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Sharing the "Fame" of Quality Certification: Quality Supply Chain Effects Evidence

Partager la « réputation » de la certification qualité : l'identification d'un effet de chaîne d'approvisionnement

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SHARING THE "FAME" OF QUALITY CERTIFICATION: QUALITY SUPPLY CHAIN EFFECTS EVIDENCE

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ABSTRACT

The objective of this paper is to provide empirical evidence for whether the hierarchical position (determined by firm's quality strength) of different types of quality supply chain categories implies the same hierarchy in terms of economic gains. Using the French survey on *Organisational Change and Computerisation* (*COI-TIC*), we distinguish four types of quality supply chain categories that help us to empirically construct a relationship between firms and their suppliers (quality certified/non quality certified). Our findings, from a two-regime switching model, reveal that there is a positive correlation between the hierarchical positions of the quality supply chain categories and the impact on firm performance.

Keywords: quality certification, quality standards, supply chain, firm performance, *COI-TIC* survey.

Classification JEL : D24, L14, L15

Partager la « réputation » de la certification qualité : l'identification d'un effet de chaîne d'approvisionnement[1]

Résumé

L'objectif de cet article est d'identifier empiriquement si l'importance accordée par l'entreprise à la gestion de la qualité dans sa production et sa chaîne d'approvisionnement est corrélée avec l'importance des gains qu'elle en retire. À partir de l'enquête Changements Organisationnels et Informatisation (COI-TIC), *on distingue quatre types de chaînes d'approvisionnement selon la place faite à la gestion de la qualité, mesurée par le recours aux standards et procédures de qualité, dans les relations entre les entreprises et leurs fournisseurs. S'appuyant sur l'estimation d'un modèle à changement de régime, nos résultats montrent qu'il existe bien une corrélation positive entre la position hiérarchique de l'entreprise dans sa chaîne d'approvisionnement, telle que définie par les enjeux de gestion de la qualité, et sa performance économique.*

Mots-clefs : *certification qualité, standards de qualité, chaîne d'approvisionnement, performance des entreprises, enquête* COI-TIC.

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INTRODUCTION[2]

The lack of well-established quality management system (QMS) all along the supply chain increases the risks of supply chain disruption, which may harm a firm's operations, business performance and public image (Hendricks and Singhal, 2005a). Nevertheless, establishing quality within supply chains requires substantial resources and long-term commitments from all parties involved, which can negatively affect a firm's competitiveness (*e.g.* Zu and Kaynak, 2012). However, since a firm's final product is only as good as its inputs, final product quality is also dependent on the quality of supplied inputs (*e.g.* Forker *et al*., 1997; Tan *et al*., 1999; Romano and Vinelli, 2001; Romano, 2002; Wu *et al*., 2011). Actually, Forker *et al*. (1997) argue that improvements in quality depend greatly on the implementation and coordination of quality management activities upstream in suppliers' operations. Consequently, the effectiveness of firm performance does not only depend on firm's quality but may also vary according to the characteristics of the quality relationship between the firm and its suppliers (Cusumano and Takeshi, 1991; Dyer and Nobeoka, 2000).

While a growing body of literature analyses the impact of quality standards on firm performance, scholars have provided less empirical evidence on whether the quality level of upstream and downstream players in the supply chain also counts for individual firm corporate performance (Romano, 2002). Therefore, the question we address in this paper is whether the impact of different types of supply chains (in term of quality sensitivity) on firm performance is the same according to the type of supply chain a firm belongs to. Actually, we will examine the direct link between the level of quality established within supply chain and firm corporate performance measured by profit per employee.

Due to data limitation, we are only able to analyse the upstream side of supply chain sensitivity towards quality standards. Based on the firm's and supplier's characteristics related to quality certification, we create four possible types of quality generated supply chains. The first type of quality supply chain that we call *direct complete quality supply chain* includes firms that are quality certified and whose suppliers follow quality standards or quality control procedures. The second type, *direct non complete quality supply chain*, presents those firms that are quality certified, although their suppliers are not. The third type, *indirect quality supply chain*, includes firms that are not quality certified, but their suppliers follow quality standards or quality control procedures. The fourth type, *non quality supply chain*, includes firms that are not quality certified, and their suppliers also lack quality certification. According to the strength of the quality established in the firm's supply chain network, we can classify our four categories as follows: the *direct complete quality supply chain* is at the top of the classification, followed by the *direct non complete quality supply chain*, then the *indirect quality supply chain* and finally the *non quality supply chain*. We will evaluate empirically whether the hierarchical positioning in term of quality signal of the four quality supply chain categories implies the same hierarchy in terms of economic gains. This question is important because a positive answer means that quality standards, like the ISO certification, could be considered as *club goods*, which are a subtype of public goods that are excludable but non rivalrous, leading to some fundamental open questions such as whether

[2] A revised version of this paper has been published in the *International Journal of Production Research* : Diaye M.-A., Greenan N. and Pekovic S., 2014, « Sharing the 'fame' of ISO standard adoption: quality supply chain effects evidence », *International Journal of Production Research*, DOI: 10.1080/00207543.2014.907512.

the number of quality certified firms is Pareto optimal. Indeed, given the existence of externalities, it may be the case that the number of firms that are quality certified is lower than the Pareto optimal number of quality certified firms.

The remainder of the paper is organised as follows: section 1 reviews the literature on quality standards and supply chain management; section 2 develops the main hypotheses; section 3 presents the data sets and introduces our econometric analysis and section 4 presents the results discussion. Finally, we conclude with a discussion on managerial implications and future directions for research.

1. LITERATURE REVIEW

1.1. The impact of quality standards on firm performance

The relationship between quality standards and firm performance has received increased attention over the last few years (see *e.g.* Grolleau *et al*. [2012] for comprehensive reviews). However, no consensus has emerged so far. The literature presents conflicting arguments concerning the impact of quality standards on firm corporate performance. One set of arguments supports a positive relationship between quality standards and firm performance, implying that quality standards are likely to increase firms' competitiveness by lowering defect rates, reducing the cost of quality, and increasing productivity, on-time delivery and customer satisfaction (Terziovski *et al*., 2003; Sharma, 2005; Corbett *et al*., 2005; Terlaak and King, 2006; Benner and Veloso, 2008; Lo *et al*., 2008; Levine and Toffel, 2009). The opposing set of arguments claims that quality standards implementation is costly and is likely to decrease firms' competitiveness (Lima *et al*., 2000; Martinez-Costa and Martinez-Lorente, 2003; McGuire and Dilts, 2007; Martínez-Costa *et al*., 2009). In turn, recent research by Grolleau *et al.* (2012) provides findings that the inconsistency in results could be due to the definition of firm performance or misspecification of models. Moreover, the authors provide some positive evidence about the relationship between quality and firm performance, but stress that the complementarity between quality and environmental standards improves this relationship better.

