if we do not find both actors of Direct Non Complete Adopters as a member of ISO Club, the firm's certification permits this group to have a strong relationship in one way of diffusion of quality improvement information (link "b"). They lost on their link's strength, but still they have a strong position inside the ISO Club. Further more, in the group of Indirect Adopters, the principal beneficer (firm) of ISO advantages does not belong to ISO Club, but this firm indirectly benefits 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 (link "c"). Finally, firms which belong to the Non Adopters category are not members of ISO Club; the signal in terms of quality information is therefore very weak. So we define the ties between firms belonging to this category as a very weak relationship in terms of diffusion of quality improvement information (link "d").

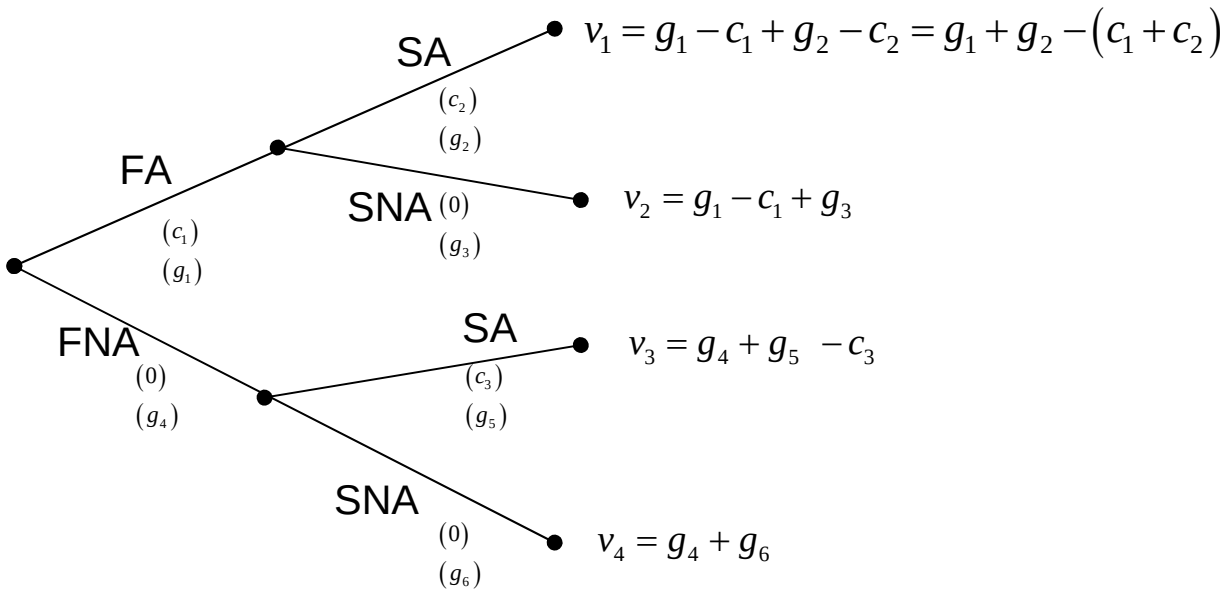
Driving by the strength of the links ("a", "b", "c" and "d"), we can classify our four types of firms: the Direct Complete Adopters are on the top of the classification followed by Direct Non Complete Adopters, Indirect Adopters and Non Adopters, respectively.

3.2. Positioning by Cost-Benefit Analysis

Does this ordering inside the ISO network implies a similar ordering in terms of monetary gains? The level of the cost and benefits could help us to define the real advantages of each member inside the network. Taking into account all possible benefits and costs that are part of being a member of the ISO Club, we will try to graphically understand what is the correlation between the strength of the links and economic value inside the network.

[5]The Direct Complete Adopters includes companies that have ISO 9000 certification and their suppliers also are ISO 9000 certified, the Direct Non Complete Adopters presents the firms that are certified with ISO 9000 certification but their suppliers are not; the Indirect Adopters includes firms which are not ISO certified but their suppliers have ISO certification; and the Non Adopters includes firms that are not ISO certified and whose suppliers do not have ISO certification

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



where:

- FA, FNA, SA and SNA respectively mean "ISO Adopter Firm", "not ISO Adopter Firm", "ISO Adopter Supplier", "not 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 the suppliers that are certified with ISO when the company is not certified ISO certification.

- $g_1 + g_2$ is the gain of the company that is certified with ISO when its suppliers are also certified with ISO certification.

- $g_1 + g_3$ is the gain of the company that is certified with ISO certification when its suppliers are not certified with ISO certification.

- $g_4 + g_5$ is the gain of company that is not certified with ISO certification when its suppliers are certified with ISO certification.

- $g_4 + g_6$ is the gain of company that is not certified with ISO certification when its suppliers are not certified with ISO certification[6]*.*

- v_j , $j \in \{1, 2, 3, 4\}$, is the net monetary gain that company could receive from the implementation/non-implementation of ISO certification.

It is easy to see that v_1, v_2, v_3, v_4 are respectively the value of the Direct Complete Adopters firms, the Direct Non Complete Adopters firms, the Indirect Adopters firms and the Non Adopters firms. Thus, if we consider firms as rational then if they decide to be Direct Complete Adopter, Direct Non Complete Adopter, Indirect Adopter or Non Adopter; it is because the other alternatives lead to a

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

weaker net monetary gain. That is, the decision of a firm to be 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 or Non Adopter, then it is a *priori* impossible to say whether the net monetary gains (v_1) for the Direct Complete Adopter firm is higher than the net monetary gains (v_2) for the Direct Non Complete Adopter firm which is higher than the net monetary gains (v_3) for the Indirect Adopter firm which is higher than the net monetary gains (v_4) for the Non Adopter firm.

3.3 The main question

We want in this paper, to show that the net monetary gain (v_j) of a firm varies according to its relative position in the network (network effect). That is, 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). If the answer to this question is yes this suggests on one hand that our analysis using the concept of Club Goods is pertinent and on the other hand that everything is passing like a network that we presented in Appendix A.