1.2. Quality management from the supply chain perspective

In recent years, firms have begun to look beyond their own boundaries to meet the challenge of moving from internal efficiency to supply chain efficiency (Olhager and Selldin, 2002), which is defined as a strategic collaboration or partnership between firms to leverage strategic position and to improve operating efficiency. Moreover, due to the increasing importance of quality management, firms have also been obliged to establish cooperative relationships with suppliers especially in the area of quality management (*e.g.* Romano, 2002; Kaynak, 2003; Zu and Kaynak, 2012). Forster (2008) defines quality supply chain as "a systems-based approach to performance improvement that leverages opportunities created by upstream and downstream linkages with customers". Moreover, several researchers argue that there is a positive correlation between quality management and supply chain management (Flynn and Flynn, 2005; Foster and Ogden, 2008; Vanichchinchai and Igel, 2010) and they are even complementary with respect to firm performance (*e.g.* Tan *et al*., 1998; Zu and Kaynak, 2012). Similarly, the integration of quality management into the

supply chain focuses on cooperative relationships between members of the supply chain, permitting the achievement of cumulative competitive capabilities (Flynn and Flynn, 2005). However, integrating quality management and supply chain management is not easy to implement due to the structural and cultural differences of the firms concerned (*e.g.* Pagell 2004; Foster and Ogden, 2008). Robinson and Malhotra (2005) stress that the implementation of quality management in the supply chain needs to be chain-centered rather than firm-centered, as it typically is in the intra-organisational perspective of traditional quality management.

2. HYPOTHESES

The implementation of quality standards inside the firm principally improves individual internal processes (Robinson and Malhotra, 2005; Zu and Kaynak, 2012). However, the quality level delivered to the final customer is the result of the quality management practices of each member of the supply chain (Forker *et al*., 1997; Tan *et al*., 1999; Romano and Vinelli, 2001; Romano, 2002; Wu *et al*., 2011). Therefore, having a supplier that has problems related to quality can cause various problems to the firm (Sodhi and Lee, 2007). In this sense, Das (2011) argues that the avoidance of costs related to product recall arising from quality failure is possible only by integrating quality management systems all along the supply chain network. In other words, as demonstrated by Kaynak (2003), the role of supplier quality management in effective firm quality management lies in its direct relationships with product/service design and process management. Moreover, establishing quality relationship between firm and supplier improves coordination and configuration of the business process between the two parties, which should increase customer satisfaction and firm performance (Forker *et al*., 1997).

Several research projects have underlined the importance of quality management integration internally within each supply chain member. For instance, working on survey data from a cross-industry sample of quality directors and vice presidents in US firms, Tan *et al*. (1998) show that quality management and supply base management techniques and tools must be implemented conjointly to achieve superior financial and business performance. Romano (2002) finds that supply chain sensitivity to quality improves punctuality, delivery speed and volume flexibility in Italian certified manufacturing firms. Using data on Taiwanese firms, Kuei *et al.* (2001) show that firms with higher supply chain quality management tend to perform better on cost savings than those with low quality systems. Investigating factors that influence supply chain quality management, Lin *et al.* (2005) use data from Taiwan and Hong Kong to show that Quality Management (QM) practices are significantly correlated with the supplier participation strategy, and this influences tangible business results and customer satisfaction levels. Working on a sample of 565 observations, Kannan and Tan (2005) conclude that a commitment to quality and an understanding of supply chain dynamics have the greatest effect on performance. In the same sense, Kaynak and Hartley (2008) confirm empirically that the implementation of QM within each supply chain member's organisation is a prerequisite for supply chain quality that could in turn improve firm business performance. Based on quantitative and qualitative investigations of 225 electronics manufacturing firms, Yeung (2008) concludes that strategic supply management is essentially a quality management initiative which leads to improvements in on-time shipments, reduces operational costs, and creates customer satisfaction and better business performance.

Therefore, all the studies cited above indicate that being quality certified is a positive signal of quality improvement, and having a supplier that is a certified firm amplifies this positive signal. In the following, we are going to distinguish between four types of supply chains: *direct complete quality supply chains* include companies that have quality certification, and their (largest) suppliers follow quality standards or quality control procedures; *direct non complete quality supply chains* contain firms that are quality certified, but their suppliers are not; *indirect quality supply chains* include firms which are not quality certified, but their suppliers follow quality standards or quality control procedures; and *non quality supply chains* include firms that are not quality certified, and whose suppliers do not have any quality certification. We propose the following hypotheses:

H1a: The performances of the firms belonging to the direct complete quality supply chain are higher than those of the direct non complete quality supply chain.

H1b: The performances of the firms belonging to the direct complete quality supply chain are higher than those of the firms belonging to the indirect quality supply chain.

H1c: The performances of the firms belonging to the direct complete quality supply chain are higher than those of the firms belonging to the non quality supply chain.

A certified firm that has a non-certified firm as a supplier reduces the positive signals stemming from quality improvement since the mismatch between firm and supplier is found to be negatively associated with firm performance (*e.g*. Hendricks and Singhal, 2005a; Hendricks and Singhal, 2005b). However, even if the suppliers are not certified in the *direct non complete quality supply chain* category, the firm's certification nonetheless permits this group to increase quality performance. Even though we have indicated that the empirical research on quality standards and firm performance provides conflicting conclusions, there are several important arguments supporting a positive relationship between quality standards and firm corporate performance. One of the main arguments supporting the positive idea could be that quality standards refer to flexible work organisation that entails quality, flexibility and economies of scale through systematic organisational learning, elimination of waste, maximised utilisation of employees' skills and initiatives, and improvement of managerial competence. Moreover, the premise of the quality management standards is based on improving an organisation's efficiency through high-level coordination of its activities in a rationalised system of end-to-end processes, which includes every aspect of firm performance (Benner and Tushman, 2002). Firms that adopt quality management practices significantly alter work organisation, demanding new attitudes, roles and responsibilities for all firm members (Womack *et al*., 1990). Hence, firms that adopt QM gain competitive advantage through provision of superior value to customers, thereby increasing revenues, sales and market share, reducing costs and waste through better process efficiency, and improving of firms' quality performance and corporate image (Terlaak and King, 2006). Additionally, with regards to an employee-based perspective, QM practices contribute to workforce improvement. Working under QM improves employee initiative and flexibility through broadening job classifications, creating flexible assignments, decentralising workplace organisation, offering training and work in groups, and involving employees in decision making (Greenan and Mairesse, 1999; Greenan and Mairesse, 2006; Levine and Toffel, 2009).

On the basis of this reasoning, we formulate the following hypotheses:

H2a: The performances of the firms belonging to the direct non complete quality supply chain *are higher than those of the firms belonging to the indirect quality supply chain.*

H2b: The performances of the firms belonging to the direct non complete quality supply chain are higher than those of the firms belonging to the non quality supply chain.

We argue that having a certified firm as a supplier, while being non-certified, improves the signals regarding quality improvement. Since a quality certified supplier is more likely to reduce the risk of quality problems and failure, it would be capable of providing better quality to the firm (Kaynak and Hartley, 2008). In this one-way quality relationship, in addition to helping a firm compete on speed, suppliers can also provide quality and design insights to the firm (Flynn and Flynn, 2005). Similarly, working with quality certified suppliers reduces pre-processing cycle time delays for incoming inspection (Heiko, 1990). It is worth noting that the quality of the firm's outputs is always dependent on the quality of the inputs obtained from the firm's supplier. In fact, as argued by Levine (1995), a high level of involvement between the firm and its suppliers is an important characteristic of many successful businesses because more than half the value of a firm's product is purchased from suppliers. Moreover, suppliers are encouraged to share quality information with members of the supply chain network in order to improve overall supply chain performance (Kaynak and Hartley, 2008; Wu *et al*., 2011). Certainly, supplier partnering, which involves close cooperation between firms and their suppliers, allows non-certified firms to learn about the best quality management practices from their certified supply chain partners (Terlaak, 2001). In a same sense, open communication and cooperation between firm and supplier creates conditions that could help the firm to reduce the risk of quality failure (Zu and Kaynak, 2012). Furthermore, the results of Wu *et al.* (2011) indicate that a firm always benefits from quality information sharing, that reduces its total cost, through indirect membership. Additionally, firms choose high quality suppliers to enhance their own quality reputations (Delmas and Montiel, 2009) since a customer's beliefs about a firm's quality could be established upon observing the firm's decision to form a quality partnership with its suppliers (Costa and Vasconcelos, 2010). In this sense, in the case of the *indirect quality supply chain*, although the principal beneficiary of quality certification advantages is not directly certified, firms in this group indirectly benefit from quality certification advantages through their suppliers, which are certified. We consider this relationship as fairly weak in terms of the diffusion of quality improvement information. However, since firms that belong to the *non quality supply chain* category are not quality certified and do not have quality certified suppliers, we argue that the quality signal of *indirect quality supply chain* firms is stronger than the quality signal of firms belonging to the *non quality supply chain*. In addition, an empirical study by Pekovic and Galia (2009) corroborates this contention. Working on a sample of French manufacturing firms, the authors find that non quality certified firms can access indirect quality certification *via* their quality certified suppliers and therefore improve their innovation performance better than firms that are non quality certified and also do not have certified suppliers. Consequently, we hypothesise:

H3: The performances of the firms belonging to the indirect quality supply chain are higher than those of the firms belonging to the non quality supply chain.

3. METHODS

3.1. The database

The data is extracted from the French *Organisational Changes and Computerisation* (*COI*) 2006 survey[3]. The *COI* survey is a matched employer-employee dataset on organisational change and computerisation. The survey was developed by researchers and statisticians from the National Institute for Statistics and Economic Studies (INSEE), the Ministry of Labour, and the Center for Labour Studies (CEE) and carried out in the field by INSEE. The questionnaires were prepared based on collective discussion involving researchers in economics, management, sociology, ergonomics and trade unions and management representatives. Consequently, the survey is doubly rooted in research issues and in social demand. A representative sample of 14,369 private firms with ten employees and more located in France from all industries except agriculture, forestry and fishing responded to the survey. Each firm filled in a self-administered questionnaire concerning the utilisation of information technologies and work organisational practices in 2006, and changes that have occurred in those areas since 2003. Firms were also interviewed on the economic goals driving the decision to implement organisational changes and the economic context in which those decisions were made. In order to obtain information on profit and capital, the *COI* survey was merged with another survey called the *Annual Enterprise Survey* (*EAE*). It is an annual survey conducted by the French Ministry of Industry and INSEE to collect basic data on the structure of surveyed firms such as business activities, size and location. The banking sector is not covered by this survey. As a result of these merges, our sample includes 7,685 firms.

3.1.1 Dependent Variable

Drawing on prior research (*e.g*. Waddock and Graves, 1997), we measure firm performance as the logarithm of the firm's profit by the number of employees. The *Annual Enterprise Survey* (*EAE*) is used to obtain information on the firm profit. Number of employees is obtained from the *Organisational Changes and Computerisation* (*COI*) database.

3.1.2 Independent Variable

The four categories of quality supply chain were assessed by using two variables from the *COI* survey. First, we use information on whether the firm is registered for quality certification like ISO 9001, EAQF, etc., and, on second, whether the firm's supplier follows quality standards or quality control procedure. Based on our four categories of quality supply chains, the *direct complete quality supply chain*, the *direct non complete quality supply chain*, the *indirect quality supply chain* and the *non quality supply chain*, we create six dummies of quality supply chain categories that will permit us to test our hypotheses.

[3] More details about the design and scope of this survey are available on www.enquetecoi.net. See also the general presentation of the survey and main results in Greenan *et al.* (2010). Papers using the COI survey are listed at the following address: http://scholar.google.fr/citations?user=Ab_WMDcAAAAJ&hl=en.

To summarise, we consider the following six models:

- In Model 1, the dummy variable is 1 if the firm belongs to a *direct complete quality supply chain* and is 0 if the firm belongs to a *direct non complete quality supply chain*.
- In Model 2, the dummy variable is 1 if the firm belongs to a *direct complete Quality supply chain* and is 0 if the firm belongs to an *indirect quality supply chain*.
- In Model 3, the dummy variable is 1 if the firm belongs to a *direct complete quality supply chain* and is 0 if the firm belongs to a *non quality supply chain*.
- In Model 4, the dummy variable is 1 if the firm belongs to a *direct non complete quality supply chain* and is 0 if the firm to an *indirect quality supply chain*.
- In Model 5, the dummy variable is 1 if the firm belongs to a *direct non complete quality supply chain* and is 0 if the firm belongs to a *non quality supply chain*.
- In Model 6, the dummy variable is 1 if the firm belongs to an *indirect quality supply chain* and is 0 if the firm belongs to a *non quality supply chain*.

For instance, when we compare firms in the *direct complete quality supply chain* category to firms in the *direct non complete quality supply chain* category, y_1 is the logarithm of the profit per employee for firms in the *direct complete quality supply chain* category, and y_0 is the logarithm of the profit per employee for the firms in the *direct non complete quality supply chain* category.

3.1.3. Controls

Our analysis includes several firm characteristics to control for sources of firm-level heterogeneity. The choice of variables is based on previous analysis of firm performance (*e.g.* Greenan and Mairesse, 2000; Black and Lynch; 2001; Terlaak and King, 2006; Pekovic, 2010).

Features of the firm's strategy. It is argued that the adoption of quality standards is positively associated with features of the firm's strategy such as quality improvement, cost reduction and competitive price policy. This is because the adoption of quality practices contributes to the improvement of these strategies by work method continuity, reducing non-profit activities, improving operations and supporting innovation (Pekovic, 2010). To introduce a specific strategy, a firm has to significantly change the way the business is organised. Therefore, following Black and Lynch (2001), we argue that changes in organisation strategy have been significant determinants of the firm performance. We create three binary variables representing quality improvement, cost reduction and competitive price policy that equal 1 if the firm considers quality improvement, cost reduction, and competitive price policy as important or very important strategies, respectively.

External market constraints. The literature review confirms that a firm is driven to implement quality practices by external pressure (*e.g.* Terlaak and King, 2006). The belief that external pressure enhances a firm performance is widespread and is based on the fact that external pressure plays a role in motivating organisational efficiency and growth (*e.g.* Aghion *et al*., 1999). We include four measures to control for the external market constraints. More precisely, we introduce two variables that have a value of 1 if the firm has been affected strongly or very strongly by competitive pressure and market uncertainty. Additionally, we include two more variables presenting conditions imposed by suppliers and

clients that take a value of 1 if the three main suppliers or clients make up 50% of the firm's turnover, respectively.

Previous experience. We also control for experience with related management standards, such as environmental standards. Prior adoption of similar standards can ease the successful implementation of quality certification through the utilisation of related information, resources and skills. Furthermore, Grolleau *et al.* (2012) provides empirical evidence that environmental practices can increase a firm performance. We include a binary variable coded 1 if the firm was registered according to one of the following standards, *i.e*. ISO 14001 standard, organic labelling, fair trade, and other types of environmental-related standards, in 2006. Unfortunately, the database does not distinguish between those standards. However, since these standards have similar components, it is expected that their impact will be similar.