From an empirical standpoint, we will either look at the ordering $v_1 > v_2 > v_3 > v_4$ or to the ordering $v_{1\_2} > v_3 > v_4$ where v_{1_2} is the net monetary gains of the Direct Complete Adopters and the Direct Non Complete Adopters considered as one category. More precisely let y be an economic performance variable (for instance turnover per employee or value-added per employee). y_i is therefore the economic performance variable of firm i. y_i writes: $y_i = Z_{1i} + Z_{2i}$, where Z_{1i} is the economic performance due to all other factors but the position inside the ISO network, and Z_{2i} is the economic performance due to the position inside the ISO network. Let $Z_{1i} = \beta_0 + \beta_1 X_{1i} + \ldots.. + \beta_p X_{pi} + \varepsilon_{1i}$ where the $X_1, \ldots., X_p$ are variables which explained Z_1 and $Z_{2i} = v_1\chi_{1i} + v_2\chi_{2i} + v_3\chi_{3i} + v_4\chi_{4i} + \varepsilon_{2i}$ if we look at the ordering $v_1 > v_2 > v_3 > v_4$ or $Z_{2i} = v_{1\_2}\chi_{1\_2i} + v_3\chi_{3i} + v_4\chi_{4i} + \varepsilon_{2i}$ if we look at the ordering $v_{1\_2} > v_3 > v_4$. Of course, the χ_{1i}, χ_{1_2i}, χ_{2i} , χ_{3i} , χ_{4i} are the characteristic functions equal to 1 if firm i belongs to the corresponding category and 0 otherwise; and ε_{1i} , ε_{2i} are error terms. We will estimate either $y_i = \beta_0 + \beta_1 X_{1i} + \ldots.. + \beta_p X_{pi} + v_1\chi_{1i} + v_2\chi_{2i} + v_3\chi_{3i} + v_4\chi_{4i} + \varepsilon_i$ or $y_i = \beta_0 + \beta_1 X_{1i} + \ldots.. + \beta_p X_{pi} + v_{1\_2}\chi_{1\_2i} + v_3\chi_{3i} + v_4\chi_{4i} + \varepsilon_i$, where ε_i are error term. These two models are of course equivalent respectively to $y_i = \gamma_0 + \beta_1 X_{1i} + \ldots.. + \beta_p X_{pi} + v'_2\chi_{2i} + v'_3\chi_{3i} + v'_4\chi_{4i} + \varepsilon_i$ or $y_i = \gamma_0 + \beta_1 X_{1i} + \ldots.. + \beta_p X_{pi} + v'_3\chi_{3i} + v'_4\chi_{4i} + \varepsilon_i$. As a consequence testing $v_1 > v_2 > v_3 > v_4$ in the model $y_i = \beta_0 + \beta_1 X_{1i} + \ldots.. + \beta_p X_{pi} + v_1\chi_{1i} + v_2\chi_{2i} + v_3\chi_{3i} + v_4\chi_{4i} + \varepsilon_i$ is equivalent to test $0 > v'_2 > v'_3 > v'_4$ in the model $y_i = \gamma_0 + \beta_1 X_{1i} + \ldots..+$

$\beta_p X_{pi} + v'_2\chi_{2i} + v'_3\chi_{3i} + v'_4\chi_{4i} + \varepsilon_i$ and testing $v_{1\_2} > v_3 > v_4$ in the model $y_i = \beta_0 + \beta_1 X_{1i} + \ldots.. + \beta_p X_{pi} + v_{1\_2}\chi_{1\_2i} + v_3\chi_{3i} + v_4\chi_{4i} + \varepsilon_i$ is equivalent to testing $0 > v'_3 > v'_4$ in the model $y_i = \gamma_0 + \beta_1 X_{1i} + \ldots.. + \beta_p X_{pi} + v'_3\chi_{3i} + v'_4\chi_{4i} + \varepsilon_i$. These two models will be estimated in section 4.3.1.

However the position inside the ISO certification network may not be random and may depend to the firms' individual characteristics. Hence, the results provided by the two previous models may be subject to a selection bias. Propensity score technology (which will be used in section 4.3.2) allows correcting the selection bias by matching firms according to their propensity score which is the estimated probability of receiving treatment (the position inside the ISO network) given background characteristics. Moreover, the results of Rosenbaum and Rubin (1983) allow constructing a group of treated firms and a group of non treated ones comparables in accordance to their propensity score. And we can use a non parametric Kernel matching estimator proposed by Heckman, Ichimura, and Todd (1997, 1998) which under some regularity assumptions is convergent and asymptotically normal. Broadly speaking, in this estimator each non treated firm takes part in the construction of a counterfactual of each treated individual, that is to say of an estimate of what would be the response for the treated firm if it was in the non treated population. And the importance of each non treated firm in this construction varies as the distance between his propensity score and that of the treated firm. Moreover, since in order to estimate the treatment effect we have to construct for each treated firm a counterfactual from firms in the non treated population, we must have a set of non treated firms which have propensities scores close to the propensity score of the treated firm. In other words a counterfactual can only be constructed for the firms whose propensity score belongs to the intersection between the support of the propensity score distribution of the treated firms and the support of the propensity score distribution of the non treated firms. Consequently an important point in the estimation concerns the determination of the common support of the propensity score distributions.

4. EMPIRICAL ANALYSIS

4.1 The database

The research is based on two cross section surveys from the French National Institute of Statistics (INSEE): the "Enquête Annuelle d'Entreprises" (the Annual Survey of Industry EAE 1997) and the "Changement Organisationnel et Informatisation" (the Organizational Changes and Computerization COI 1997). The Annual Survey of Industry (EAE) is the principal source of economic data regarding companies' activities, structure and performance. The COI survey was created by researchers and statisticians from the economic administration. This collaboration gathered together a great deal of knowledge, which has made it possible to put together the surveys of different companies and the

survey concerning employees section ("labour force"). In this survey, we can find the manufacturing industry, the agro-food industry, branches of the services industry (i.e. accountancy), and branches of the commercial industry. This COI survey has been used by several researchers like Acemoglu et al. (2007) or Aubert et al. (2006). The choice of the companies is based on the file of the companies in the Annual Survey of Industry (EAE).
We restrict our empirical analysis to the manufacturing industry (Appendix B) and we work with a sample of 4699 companies with more than 20 employees.

4.2. Descriptive Statistics

From the table 1 we can see the distribution of each category of adopters: 2000 (43%), 194 (4%), 983 (21%) and 1522 (32%) respectively for the Direct Complete Adopters, Direct Non Complete Adopters, Indirect Adopters and Non Adopters.
Only 4% of the companies that are under the category of Direct Non Complete Adopters suggests that ISO certified companies avoid having relationships with companies or suppliers that are not certified with ISO. Moreover the proportion of companies not ISO certified but that have certified companies as suppliers is important: 983 firms (from 2505 non certified companies) are part of this group, or approximately 40% of non certified companies. In comparison, only 194 companies certified with ISO (from the 2194 companies that are certified) have for suppliers companies that are not certified with ISO or less then 10%. This suggests, as we excepted, that being certified is (inside this network) a positive signal concerning quality information, and having as a supplier a certified firm amplifies this positive signal.

Our data suggest several important first-order differences between four types of ISO firms. In particular, we can notice that there is a positive correlation between companies' size and the four types of adopters. Furthermore, the quality department is dispersed in each category of adopters, but still the percentage of concentration is positively related with group position inside the network. On the other hand, there is small number of companies (in each category) that utilize quality service from their external partners. Regarded like an investment in a diploma, investment in quality norms can at the same time be a function of improvement of the company's competence and can also make a 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 can notice that the percentage of export is correlated to the position inside the network, decreasing from Direct Complete Adopters (Direct Complete Adopters > Direct Non Complete Adopters > Indirect Adopters > Non Adopters). Finally we observe that firms which are not ISO certified do not actually substitute ISO certification to another type of

certification (QA, ISO 14000, QS …). Indeed as we can see in table 1, 43 % of the Direct Complete Adopters have other types of certification. On the other side, only 16% of the Non Adopters has another kind of certification. It seems therefore that there is no strategy of substitution among companies relating to the quality norms. On the contrary, ISO certification and the other certifications could be complement.

Table 1. Descriptive Statistics

	Direct Complete Adopters	Direct Non Complete Adopters	Indirect Adopters	Non Adopters
	Company's Size			
20 to 49 employees	16% (a)	27%	39%	50%
50 to 199 employees	30%	35%	35%	35%
200 employees and more	54%	38%	26%	15%
	Quality department			
Quality department	84% (b)	68%	54%	27%
	External partners			
External partners	17% (c)	21%	14%	8%
	Export (mean)			
Export	0.25 (d)	0.18	0.17	0.14
	Other Types of Certification			
Not Having other types of certification	57%	73%	46%	84%
Having other types of certification	43% (e)	27%	54%	16%
Total	2000 43%	194 4%	983 21%	1522 32%

Source: Survey COI merges to the EAE, sample 4699 companies, not weighted by the number of employees.
Parameter: manufacturing industries of more than 20 employees.
Lecture: (a) 16% of "direct complete adopters" are companies that have
from 20 to 49 employees (category-small company).
Lecture: (b) 84% of "direct complete adopters" are companies that have quality department.
Lecture: (c) 17% of "direct complete adopters" are companies that ask services of quality form external partners.
Lecture: (d) export of the "direct complete adopters" represent 25% of their turnover.
Lecture: (e) 43% of "direct complete adopters" are companies that have others types of certification.

4.3. The results

4.3.1 OLS Results

We want to estimate using the OLS the model $y_i = \beta_0 + \beta_1 X_{1i} + \ldots.. + \beta_p X_{pi} + v_1 \chi_{1i} + v_2 \chi_{2i} + v_3 \chi_{3i} + v_4 \chi_{4i} + \varepsilon_i$ and the model $y_i = \beta_0 + \beta_1 X_{1i} + \ldots.. + \beta_p X_{pi} + v_{1\_2} \chi_{1\_2i} + v_3 \chi_{3i} + v_4 \chi_{4i} + \varepsilon_i$. However since we use two kinds of dependent variable, we get four models (MODEL 1A, MODEL 1B, MODEL 2A and MODEL 2B).

In MODEL 1A (table 2), the dependent variable is the logarithm of turnover per employee and the independent variables are: the position inside the ISO certification network (Direct Complete Adopters, Direct Non Complete Adopters, Indirect Adopters and Non Adopters), the firm's size, the features of the company's strategy (quality improvement, cost reduction, new procedure), the external constraints (concurrence pressure, uncertainty on the market, clients conditioned, suppliers conditioned, stockholders conditioned), the sectors (45 sectors according to the so-called NAF 114).
MODEL 2A (table 2) is the same as MODEL 1A except that there are only three types of adopters (Direct Complete Adopters + Direct Non Complete Adopters [7] , Indirect Adopters and Non Adopters).
MODEL 1B (table 3) is the same as MODEL 1A, except that the dependent variable is here the logarithm of value-added per employee.
Finally MODEL 2B (table 3) is the same as MODEL 2A except that the dependent variable is (in MODEL 2B) the value-added per employee.

The four models provide similar results. The turnover per employee and the value-added per employee of the Direct Complete Adopters firms are better than those of the Direct Non Complete Adopters firms which are higher than those of the Indirect Adopters firms which are higher than those of the Non Adopters firms. These findings suggest that being certified amplifies a positive effect on the economic performance of firms; however thanks to the network effect a non-certified firm dealing with certified suppliers (Indirect Adopters) can improve their economic performance. There is a positive correlation between the hierarchy in the network and the impact on the turnover per employee and the value-added per employee, it starts with Direct Complete Adopters, then Direct Non Complete Adopters after Indirect Adopters and on the last position are the Non Adopters.

However since these results do not take into account the selection effects it may be the case that they are biased.

[7] We have merged Direct Complete and Direct Non Complete Adopters.

Table 2. Effect on the logarithm of the Turnover per Employee

	Model 1	**Model 2** (a)
Intercept	7.26***	7.25***
	Types of ISO's adopters	
Direct Complete Adopters	**ref**	
Direct non Complete Adopters	-0.08*	**ref**
Indirect Adopters	-0.10***	-0.09***
Non Adopters	-0.23***	-0.21***
	Company's size	
20 to 49 employees	**ref**	**ref**
50 to 199 employees	-0.00	-0.00
200 employees and more	0.11***	0.11***
	Features of the company's strategy	
Quality improvement (b)	-0.05*	0.05*
Cost reduction (b)	-0.04	-0.04
New procedure (b)	0.03	0.03
	External market's constraints	
Concurrence pressure-yes	-0.03	-0.04
Uncertainty on the market-yes	-0.07***	-0.07***
Clients conditioned- yes	-0.03	-0.02
Suppliers conditioned-yes	-0.01	-0.01
Stockholders conditioned-yes	0.12***	0.12***
R-Square	0.29	0.29

Source: Survey COI merges to the EAE, sample 4699 companies.
Parameter: manufacturing industries of more than 20 employees.
The regression integrates 45 indexes of industries that correspond to NAF 114 (reference: textile industry).
Notes: (*), (**) and (***) indicate parameter significance at the 10, 5 and 1 percent level respectively.
(a) In the model 2 the categories "Direct Complete Adopters" and "Direct Non Complete Adopters" are merged.
(b) Ref: for the category of features of the company's strategy- important and very important.