Relationship with Clients. The concept of quality practices is based on the need to maintain very close links with customers to both identify their needs and receive the feedback necessary for the firm to understand to what extent it has succeeded in satisfying those requirements and whether to initiate the relevant improvement activities. Moreover, if the quality levels of firms are unobservable, from a signalling perspective, quality standards can provide information on the general capability of a firm to meet the quality expectations of customers and thus make unobservable characteristics more public (Spence, 1973). It is expected that good relationships with clients have positive impacts on a firm's performance because improvements in customer satisfaction can decrease the time and effort devoted to handling returns, rework, warranties and complaint management while at the same time lowering the costs of making future transactions (Anderson and Rust, 1997). We use three binary variables as indicators for relationships with clients: using labelling for goods and services, delivering or supplying goods or services on a fixed deadline and having an external manager for client relations. They take the value 1 if under customer policy firm uses labelling for goods and services, contract to assure timeless delivery and has external department related to client relations.

Capital. Firms with more capital are expected to invest in quality standards. Furthermore, capital is considered as an important determinant of firm performance (Greenan and Mairesse, 2000; *e.g.* Capon *et al*., 1990). Therefore, we introduce a continuous variable that indicates firm's capital.

Size. The majority of empirical studies (*e.g.* Terlaak and King, 2006) found that the probability of the adoption of quality standards increases with a firm's size. Furthermore, size has also been considered as a significant determinant of firm performance (*e.g.* Waddock and Graves, 1997), although the direction of its effect is not consistent (Russo and Fouts, 1997). Firm size is measured as a logarithm of the number of employees within the firm.

Sector of Activity. Finally, it is argued that sector characteristics influence the likelihood of a firm deciding to implement quality practices. Furthermore, the firm performance effects of one sector cannot easily be transferred to other sectors (Godard and Delaney, 2000). To control for sectoral differences, we include sectoral dummy variables based on the N36 sector classification created by the French National Institute for Statistics and Economic Studies. More precisely, we introduce 11 dummy variables that equal 1 if the firm's activity is agro-food, consumption goods, cars and equipment, intermediate goods, energy, construction, commercial, transport, financial and real-estate activities, services for firms and services for individuals.

The variables used in the estimation, their definitions and data sources are presented in Table 1. No strong correlation problem has been detected (Appendix 1).

Table 1. Definition of variables

Variable	Definition	Mean	SD	Min	Max
Dependent variables					
PROFIT**	Logarithm of Profit per employee (Continuous variable)	1.43	1.32	-1.73	7.67
Independent variables					
DIRECT COMPLETE QUALITY SUPPLY CHAIN*	The firm is registered for ISO 9001, EAQF, etc and the supplier follows quality standards or quality control procedure Dummy variable (=1 if firm and supplier- yes)	0.35	0.48	0.00	1.00
DIRECT NON COMPLETE QUALITY SUPPLY CHAIN*	The firm is registered for ISO 9001, EAQF, etc and the supplier does not follow quality standards or quality control procedure Dummy variable (=1 if firm-yes and supplier-no)	0.13	0.34	0.00	1.00
INDIRECT QUALITY SUPPLY CHAIN*	The firm is not registered for ISO 9001, EAQF, etc and the supplier follows quality standards or quality control procedure Dummy variable (=1 if firm-no and supplier-yes)	0.23	0.42	0.00	1.00
NON QUALITY SUPPLY CHAIN*	The firm is not registered for ISO 9001, EAQF, etc and the supplier does not follow quality standards or quality control procedure Dummy variable (=1 if firm-no and supplier-no)	0.29	0.45	0.00	1.00
Control variables					
ACTIVITY*	The main activity of the firm: 11 dummy variables (=1 agro-food; consumption goods; cars and equipments; intermediate goods; energy; construction; commercial; transport; financial and real-estate activities; services for firms; and services for individuals respectively)				
QUALDEP*	The firm has had quality department since 2003. Dummy variable (=1 if yes)	0.48	0.50	0.00	1.00
QUALEXT*	The firm has had external manager for quality since 2003. Dummy variable (=1 if yes)	0.34	0.47	0.00	1.00
ES*	Certified with ISO 14001, organic food labeling or fair trade Dummy variable (=1 if certified in 2003)	0.13	0.34	0.00	1.00
QUALITY IMPROVEMENT*	Quality strong or very strong strategic importance Dummy variable (=1 if yes)	0.97	0.18	0.00	1.00
COST REDUCTION*	Cost reduction strong or very strong strategic importance Dummy variable (=1 if yes)	0.85	0.35	0.00	1.00
COMPETITIVE PRICE*	Competitive price strong or very strong strategic importance Dummy variable (=1 if yes)	0.85	0.35	0.00	1.00

COMPETITIVE PRESSURE*	Since 2003, the firm has been affected by strongly or very strongly by competitive pressure Dummy variable (=1 if yes)	0.41	0.49	0.00	1.00
MARKET UNCERTAINTY*	Since 2003, the firm has been affected by strongly or very strongly by market uncertainty Dummy variable (=1 if yes)	0.62	0.49	0.00	1.00
CLIENTS CONDITIONED*	Three main clients make up 50% of the firm's turnover Dummy variable (=1 if yes)	0.24	0.43	0.00	1.00
SUPPLIERS CONDITIONED*	Three main suppliers make up 50% of the firm's purchase Dummy variable (=1 if yes)	0.30	0.46	0.00	1.00
SIZE*	Logarithm of number of employees (Continuous variable)	4.68	1.31	3.00	11.62
CAPITAL**	Logarithm of capital per employee (Continuous variable)	3.29	1.51	-2.35	10.14
LABELLING*	Since 2003, under customer policy firm uses labeling goods and services with certain clients Dummy variable (=1 if yes)	0.34	0.47	0.00	1.00
FIXED DEADLINES*	Since 2003, under customer policy firm uses contract to assure delivery timeless Dummy variable (=1 if yes)	0.66	0.47	0.00	1.00
CLIENT DEPARTMENT*	Since 2003, the firm has had external manager for relation with client. Dummy variable (=1 if yes)	0.20	0.40	0.00	1.00

Source: *COI-TIC* survey (INSEE-CEE), *EAE*, 2006.

Note: * the variables were retrieved from *COI*, ** the variables were retrieved from *EAE*.

3.2. Econometric Strategy

The obvious model is the ordinary least square (OLS) regression model. However this model requires the explanatory variables to be exogenous, while it is clear in our case that supply chain quality categories are not exogenous since the same unobservable and observable factors (*e.g*. size, sector of activity, firm's strategy, etc.) may have an impact on both firm's probability to choose one of quality supply chain categories and its performance. Therefore, the utilisation of OLS regression model would provide biased results. Thus, to address this problem we apply an endogenous switching regression model that permits us to control for the endogenous effects by simultaneously estimating the selection equation and the firm performance equations for two regimes: superior or inferior quality supply chain category. The endogenous switching model structure is defined by two states: state 1 and state 0, corresponding to a specific type of quality supply chain category (for instance state 1 may correspond to the *direct complete quality supply chain* and state 0 to the *indirect quality supply chain*).

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

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

$$log(y_{0i}) = \beta'_0 X_i + \varepsilon_{oi} \quad (2)$$

$$ISO_i^* = \gamma' M_i + Z_i + \mu_i > 0 \quad (3)$$

Equations (1) and (2) are the structural equations that describe the firm performance in the alternative regimes. More precisely, as we have defined previously, y_{1i} and y_{0i} represent the performance of firm i in state 1 and state 0, respectively. Furthermore, X_i is a vector of explanatory variables (features of the firm's strategy, external market constraints, previous experience with related management practices, relations with clients, logarithm of the capital per employee, size and sector of activity), β'_1 and β'_0 are vectors of the slope coefficients to be estimated. Finally ε_1 and ε_0 are the disturbance terms for the two equations with null means and variances equal to σ_1^2 and σ_0^2, respectively.