Table 3. Effect on the logarithm of the Value- Added per Employee

	Model 1	**Model 2** (a)
Intercept	5.90***	5.89***
	Types of ISO's adopters	
Direct Complete Adopters	**ref**	
Direct non Complete Adopters	-0.08*	**ref**
Indirect Adopters	-0.12***	-0.11***
Non Adopters	-0.17***	-0.16***
	Company's size	
20 to 49 employees	**ref**	**ref**
50 to 199 employees	-0.05**	-0.05**
200 employees and more	0.05*	0.05**
	Features of the company's strategy	
Quality improvement (b)	-0.02	-0.04
Cost reduction (b)	0.02	0.02
New procedure (b)	-0.00	0.00
	External market's constraints	
Concurrence pressure-yes	-0.07***	-0.07***
Uncertainty on the market-yes	-0.06***	-0.06***
Clients conditioned- yes	-0.02	-0.02
Suppliers conditioned-yes	-0.03*	0.03*
Stockholders conditioned-yes	0.03	0.04
R-Square	0.21	0.20

Source: Survey COI merges to the EAE, sample 4699 companies.
Parameter: manufacturing industries of more than 20 employees.
The regression integrates 45 indexes of industries that correspond to NAF 114 (reference: textile industry).
Notes: (*), (**) and (***) indicate parameter significance at the 10, 5 and 1 percent level respectively.
(a) In the model 2 the categories "Direct Complete Adopters" and "Direct Non Complete Adopters" are merged.
(b) Ref: for the category of features of the company's strategy- important and very important.

4.3.2 Results with Propensity Score Estimates

a. Method

Let us remind that the economic performance variable was denoted y and that y is either the (logarithm of the) turnover per employee or the (logarithm of the) value-added per employee. To test the existence of a network effect, we will consider the positions inside the network as the treatments and evaluate the effect of each treatment on y. Let T be a dummy variable indicating if the firm has received (T=1) or not (T=0) the treatment. y_1 will be the economic performance of the treated firms and y_0 will be the economic performance of the non-treated firms. For instance, let us consider the following model in which we compare the Direct Complete Adopters to the Indirect Adopters (MODEL 1C1) then T = 1 if the firm is a Direct Complete Adopter and 0 if the firm is an Indirect Adopter. y_1 will be for instance the (logarithm of the) value-added per employee of the Direct Complete Adopters firms and y_0 will be the (logarithm of the) value-added per employee of the Indirect Adopters firms.

Thus three quantities are of interest to us: $C=E [y_1-y_0]$ is the average treatment effect over the whole population; $C_1 = E [y_1-y_0 \mid T = 1]$ is the average treatment effect over treated firms and $C_0 = E [y_1-y_0 \mid T = 0]$ is the average treatment effect over non-treated firms.

To resume, we will consider ten models[8]:

- *In Models 1C1 and 1D1*, T = 1 if the firm is a Direct Complete Adopter and T = 0 this firm is an Indirect Adopter.
- *In Models 1C2 and 1D2*, T = 1 if the firm is a Direct Complete Adopter and T = 0 this firm is a Non Adopter.
- *In Models 1C3 and 1D3*, T = 1 if the firm is an Indirect Adopter and T = 0 this firm is a Non Adopter.
- *In Models 2C1 and 2D1*, T = 1 if the firm is a Direct Complete Adopter or a Direct Non Complete Adopter and T = 0 if this firm is an Indirect Adopter.
- *In Models 2C2 and 2D2*, T = 1 if the firm is a Direct Complete Adopter or a Direct Non Complete Adopter and T = 0 if this firm is a Non Adopter.

For each model, we will estimate the quantities C, C_1 and C_0. The estimation proceeds as follows:

- The propensity score is estimated from a logistic model. That is, treatment (position inside the ISO network) is the explained variable, background characteristics are the explanatory

[8] We do not take directly compare the Direct Non Complete Adopters with the other categories because only 195 firms are Direct Non Complete Adopters.

variables, and the estimated probability of receiving treatment given background characteristics is the propensity score.

- The common support is computed as the intersection between the propensity score for the treated group and the propensity score for the control group.
- We estimate the treatment causal effect using a non parametric Kernel matching estimator proposed by Heckman, Ichimura, and Todd (1997, 1998).
- The estimate standard deviation is computed by bootstrap.

b. Determinants of the position inside the ISO network

The results concerning the logistic regressions are available in Appendix C (tables C1 and C2). The first group of variables that we have utilised are company's size and sector of activity. We found the same results as in the literature relating the effect of company's size or sector of activity on the adoption of ISO certification (Anderson et al., 1999; Terlaak and King, 2006). Generally, the firm's size mainly determines firm possibility (in sense of financial resources) to choose one of the categories of ISO adopters. We can note in tables C1 and C2 that variables concerning the company's size are positive and significant for the five logistic regressions.

We have used 45 sectors of different activities and as a reference the sector of textile industry. As in the literature, we find out that the probability to be ISO certified in stronger in some industries like the electrical, basic metal, construction, machinery, chemical industries, and steel industry.

Concerning the features of the company's strategy, we can see from tables C1 and C2 that for our five logistic regressions and for the three variables (Quality improvement, Cost reduction, New procedure), the coefficients, when significant, are negative. When quality improvement, cost reduction and new procedure are important or very important for the company's strategy, it will increase the probability to be ISO certified and to be a Direct Complete Adopter (comparing to being a Non Adopter). It is interesting to note that when comparing the Direct Complete Adopters to the Indirect Adopters, only the new procedure variable plays a role in the decision to be a Direct Complete Adopter, but only at a 10% level of significance. When comparing the Indirect Adopters to the 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 the probability to be ISO certified and in the position inside the ISO network. Indeed this variable is not significant in four regressions (out of five). It is significant (only at 10%) when comparing the Direct Complete Adopters + Direct Non Complete Adopters with the

Indirect Adopters. A meaning could be that market uncertainty increases the probability, that non ISO certified firms want to have ISO certified firms as suppliers. If we look at the other variables (concurrence pressure, clients-conditioned, suppliers-conditioned and stockholders-conditioned), the coefficients, when significant, are positive. For instance, the variable clients-conditioned is significant (at 1%) for three logistic regressions out of five. A meaning is that when clients' condition is an important external constraint then firms will adopt ISO certification either directly or through their suppliers. The same explanation can also be used for the stockholders, except in this case that the companies are more obligated to perform driven by stockholders' conditions. Another interesting result is that only firms under the category Indirect Adopters vs Non Adopters are sensible on the conditions imposed by suppliers. The possible explanation for this is that companies that represent other categories have only chosen suppliers that have similar attitudes to business as them. Finally it is quite surprising that the variable "concurrence pressure" is significant (at 5%) only when comparing the Indirect Adopters with the Non Adopters and when comparing the Direct Complete Adopters + Direct Non Complete Adopters with the Non Adopters. A meaning could be that concurrence pressures both increases the probability that a non-certified firm wants to have a certified firm as supplier and that the probability that a certified firm wants be a supplier of a non-certified firm.

c. Naïve results and PS-matching results

We will first introduce the PS-matching results and then compare these results with the naïve ones, revealing some selection effects. Broadly speaking, the PS-matching results (in table 5) stand for the OLS results. The comparison between the group of Direct Complete Adopters and Indirect Adopters releases positive results concerning the effect on the turnover per employee. This result confirms the intuitions given by the graphic in Appendix A: the Indirect Adopters dispose the link that permits them to enter into the ISO Club and like this to differentiate themselves from Non Adopters. We can find similar results for the effect of ISO categories on the value-added per employee. One can also remark that the coefficient of significance in MODELS 2C1, 2C2, 2D1 and 2D2 are similar to those in MODELS 1C1, 1C2, 1D1 and 1D2, despite the fact the Direct Complete Adopters and Direct Non Complete Adopters have been merged. This can drive us to the conclusion that Direct Non Complete Adopters are in an advantageous position inside the network compared to the Indirect Adopters or the Non Adopters. Moreover the fact that both two actors (firm and suppliers) are certified permits the group of Direct Complete Adopters to have the strongest impact on the economic performance. Further more, even if suppliers of Direct Non Complete Adopters are not certified the firms' certification gives them the possibility to have a strong impact, due to evidence that those companies are on the second position concerning the strength of the impact inside the network hierarchy. The case of Indirect Adopters proves that firms can indirectly profit form the ISO certification (via suppliers) and that firms inside this group differ from Non Adopters. Moreover, the firms under the category of Indirect

Adopters are on the third position relating the strength of impact effect, while the group of Non Adopters occupied the last position. We observe also that the highest difference is between firms under the categories of Direct Complete Adopters and Non Adopters for two dependent variables, turnover per employee and value-added per employee. Further more, the difference between firms under categories Indirect Adopters and Non Adopters shows us more again that the companies under the category Indirect Adopters gain from ISO certification via their certified suppliers. In MODELS 2C1, 2C2, 2D1 and 2D2, merging the Direct Complete Adopters with the Direct Non Complete Adopters decreases the value of the estimated coefficients (starting from MODELS 1C1, 1C2, 1D1 and 1D2). A meaning could be that for ISO certified firms, dealing with non ISO certified firms represents a negative signal.

Finally the comparison of the results of the naïve estimates with the results of the PS-matching provides empirical evidence of selection effects. Indeed in general, the figures of the naïve estimates are different (and higher) than those of the PS-matching. For instance, in MODELS 1D1 and 1D2, the mean difference in terms of the logarithm of the turnover per employee between the Indirect Adopters and the non Adopters is 0.28 (significant at 1%, see table 4a) while this difference is only 0.13 (significant at 1%, see table 6).

Table 4a. Mean on the logarithm of the Turnover per employee and the logarithm of the Value-Added per employee

	Mean on the logarithm of the Turnover per employee	Mean on the logarithm of the Value-Added per employee
Direct Complete Adopters	6.91	5.79
Direct Non Complete Adopters	6.85	5.69
Indirect Adopters	6.79	5.64
Non Adopters	6.51	5.51
	Difference of Mean (Naïve estimates)	
Direct Complete Adopters vs Indirect Adopters	0.12***	0.25***
Direct Complete Adopters vs Non Adopters	0.40***	0.28***
Indirect Adopters vs Non Adopters	0.28***	0.13***

Source: Survey COI merges to the EAE, sample 4699 companies.
Parameter: manufacturing industries of more than 20 employees.
The regression integrates 45 indexes of industries that correspond to NAF 114 (reference: textile industry).
Notes: (*), (**) and (***) indicate parameter significance at the 10, 5 and 1 percent level respectively.

Table 4b. Mean on the logarithm of the Turnover per employee and the logarithm of the Value-Added per employee

	Mean on the logarithm of the Turnover per employee	Mean on the logarithm of the Value-Added per employee
Direct Complete Adopters and Direct Non Complete Adopters (a)	6.90	5.78
Indirect Adopters	6.79	5.64
Non Adopters	6.51	5.51
	Difference of Mean (Naïve estimates)	
Direct Complete and Direct Non Complete Adopters (a) vs Indirect Adopters	0.11***	0.14***
Direct Complete and Direct Non Complete Adopters (a) vs Non Adopters	0.39***	0.27***

Source: Survey COI merges to the EAE, sample 4699 companies.
Parameter: manufacturing industries of more than 20 employees.
The regression integrates 45 indexes of industries that correspond to NAF 114 (reference: textile industry).
Notes: (*), (**) and (***) indicate parameter significance at the 10, 5 and 1 percent level respectively.
(a) The categories Direct Complete Adopters and Direct Non Complete Adopters are merged.