Equation (3) is the selection equation that determines a firm's "propensity" of belonging in one of the quality supply chain categories that depends on the differences between the economic gains associated with each category. More precisely, ISO^*_i is the economic gain to firm i for belonging to one of the quality supply chain categories, and firm i will choose one of the categories if its economic gain from belonging to this category is strictly positive. In equation (3), M_i is a vector of explanatory factors for being in one of the quality supply chain categories, and μ is an error term that follows a normal rule, with mean and variance equal to 0 and 1, respectively.

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

$$ISO_i = 1 \quad if \quad ISO_i^* > 0$$
$$ISO_i = 0 \quad otherwise. \quad (4)$$

Importantly, it is well known that this type of model is sensitive to the distributional assumption and the specification of both the first step switching equation and the firm performance equations. Hence, to reduce this sensitivity, we need to have an additional variable that influences a firm's choice to become a part of a specific quality supply chain category but does not influence firm performance (*i.e.* at least one variable in M that is not in X). To achieve this identification, we include the vector Zi: whether a firm has a full time quality manager or external manager for quality. The inclusion of those variables may be justified by the argument that an administrative unit (such as the internal and external quality unit) indicates a closer proximity to institutionalised norms, thus increasing the perceived need to comply with those norms (Beck and Walgenbach, 2003; Pekovic, 2010). Additionally, administrative departments (in our case internal and external quality departments) serve as direct channels through which new practices enter the firm from its institutional environment (Pekovic, 2010). Moreover, Beck and Walgenbach (2003) find that having a larger proportion of administrative staff, *i.e.* concerning the issue of quality, improves and promotes the possibility of implementing quality standards. Similarly, Pekovic (2010) finds that internal and external quality departments positively impact the adoption of

quality standards. Even if this is not a proper test for instrumental variable validity, it is worth noting that none of our proposed instrumental variables appears to be a significant determinant when included directly in a single equation logit model. Furthermore, to our knowledge, there is no empirical or theoretical evidence regarding the direct relationship between those variables and a firm performance.

Finally, we observe $\log(y_{1i})$ if $ISO_i=1$ and $\log(y_{0i})$ if $ISO_i=0$, with $\sum$ as the variance-covariance matrix, which can be written as follows:

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

Additionally, the variance-covariance matrix $\sum$ can be estimated in one step. To test for endogeneity in the switching model, the parameters of interest are the covariances of the error terms of each firm performance equation with the error terms of the selection equation. If these covariances are different from zero, then the selection process is not exogenous, and the estimation of the firm performance equations by Ordinary Least Squares (OLS) would produce inconsistent estimators of the parameters of the model. The covariance between the error terms of the selection equation and firm performance equations informs us about the adequacy of using the switching model to describe the selection process. Fundamentally, we have endogeneity if $\rho_{1\mu}$ or $\rho_{0\mu}$ are significantly different from zero, *i.e.* if the errors of the firm performance equations and the error of the choice equation are correlated. ρ_{10} is not defined because the two regimes are never observed simultaneously.

The switching models are then based on the analysis of three variables, but each of them is only partly observed (Maddala, 1983). The selection variable, ISO^*_i, is not directly observed but rather 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 firm performance, conditional on being in state 1, can be calculated as follows:

$$E\left[\log(y_{1i}) \mid ISO_i = 1\right] = \beta_1' X_i + \sigma_1 \rho_{1\mu} \frac{\phi(\gamma' M_i)}{\Phi(\gamma' M_i)} \tag{5}$$

In the same way, the expected firm performance, conditional on being in state 0, is given by

$$E\left[\log(y_{0i}) \mid ISO_i = 0\right] = \beta_0' X_i + \sigma_0 \rho_{0\mu} \frac{-\phi(\gamma' M_i)}{1-\Phi(\gamma' M_i)} \tag{6}$$

The model is estimated using the Maximum Likelihood method. Although we do not observe the tendency of a firm being in one particular firm performance regime, we know that if

ISO_i=1, the firm performance is determined by equation (1), and if ISO_i=0, the firm performance is determined by equation (2).

4. RESULTS

The results of estimation are presented in Table 2 to Table 7. To test H1 (1a, 1b and 1c, respectively), we compare the predicted mean of profit obtained from the switching model[4] between: *direct complete quality supply chain* and *direct non complete quality chain* categories; *direct complete quality supply chain* and *indirect quality supply chain* categories; *direct complete quality supply chain* and *non quality supply chain*. To assess H2 (2a, 2b and 2c, respectively), we compare the predicted mean of profit between: *direct non quality complete supply chain* and *indirect quality supply chain* categories; *direct non complete quality supply chain* and *non quality supply chain*. To check H3, we compare the predicted mean of profit between: *indirect quality supply chain* and *non quality supply chain*.

From the Table 2, we may notice that the obtained results from the comparison between firms in the *direct complete quality supply chain* and the *direct non complete quality supply chain* categories indicate that being a quality certified firm and dealing with a quality certified firm amplifies the positive signal, while dealing with a non-certified firm when a firm is certified decreases the positive signal.

Table 2. Differences of predicted profit between *direct complete quality supply chain* and *direct non complete quality supply chain* (H1)

Model 1[(a)]	***Direct complete quality supply chain***		***Direct non complete quality supply chain***		***Direct complete quality supply chain* vs *direct non complete quality supply chain***
	Observed Profit	*Predicted Profit*[(b)]	*Observed Profit*	*Predicted Profit*[(b)]	*Differences of predicted Profit*
Means	1.57	1.57	1.33	1.32	0.25***

Source: *COI-TIC* 2006 survey (INSEE-CEE), *EAE* 2006.

Coverage: firms with more than 10 employees in given quality supply chain categories, sample of 3,675 firms.

Notes: (***) indicate parameter significance at 1 percent level.

(a) In Model 1, the dummy variable is 1 if the firm is a *direct complete quality supply chain* and is 0 if the firm is a *direct Non complete quality supply chain*.

(b) The predicted profit comes from the switching model.

The results go in the same direction when we compare the firms that belong to the *direct complete quality supply chain* to the *indirect quality supply chain* categories (Tables 3) and the firms that belong to the *direct complete quality supply chain* to the *non quality supply chain* categories (Table 4).

[4] For parsimony, only the predicted means that come from switching model are presented. The results of the switching model estimation are available from the authors upon request. It is noteworthy that generally the obtained findings tell us that there is evidence of endogeneity. Thus, we may conclude that our econometric model is appropriate.

Table 3. Differences of predicted profit between *direct complete quality supply chain* and *indirect quality supply chain* (H2)

Model 2 [(a)]	***Direct complete quality supply chain***		***Indirect quality supply chain***		***Direct complete quality supply chain* vs *indirect quality supply chain***
	Observed Profit	*Predicted Profit*[(b)]	*Observed Profit*	*Predicted Profit*[(b)]	*Differences of predicted Profit*
Means	1.57	1.57	1.46	1.21	0.36***

Source: *COI-TIC* 2006 survey (INSEE-CEE), *EAE* 2006.

Coverage: firms with more than 10 employees in given quality supply chain categories, sample of 4,422 firms.