Table 5. PS-matching estimates (a)

	Global	Treated	Non-treated
	Effect on the logarithm of Company's Turnover per employee		
MODEL 1C1 : Direct Complete Adopters *vs* Indirect Adopters	0.11***	0.09**	0.14***
MODEL 1C2 : Direct Complete Adopters *vs* Non Adopters	0.26***	0.24***	0.28***
MODEL 1C3 : Indirect Adopters vs Non Adopters	0.13***	0.13***	0.13***
	Effect on the logarithm of Company's Value-Added per employee		
MODEL 1D1 : Direct Complete Adopters *vs* Indirect Adopters	0.11***	0.10**	0.13**
MODEL 1D2 : Direct Complete Adopters *vs* Non Adopters	0.18***	0.16***	0.19***
MODEL 1D3 : Indirect Adopters vs Non Adopters	0.05**	0.05*	0.05*
	Effect on the logarithm of Company's Turnover per employee		
MODEL 2C1 : Direct Complete and Direct Non Complete Adopters *vs* Indirect Adopters	0.09**	0.08**	0.13**
MODEL 2C2 : Direct Complete Adopters and Direct Non Complete *vs* Non Adopters	0.23***	0.22***	0.25***
	Effect on the logarithm of Company's Value-Added per employee		
MODEL 2D1 : Direct Complete and Direct Non Complete Adopters *vs* Indirect Adopters	0.10***	0.09***	0.13***
MODEL 2D2 : Direct Complete Adopters and Direct Non Complete *vs* Non Adopters	0.16***	0.15***	0.18***

Source: Survey COI merges to the EAE, sample 4699 companies.
Parameter: manufacturing industries of more than 20 employees.
The regression integrates 45 indexes of industries that correspond to NAF 114 (reference: textile industry).
Notes: (*), (**) and (***) indicate parameter significance at the 10, 5 and 1 percent level respectively.
(a) The supports are available in Appendix D.

5. Conclusion

The main contribution of this article is to provide, trough network analysis, an empirical evidence of ISO norms as Club Goods. We show for instance that companies which are not ISO certified will, if they have ISO certified firms as suppliers, profit from this network generating the positive signal of their certified suppliers. Because of these externalities, our paper states the important theoretical question whether the number of firms which are ISO certified is equal to the Pareto optimal number of firms. The question is not trivial. Indeed at first glance, because of the existence of these externalities, the answer could be negative (the number of firms which are ISO certified is less than the Pareto optimal number of firms). However, since there is here no poaching effect (i.e. the companies which are not ISO certified pay an additional cost in order to have a ISO certified suppliers), the firms which are not ISO certified have in some sense internalized the external effects of their behaviour. Hence it may be the case that the number of firms which are ISO certified is equal to the Pareto optimal number of firms.

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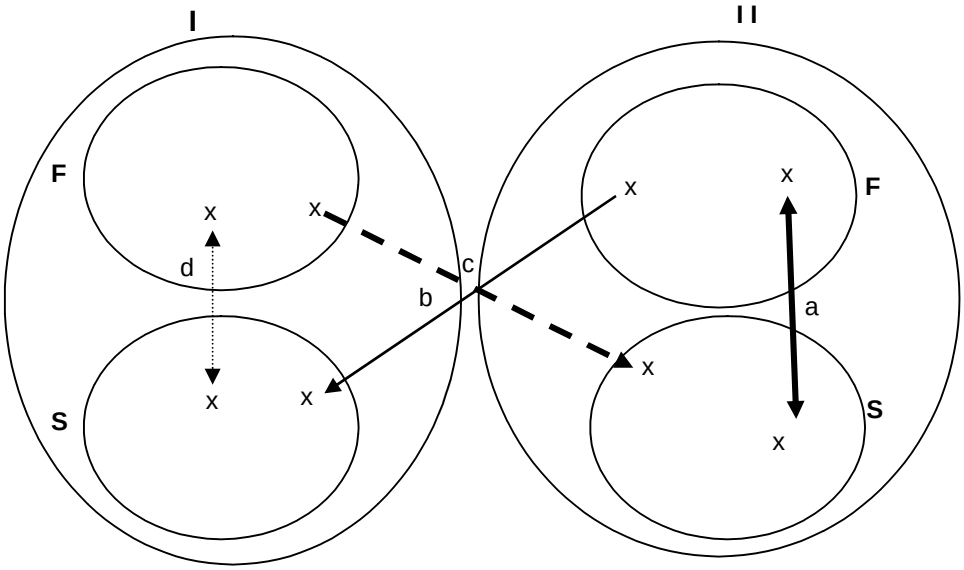
Appendix A.
Graph of Correlation inside ISO Network



LEGEND:

Set "I" is the Non-adopter's network
Set "II" is the ISO adopter's network

Subset "F" is a set of firms which do not supply any other firms
Subset "S" is the set of firms which supplies other firms

The nodes:
Node "x" = firm or supplier

The links:

- *Link "a"* represents a very strong correlation in both ways of diffusion of quality improvement information between ISO's adopters. It represents the Direct Complete Adopters companies that have ISO certification and their supplier also certified and was therefore called Direct Complete Adopters.
- *Link "b"* represents a strong correlation in one way of diffusion of quality improvement information between ISO's adopters and non adopters (that could be reflected by firm- adopter of ISO). It represents the Direct Non Complete Adopters the companies that are certified with ISO certification but their suppliers are not
- *Link "c"* represents a not strong correlation in way of diffusion of quality improvement information between ISO's adopters and non adopters (that could be reflected by supplier- adopter of ISO). It represents the Indirect Adopters which is focused on suppliers that have ISO certification, but companies they supply are not certified.
- *Link "d"* represents a very weak correlation in way of diffusion of quality improvement information between ISO's non adopters. It represents the Non Adopters companies that are not certified in either direct or indirect way, companies that do not have ISO certification and also their suppliers that do not have ISO certification.

Appendix B.
Variables from the COI and EAE data sets

1) VARIABLES FROM THE COI SURVEY

FEATURES OF THE COMPANY'S STRATEGY (control variables)

What is the importance of the following factors concerning the general strategy of your company?

		Not much important	Quite important	Important	Very important
Q11	**Quality improvement**	1	2	3	4
Q14	**Cost reduction**	1	2	3	4
Q15	**New procedure**	1	2	3	4

EXTERNAL MARKET'S CONSTRAINTS (control variables)

Between 1994 and 1997, which constraints have influenced on the choice of your company concerning… Q2XORGfor organisation and Q2XINF for computerization		**...of the organization**		**...of the computerization**	
		Yes	No	Yes	No
Q21	**Concurrence pressure**	1	2	1	2
Q22	**Uncertainty on the market**	1	2	1	2
Q23	**Clients conditioned**	1	2	1	2
Q24	**Suppliers conditioned**	1	2	1	2
Q27	**Stockholders conditioned**	1	2	1	2

QUALITY DEPARTMENT AND EXTERNAL PARTNERS (*descriptive statistics table 1)*

Does your company dispose with full time employed employees for each following function? **Does your company have external partners for certain functions?**		**In 1997**		**Created since 1994**		**In 1997**		**Evolution since 1994**		
		Yes	No	Yes	No	Yes	No	+	=	-
Q35CA97 /Q35PR97	**Quality**	1	2	1	2	1	2	1	2	3

HAVING ISO CERTIFICATION IN 1994 AND 1997 (using for creation of variable for treatment)

Does your company use following? Q4X97 for 97 and Q4XEV for evolution?		**In 1997**		**Change in the % of employees affected since 1994**		
		Yes	No	+	=	-
Q41	**Certification ISO 9001, ISO 9002,**	1	2	1	2	3

OTHER TYPES OF CERTIFICATION (descriptive statistics table 1)

Does your company use following? Q4X97 for 97 and Q4XEV for evolution?		**In 1997**		**Change in the % of employees affected since 1994**		
		Yes	No	+	=	-
	Other system of certification or measure of total quality	1	2	1	2	3

HAVING ISO CERTIFIED SUPPLIERS IN 1994 AND 1997 (using for creation of variable for treatment)

IN 1997 does your company ask certain suppliers or subcontractors		**Yes**	**No**
Q103	**… to conform to ISO norms or to others quality norms?**	1	2

2) VARIABLES FROM THE EAE SURVEY

TURNOVER (dependent variable)

We used the logarithm of turnover per employee.

VALUE-ADDED (dependent variable)

We used the logarithm of value-added per employee.

EXPORT (descriptive statistics table 1)

The variable export is presented as percentage. The percentage is calculated, export by company's turnover.

Appendix C.
Logistic Regressions

Table C1: 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)
Intercept	-0.72***	-1.50***	-0.87***
	Size of the company *Ref = 20 to 49 employees*		
50 to 199 employees	0.78***	1.11***	0.33** *
200 employees and more	1.75***	2.69***	0.92***
	Features of the company's strategy *Ref = Important and Very Important*		
Quality improvement	0.01	-0.34**	-0.37***
Cost reduction	-0.13	-0.31**	-0.18
New procedure	-0.19*	-0.34***	-0.13
	External market's constraints		
Concurrence pressure-yes	0.04	0.17	0.27**
Uncertainty on the market-yes	-0.16	-0.13	0.05
Clients conditioned- yes	0.10	0.52***	0.39***
Suppliers conditioned-yes	-0.13	0.16	0.18*
Stockholders conditioned-yes	0.16	0.50***	0.27**
	Sector of Activity *Ref = textile industry*		
Industry of leather and shoes	-1.31***	-2.88***	-1.57***
Manufacture of wearing	-1.29**	-3.44***	-1.79***
Pharmaceutical industry	-0.11	-1.75***	-1.28***
Manufacture of soap, perfumes and care products	-1.35***	0.44	1.61***
Manufacture of furniture	-0.26	-0.13	-0.28
Manufacture of jewellery, musical instruments/ sport products and games	-0.26	-1.25***	-0.88***
Manufacture of household equipments	-1.09**	-1.52***	-0.55*
Manufacture of equipment for reproduction and record (sound and image)/ optical materials, camera, watch	0.14	1.35**	0.94
Manufacture of automobiles	0.34	0.19	-0.25
Manufacture of automobiles equipment	0.62*	0.40	-0.20
Naval construction / railroad materials	2.52***	1.86***	-0.56
Aeronautical and spatial construction	0.92**	0.66	0.07
Manufacture of, vehicles, motor vehicles, transport equipment/ metal elements for construction	0.50	2.79***	2.10**
Boilers, manufacture of metallic tank	-0.37	-0.15	0.24
Manufacture of mechanical equipment	0.86***	0.93***	0.17
Manufacture machines for general utilisation	1.96***	2.25***	0.40
Manufacture of machines for agro-culture/ machines-tools	0.73***	0.67**	-0.16
Manufacture of others specific machines / weapon and munitions	0.23	-0.14	-0.35
Manufacture of machines for office and informatics equipment	0.09	0.41	0.29
Manufacture of motors, generator and equipment for electrical transformation	1.48**	0.74	-0.53

	Direct Complete Adopters vs Indirect Adopters (ref)	Direct Complete Adopters vs Non Adopters (ref)	Indirect Adopters vs Non Adopters (ref)
	Sector of Activity *Ref = textile industry*		
Manufacture of equipment for emission and transmission	1.30***	1.10**	-0.20
Manufacture of medicochirurgie and orthopaedic equipment	2.21***	1.24**	-0.75
Manufacture of equipment for the measurement and the control	1.33***	1.56***	0.24
Other extractives industries	1.09***	1.79***	0.62*
Manufacture of glass and other product glass	-0.31	-1.53***	-0.72**
Manufacture of ceramic products and construction equipments	1.06**	0.06	-1.38***
Cotton and weaving mills	0.45*	-0.29	-0.66***
Manufacture of chain	0.43	-1.05***	-1.44***
Manufacture wood articles	-1.60**	-2.67***	-1.18**
Manufacture of wood filler	-0.48	-1.43***	-1.15***
Manufacture of paper and carton	0.91*	0.80	-0.02
Industry of mineral products	0.66**	0.56*	0.06
Industry of organic products	2.28***	-0.18	-0.26***
Industry of parchemical , artificial fiber and synthetic products	1.24***	2.50***	1.28**
Transformation of plastic materials	1.53***	1.72***	0.10
Steel industry	1.17***	1.04***	-0.07
Manufacture of non-ferrous metals	1.32***	2.41***	1.46**
Industry of melting	2.32***	1.56***	-0.76
Manufacture of metal products	2.08***	1.81***	0.04
Manufacture of electric products	0.78***	0.41*	-0.30
Manufacture of electric corposants	1.43***	1.60***	0.26
Industrial service for metals works	1.63***	1.87***	0.27
Extraction of coal/hydrocarbon/nuclear/petrol	1.60***	1.89***	0.29
Electricity, gas and water supply	2.07***	1.67***	-0.27
Max-rescaled R-Square	0.29	0.53	0.21

Source: Survey COI merges to the EAE, sample of 2983, 3522 and 2505 companies, respectively.
Parameter: manufacturing industries of more than 20 employees.
Notes: (*), (**) and (***) indicate parameter significance at the 10, 5 and 1 percent level respectively.