Notes: (***) indicate parameter significance at 1 percent level.

(a) In Model 1, the dummy variable is 1 if the firm is a *direct complete quality supply chain* and is 0 if the firm is a *direct non complete quality supply chain*.

(b) The predicted profit comes from the switching model.

Table 4. Differences of predicted profit between *direct complete quality supply chain* and *non quality supply chain* (H3)

Model 3 [(a)]	***Direct complete quality supply chain***		***Non quality supply chain***		***Direct complete quality supply chain* vs *non quality supply chain***
	Observed Profit	*Predicted Profit*[(b)]	*Observed Profit*	*Predicted Profit*[(b)]	*Differences of predicted Profit*
Means	1.57	1.57	1.29	1.16	0.41***

Source: *COI-TIC* 2006 survey (INSEE-CEE), *EAE* 2006.

Coverage: firms with more than 10 employees in given quality supply chain categories, sample of 4,916 firms.

Notes: (***) indicate parameter significance at 1 percent level.

(a) In Model 1, the dummy variable is 1 if the firm is a *direct complete quality supply chain* and is 0 if the firm is a *direct non complete quality supply chain*.

(b) The predicted profit comes from the switching model.

Ultimately, we may conclude that firms belonging to the *direct complete quality supply chain* category have 25 points higher profit compared to the firms that belong to the *direct non complete quality supply chain* category, 36 points compared to the firms that belong to the *indirect quality supply chain* category, and 41 points compared to the firms that belong to the *non quality supply chain* category. A p-value of .01 indicates that the predicted mean of profit of firms that belongs to *direct complete quality supply chain* category is superior than those of the firms belonging to the *direct non complete quality supply chain*, which are higher than those of the firms belonging to the *indirect quality supply chain*, which are higher than those of the firms belonging to the *non quality supply chain*. Hence being a certified firm while having certified suppliers allows for the greatest impact on firm performance. Therefore, this confirms our first hypothesis (H1a, H1b and H1c) and shows that firms that belong to the *direct complete quality supply chain* category are leaders in the quality supply chain hierarchy concerning firm performance improvement. Moreover, our results confirm those from previous studies (*e.g.* Tan *et al*., 1998; Romano, 2002; Kuei *et al*., 2001; Lin *et al.*, 2005; Kannan and Tan, 2005; Kaynak and Hartley, 2008; Yeung, 2008) suggesting that having an effective QM system in a supply chain network is essential for firm performance improvement. Therefore, we argue that in order to compete successfully on the market and

achieve firm performance improvement, managers should extend their strategies beyond their own firms and into the supply chain. Additionally, in line with Flynn and Flynn (2005), our results suggest that firms aiming to improve business performance must move supplier selection to a quality-based perspective.

Table 5. Differences of predicted profit between *direct non complete quality supply chain* and *indirect quality supply chain* (H4)

Model 4 [(a)]	***Direct non complete quality supply chain***		***Indirect quality supply chain***		***Direct non complete quality supply chain* vs *indirect quality supply chain***
	Observed Profit	*Predicted Profit*[(b)]	*Observed Profit*	*Predicted Profit*[(b)]	*Differences of predicted Profit*
Means	1.33	1.33	1.46	0.42	0.91***

Source: *COI-TIC* 2006 survey (INSEE-CEE), *EAE* 2006.

Coverage: firms with more than 10 employees in given quality supply chain categories, sample of 2,769 firms.

Notes: (***) indicate parameter significance at 1 percent level.

(a) In Model 1, the dummy variable is 1 if the firm is a *direct complete quality supply chain* and is 0 if the firm is a *direct non complete quality supply chain*.

(b) The predicted profit comes from the switching model.

Table 6. Differences of predicted profit between *direct non complete quality supply chain* and *non quality supply chain* (H5)

Model 5 [(a)]	***Direct non complete quality supply chain***		***Non quality supply chain***		***Direct non complete quality supply chain* vs *non quality supply chain***
	Observed Profit	*Predicted Profit*[(b)]	*Observed Profit*	*Predicted Profit*[(b)]	*Differences of predicted Profit*
Means	1.33	1.33	1.29	0.85	0.48***

Source: *COI-TIC* 2006 survey (INSEE-CEE), *EAE* 2006.

Coverage: firms with more than 10 employees in given quality supply chain categories, sample of 3,263 firms.

Notes: (***) indicate parameter significance at 1 percent level.

(a) In Model 1, the dummy variable is 1 if the firm is a *direct complete quality supply chain* and is 0 if the firm is a *direct non complete quality supply chain*.

(b) The predicted profit comes from the switching model.

Moreover, the results show that the firms in the *direct non complete quality supply chain* category are in a more profitable position compared to the firms in *the indirect quality supply chain* (Table 5) or *non quality supply chain* categories (Table 6). More precisely, the results suggest that firms that belong to the *direct non complete quality supply chain* category also have 91 points and 48 points higher profit than firms that belong to the *indirect quality supply chain* and *non quality supply chain* categories, respectively. Important to underline that two predicted differences of the means of profit are significant ($p < .01$). Hence, even though the suppliers of the *direct non complete quality supply chain* category are not certified, the firms' direct certification is "strong" enough to have a superior impact on firm performance compared to the firms in the *indirect quality supply chain* and the *non quality supply chain* categories. Hence, our results confirm the second hypothesis (H2a and H2b) and situate the *direct non complete quality supply chain* on the second position inside the

quality supply chain hierarchy after the *direct complete quality supply chain*. Our findings are consistent with other studies that support the view that quality standards are based on the resource productivity concept, which leads to improved firm performance (Terziovski *et al*., 2003; Sharma, 2005; Naveh and Marcus, 2005; Corbett *et al*., 2005; Terlaak and King, 2006; Benner and Veloso, 2008; Lo *et al*., 2008; Levine and Toffel, 2009). Indeed, the adoption of QM may be considered as a 'win-win strategy', not only because it is a powerful tool for quality improvement, but also because it can be a source of performance improvement. However, the results confirm previous findings which indicate that the negative effect (having no certified supplier) of a partnership dominates the positive effect (being certified) on the firm performance (*e.g*. Costa and Vasconcelos, 2010). Similarly, if we consider the category of the *direct non complete quality supply chain* as the pattern of supply chain glitches (when compared to *direct complete quality supply chain*), our results confirm previous findings that the mismatch between firm and supplier influence negatively firms performance (*e.g*. Hendricks and Singhal, 2005a; Hendricks and Singhal, 2005b).

Table 7. Differences of predicted Profit between *indirect quality supply chain* and *non quality supply chain* (H6)

Model 6[(a)]	***Indirect complete quality supply chain***		***Non quality supply chain***		***Indirect quality supply chain* vs *non quality supply chain***
	Observed Profit	*Predicted Profit*[(b)]	*Observed Profit*	*Predicted Profit*[(b)]	*Differences of predicted Profit*
Means	1.46	1.46	1.29	1.08	0.38***

Source: *COI-TIC* 2006 survey (INSEE-CEE), *EAE* 2006.

Coverage: firms with more than 10 employees in given quality supply chain categories, sample of 4,010 firms.

Notes: (***) indicate parameter significance at 1 percent level.

(a) In Model 1, the dummy variable is 1 if the firm is a *direct complete quality supply chain* and is 0 if the firm is a *direct non complete quality supply chain*.

(b) The predicted profit comes from the switching model.