Table C2: 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)
Intercept	-0.39**	-1.19***
	Size of the company *Ref = 20 to 49 employees*	
50 to 199 employees	0.71***	1.03***
200 employees and more	1.64***	2.54***
	Features of the company's strategy *Ref = Important and Very Important*	
Quality improvement	0.07	-0.30**
Cost reduction	-0.11	-0.25*
New procedure	-0.15*	-0.29***
	External market's constraints	
Concurrence pressure-yes	0.04	0.20*
Uncertainty on the market-yes	-0.18*	-0.13
Clients conditioned- yes	0.01	0.41***
Suppliers conditioned-yes	-0.14	0.13
Stockholders conditioned-yes	0.16	0.51**
	Sector of Activity *Ref = textile industry*	
Industry of leather and shoes	-1.23***	-2.85***
Manufacture of wearing	-0.72	-2.83
Pharmaceutical industry	-0.06	-1.65***
Manufacture of soap, perfumes and care products	-1.45***	0.36
Manufacture of furniture	-0.32	-0.27
Manufacture of jewellery, musical instruments/ sport products and games	-0.31	-1.29***
Manufacture of household equipments	-1.00**	-1.43***
Manufacture of equipment for reproduction and record (sound and image)/ optical materials, camera, watch	0.18	1.43**
Manufacture of automobiles	0.21	0.04
Manufacture of automobiles equipment	0.45	0.18
Naval construction / railroad materials	2.49***	1.86***
Aeronautical and spatial construction	0.70*	0.44
Manufacture of, vehicles, motor vehicles, transport equipment/ metal elements for construction	0.36	2.57***
Boilers, manufacture of metal tank	-0.32	-0.12
Manufacture of mechanical equipment	0.73***	0.77**
Manufacture machines for general utilisation	1.80***	2.07***
Manufacture of machines for agro-culture/ machines-tools	0.60**	0.50*
Manufacture of others specific machines / weapon and munitions	0.16	-0.20
Manufacture of machines for office and informatics equipment	0.12	0.40
Manufacture of motors, generator and equipment for electrical transformation	1.26**	0.51
Manufacture of equipment for emission and transmission	1.09**	0.85**

	Direct Complete and Direct Non Complete Adopters vs Indirect Adopters (ref)	Direct Complete and Direct Non Complete Adopters vs Non Adopters (ref)
	Sector of Activity *Ref = textile industry*	
Manufacture of medicochirurgie and orthopaedic equipment	2.05***	1.06*
Manufacture of equipment for the measurement and the control	1.26***	1.42***
Other extractives industries	0.88***	1.52***
Manufacture of glass and other product glass	-0.07	-1.23**
Manufacture of ceramic products and construction equipments	0.91*	-0.13
Cotton and weaving mills	0.31	-0.44*
Manufacture of chain	0.35	-1.14***
Manufacture wood articles	-1.78**	-2.83***
Manufacture of wood filler	-0.45	-1.42***
Manufacture of paper and carton	0.84*	0.72
Industry of mineral products	0.49*	0.37
Industry of organic products	2.14***	-0.29
Industry of parchemical , artificial fiber and synthetic products	1.02***	2.21***
Transformation of plastic materials	1.37***	1.53***
Steel industry	1.15***	1.01***
Manufacture of non-ferrous metals	1.12***	2.20***
Industry of melting	2.18***	1.38***
Manufacture of metal products	1.94***	1.64***
Manufacture of electric products	0.69***	0.29
Manufacture of electric corposants	1.26***	1.42***
Industrial service for metals works	1.46***	1.66***
Extraction of coal/hydrocarbon/nuclear/petrol	1.46***	1.73***
Electricity, gas and water supply	1.88***	1.43***
Max-rescaled R-Square	0.25	0.50

Source: Survey COI merges to the EAE, sample of 3177 and 3716 companies, respectively.
Parameter: manufacturing industries of more than 20 employees.
Notes: (*), (**) and (***) indicate parameter significance at the 10, 5 and 1 percent level respectively.

Appendix D.
Supports of the PS-matching estimates

Model 1C1: The standard deviation of the treatment effect is computed using bootstrap with 150 simulations. The characteristics of support over 150 simulations are: min=3726; max=4175; mean=3953.41.
Model 1C2: The standard deviation of the treatment effect is computed using bootstrap with 150 simulations. The characteristics of support over 150 simulations are: min=3360; max=3856; mean=3630.87.
Model 1C3: The standard deviation of the treatment effect is computed using bootstrap with 150 simulations. The characteristics of support over 150 simulations are: min=3865; max=4311; mean=4065.67.
Model 1D1: The standard deviation of the treatment effect is computed using bootstrap with 150 simulations. The characteristics of support over 150 simulations are: min=3761; max=4163; mean=3944.27.
Model 1D2: The standard deviation of the treatment effect is computed using bootstrap with 150 simulations. The characteristics of support over 150 simulations are: min=3409; max=3856; mean=3622.89.
Model 1D3: The standard deviation of the treatment effect is computed using bootstrap with 150 simulations. The characteristics of support over 150 simulations are: min=3726; max=4203; mean=3962.61.
Model 2C1: The standard deviation of the treatment effect is computed using bootstrap with 150 simulations. The characteristics of support over 150 simulations are: min=3828; max=4214; mean= 4017.71.
Model 1C2: The standard deviation of the treatment effect is computed using bootstrap with 150 simulations. The characteristics of support over 150 simulations are: min=3443; max=3889; mean=3675.45.
Model 2D1: The standard deviation of the treatment effect is computed using bootstrap with 150 simulations. The characteristics of support over 150 simulations are: min=3802; max=4204; mean=4006.03.
Model 2D2: The standard deviation of the treatment effect is computed using bootstrap with 150 simulations. The characteristics of support over 150 simulations are: min=3436; max=3944; mean=3675.10.