Table 7 offers the results relating the differences of predicted mean of profit obtained from the switching between *indirect quality supply chain* and *non quality supply chain*. The findings associated with the third hypothesis indicate that the *indirect quality supply chain* category can indirectly profit from quality standards (*via* suppliers), which makes them different from the firms belonging to the *non quality supply chain* category. In fact, being a part of the *indirect quality supply chain* category is positively associated with 38 points improvement ($p < .01$) in profit compared to the firms in the *non quality supply chain* category. Consequently, the third hypothesis is supported by our results and firms in the *indirect quality supply chain* category are placed on the third position inside the quality supply chain hierarchy. As firms in the *non quality supply chain* category do not receive a quality signal, directly or indirectly, they are situated on the last position in the quality supply chain hierarchy. Therefore, our findings are in line with those from Pekovic and Galia (2009), who find that indirect quality certification *via* suppliers does matter for firm performance improvement. Additionally, the results support the assumption that quality information sharing between firm and supplier is beneficial not only for supply chain performance but also for firm individual performance (Wu *et al*., 2012).

Based on the obtained results, we may conclude that there is a positive relationship between the position of the quality supply chain categories inside the quality hierarchy and the impact

on firm performance. Hence, the performance of firms belonging to the *direct complete quality supply chain* is higher than that of firms belonging to the *direct non complete quality supply chain*, which is higher than that of firms belonging to the *indirect quality supply chain*, which is higher than that of firms belonging to the *non quality supply chain*. In other words, these findings suggest that being a certified firm amplifies the positive effect on the profit of firms. Thus, we may suggest that having multiple quality affiliations improves firms' performance more significantly than having only one affiliation. From a theoretical perspective, our findings underline the importance of the supply chain in the process of performance improvement. Participating in a quality supply chain offers opportunities and creates the skills necessary for better performance. Having multiple ties generates large amounts of information, including new information that competitors may not possess (Podolny and Baron, 1997). In fact, our empirical analysis shows that the performance of a firm depends on the performance of other firms upstream in its supply chain. In addition, a non-certified firm dealing with certified suppliers (*indirect quality supply chain*) can also improve its performance. In this sense, the results of this supply chain analysis confirm empirically that quality standards could be conceptualised as *club goods*[5]. We note that the similarity of the results to Roman (2003) supports the temporal validity of our results. Even though we use a database which covers only 2006, we expect analogous results in the future, since the establishment of quality supply chain, over time, could promote some learning which could, in turn, generate even better improvements in firm corporate performance.

The differences between the findings from an OLS regression (Appendix 2) with the switching model findings could be partly due to an endogeneity bias. This is especially the case for the results concerning the *direct non complete quality supply chain*. Actually, the OLS results indicate that being a part of *direct non complete quality supply chain* does not influence a firm's profit, while results from switching model reveal that those firms report higher profit. Moreover, the switching model produces higher estimates than the parameter estimate from the OLS regression model. These results suggest that a firm's decision to choose one of the Quality Supply Chain categories is not random and depends on the firm's characteristics, which indicates, at least to some extent, the relevance of using a switching model.

CONCLUSION

Rather than simply investigating whether quality certification positively or negatively impacts firm performance, this paper attempts to extend previous research by providing an empirical answer to the question of whether there is a positive correlation between the hierarchical positions of the quality supply chain categories and the impact on a firm performance. In other words, the goal of this study is to analyse whether firm corporate performance is conditioned on the quality level of the supply chain, focusing on the firm and its upstream side supply chain. Following previous scholars (Forker *et al*., 1997; Tan *et al.*, 1999; Romano and Vinelli, 2001; Romano, 2002; Wu *et al*., 2011), we argue that both the firm's and supplier's quality systems are determinant for the firm's final success.

5 In order to check the consistency of our results, we use added value as additional indicator of firm performance. The obtained results are going in the same direction as using profit as indicator of firm performance. The results are available from the authors upon request.

Because our focus is on an analysis with respect to quality supply chains, where members of supply chains are integrated based on the best strategic solutions, we have assembled datasets that aggregate different characteristics and strategies of firms and indicators of performance. We find that the performance of firms belonging to the *direct complete quality supply chain* is higher than that of firms belonging to the *direct non complete quality supply chain*, which is higher than that of the firms belonging to the *indirect quality supply chain*, which is higher than that of the firms belonging to the *non quality supply chain* what confirms the first hypothesis. The second hypothesis is also supported indicating that the performance of the firms belonging to the *direct non complete quality supply chain* is higher than that of the firms belonging to the *indirect quality supply chain*, which is higher than that of the firms belonging to the *non quality supply chain*. The results confirm the third hypothesis stating that the performance of the firms belonging to the *indirect quality supply chain* is higher than that of the firms belonging to the *non quality supply chain*. Finally, our findings demonstrate that there is a positive and significant relationship between the hierarchical position of the quality supply chain categories and the impact on firm performance. Therefore, we support the view that the adoption of quality standards produces positive interactions between the firm and its suppliers which could be reflected in various firms' outcomes such as decreased production lead times, reduced costs, faster product development, and increased quality (*e.g.* Foster and Ogden, 2008). These results are also consistent with the previous research underlining the importance of integrating quality management in supply chains in order to improve firm performance *(e.g.* Tan *et al.*, 1998, Romano, 2002; Kuei *et al*. 2001; Lin *et al*. 2005; Kannan and Tan 2005; Kaynak and Hartley, 2008; Yeung 2008). Hence, we argue that firms could gain competitive advantage by creating more quality relationships with their suppliers. Additional contribution of this paper is the provision, through supply chain analysis, of empirical evidence demonstrating that quality standards can be viewed as *club goods*.

Managerial Implications

Our study has two important implications for practitioners. First, policymakers should emphasise the benefits of quality supply chain in order to encourage managers to adopt quality standards and select only quality sensitive suppliers for their firms. Managers should pay attention not only to their own quality, but also to the quality of their suppliers, in order to obtain important improvements in firm corporate performance. Moreover, the evidence we have accumulated indicates that adopting quality standards does not per se raise performance to the same degree as where firms deal with suppliers that are also quality certified. It is this combination that seems to matter most for firm performance. Secondly, firms without quality standards can deal with quality certified suppliers in order to benefit from their experience and in this way improve their own corporate performance. We show that firms that are not quality certified will, if they have quality certified firms as suppliers, benefit from this partnership, generating a positive signal on the market through their certified suppliers. Hence, cooperation among firms and suppliers permits firms in the *indirect quality supply chain* category to benefit from supplier knowledge and experience of quality, and therefore improve their performance compared to firms in the *non quality supply chain* category. This shows that a key objective for these firms is to establish good relationships with suppliers to assure continuous improvement of their performance. We may conclude that strong relationships with suppliers will lead to faster development and performance improvements. The contribution could be especially significant for managers of small firms since the quality

certification process is costly for them (Pekovic and Galia, 2009). Nevertheless, managers ought to understand that a well-established internal quality management system is necessary to maximise corporate performance improvement. Moreover, in order to compete successfully on the market, managers should extend their vision of quality beyond their own firms and into the upstream supply chain firms.

Future directions for research

This study is subject to a number of limitations and some of them are natural avenues for future research. Firstly, as we have already indicated, due to data limitation we were not able to integrate into our analysis the quality sensitivity of the downstream players of the supply chain. The subject is of a great importance since supply chain management requires the simultaneous integration of customer requirements, internal processes, and upstream supplier performance (Romano, 2002). Moreover, by integrating downstream players we could obtain a more "complete" picture of the relationship between quality sensitivity of supply chain players and firm corporate performance. Secondly, as our analysis is based on the French context, research on this issue should be extended to an international setting because the implementation of management practices also depends on a country's institutional framework (Pekovic, 2010). Thirdly, to better generalise our conclusion supporting a positive correlation between the hierarchical positioning of the quality supply chain categories and the impact on firm performance, it would also be interesting to examine additional indicators of firm performance other than profit. The choice of performance measures matters because they mediate the relationship between the firm's probability of choosing to join particular quality categories of supply chain and firm performance. Finally, this paper asks an important theoretical question as to whether the number of firms that are quality certified is Pareto optimal. This question is not trivial. At first glance, because of external factors, the answer could be negative (*i.e*. the number of firms that are quality certified is lower than the Pareto optimal number of quality certified firms). However, as there is no 'poaching effect' (*i.e*. the firms that are not quality certified also have to pay an additional cost to have quality certified suppliers), the firms that are not quality certified have in some way directly internalised the external effects in their behaviour. Another avenue of research is to understand why firms in the *direct non complete quality supply chain* category choose to have suppliers that are not certified when such a partnership significantly damages their performance.

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Appendix 1. Pearson correlation coefficients (As for Tables 1, we do not report results concerning the variable ACTIVITY)

	PROFIT	DIRECT COMPLETE QUALITY	DIRECT NON COMPLETE QUALITY	IDIRECT QUALITY SUPPLY CHAIN	NON QUALITY SUPPLY CHAIN	QUALDEP	QUALEXT	ES	QUALITY IMPROVEMENT	COST REDUCTION	COMPETITIVE PRICE	COMPETITIVE PRESSURE	MARKET UNCERTAINTY	CLIENTS CONDITIONED	SUPPLIERS CONDITIONED	SIZE	CAPITAL	LABELLING	FIXED DEADLINES	EXTERNAL MANAGERS FOR RELATION WITH CLIENT
PROFIT	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIRECT COMPLETE QUALITY SUPPLY CHAIN	0.08	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIRECT NON COMPLETE QUALITY SUPPLY CHAIN	-0.03	-0.28	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IDIRECT QUALITY SUPPLY CHAIN	0.11	-0.40	-0.21	1.00	-	-	-	-	-	-	-	-								
NON QUALITY SUPPLY CHAIN	-0.07	-0.47	-0.25	-0.35	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
QUALDEP	0.09	0.26	0.01	-0.05	-0.23	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
QUALEXT	0.07	0.20	0.01	-0.03	-0.19	0.40	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
ES	0.07	0.30	0.03	-0.14	-0.20	0.13	0.13	1.00	-	-	-	-	-	-	-	-	-	-	-	-
QUALITY IMPROVEMENT	0.01	0.07	0.02	0.02	-0.10	0.08	0.06	0.01	1.00	-	-	-	-	-	-	-	-	-	-	-
COST REDUCTION	0.00	0.11	-0.01	0.01	-0.12	0.11	0.09	0.05	0.14	1.00	-	-	-	-	-	-	-	-	-	-
COMPETITIVE PRICE	-0.06	0.07	0.01	-0.02	-0.06	0.05	0.03	0.04	0.24	0.24	1.00	-	-	-	-	-	-	-	-	-
COMPETITIVE PRESSURE	-0.04	0.01	-0.02	0.02	-0.02	0.01	0.02	0.00	0.03	0.07	0.09	1.00	-	-	-	-	-	-	-	-
MARKET UNCERTAINTY	-0.08	0.05	0.01	-0.01	-0.05	0.03	0.03	0.02	0.05	0.12	0.09	0.27	1.00	-	-	-	-	-	-	-
CLIENTS CONDITIONED	-0.03	0.16	-0.03	-0.03	-0.12	0.05	0.03	0.06	0.01	0.03	0.03	0.03	0.05	1.00	-	-	-	-	-	-
SUPPLIERS CONDITIONED	-0.05	-0.03	0.01	0.07	-0.03	-0.08	-0.03	-0.02	0.01	-0.01	-0.00	0.03	0.03	0.00	1.00	-	-	-	-	-
SIZE	0.10	0.29	0.04	-0.10	-0.25	0.33	0.22	0.24	0.05	0.14	0.14	-0.02	0.01	-0.00	-0.18	1.00	-	-	-	-
CAPITAL	0.38	0.14	-0.02	-0.02	-0.12	0.18	0.16	0.15	0.02	0.07	0.07	-0.01	0.00	-0.00	-0.05	0.17	1.00	-	-	-
LABELLING	0.02	0.34	0.13	-0.16	-0.30	0.17	0.15	0.19	0.05	0.06	0.06	-0.00	0.00	0.01	-0.00	0.19	0.05	1.00	-	-
FIXED DEADLINES	0.04	0.29	0.03	-0.05	-0.28	0.19	0.13	0.13	0.10	0.10	0.10	0.02	0.05	0.13	0.01	0.18	0.01	0.27	1.00	-
EXTERNAL MANAGERS FOR RELATION WITH CLIENT	0.10	0.07	0.00	-0.01	-0.07	0.22	0.32	0.09	0.02	0.02	0.06	0.03	0.02	-0.09	-0.02	0.22	0.11	0.07	0.06	1.00

Source: *COI-TIC* 2006 survey (INSEE-CEE), *EAE* 2006.

Appendix 2. The relation between Quality Supply Chains and firms' performance (Ordinary Least Square)

	PROFIT
DIRECT COMPLETE QUALITY SUPPLY CHAIN	0.13***
	(3.00)
DIRECT NON COMPLETE QUALITY SUPPLY CHAIN	-0.01
	(0.28)
INDIRECT QUALITY SUPPLY CHAIN	0.11***
	(2.69)
NON QUALITY SUPPLY CHAIN	Ref.
ES	0.00
	(0.10)
QUALITY IMPROVEMENT	0.17***
	(2.19)
COST REDUCTION	-0.02
	(0.59)
COMPETITIVE PRICE	-0.25***
	(5.97)
COMPETITIVE PRESSURE	-0.05
	(1.65)
MARKET UNCERTAINTY	-0.18***
	(6.10)
CLIENTS CONDITIONED	-0.11***
	(3.57)
SUPPLIERS CONDITIONED	0.01
	(0.38)
SIZE	0.34***
	(31.27)
CAPITAL	0.00
	(0.34)
LABELLING	-0.05*

	(1.67)
FIXED DEADLINES	0.13***
	(4.18)
CLIENT DEPARTMENT	0.13***
	(3.63)
AGRIFOOD	-0.25***
	(3.45)
CONSUMPTION GOODS	0.11
	(1.48)
CARS AND EQUIPMENTS	-0.08
	(1.42)
ENERGY	0.28
	(1.65)
INTERMEDIATE GOODS	Ref.
CONSTRUCTION	-0.01
	(0.22)
COMMERCIAL	0.23***
	(4.04)
TRANSPORT	-0.49***
	(7.23)
FINANCIAL AND REAL ESTATE	-0.08
	(0.78)
SERVICES FOR FIRMS	0.16***
	(2.55)
SERVICES FOR INDIVIDUALS	-0.09
	(1.06)
Intercept	0.35***
	(3.18)
R-squared	0.18
Observations	7685

Source: *COI-TIC* 2006 survey (INSEE-CEE), *EAE* 2006.

Coverage: firms with more than 10 employees in given quality supply chain categories, sample of 4,010 firms.

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

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