Firms' openness and organizational innovation: From fashion and rational perspectives

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Abstract

Two main perspectives on drivers of Organizational Innovation (OI) adoption are generally opposed in the literature: the institutional (fashion) and the rational (efficient-choice) ones. This paper aims at bridging these two perspectives to analyse the external antecedents of OI. Using the French COI (Organizational Change and Computerization) survey for the period of 2003-2006, we find that OI is not only influenced by mimetic and coercitive pressures but also by an active external search strategy. Our results also show the existence of a substitution effect between external search activity and absorptive capacity when OI is concerned. Thus, while openness is beneficial for manufacturing firms seeking to adopt OI, internal obstacles still prevail in French manufacturing firms.

Keywords: Organizational innovation; Institutional theory; Open innovation; COI French survey.

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1. INTRODUCTION

This paper focuses on a commonly neglected type of innovation, organizational innovation (OI), which also is known by terms such as administrative innovation (Damanpour & Evan, 1984), management innovation (Birkinshaw, Hamel, & Mol, 2008; Hamel, 2006) or managerial innovation (Damanpour & Aravind, 2012). As Keupp, Palmié, and Gassmann (2011) note, only 25 of 342 articles about innovation published during 1992–2010 included OI, likely reflecting the technological bias that tends to limit innovation literature. Yet the lack of research attention is surprising, considering that OI is more widely adopted in industrial firms than any other type of innovation[1].

The literature examining why firms introduce OI still contains gaps (Mol & Birkinshaw, 2009). On one hand, the majority of studies have focused on their internal antecedents (Damanpour & Aravind, 2012), neglecting the influence of external factors. On the other hand, the few studies that have discussed the effect of firms' openness on OI adoption fall into two distinct perspectives that do not meet together. The first is the institutional perspective that considers the introduction of new organizational practices as a fad-fashion-driven process (Abrahamson, 1991) or a way of reaffirming control over firms (DiMaggio & Powell, 1983). In particular, according to the forced-selection perspective, a number of organizations such as clients or suppliers may have sufficient power to dictate which organizational innovation will diffuse across organizations (DiMaggio & Powell, 1983). The fad and fashion perspective insists on pressures to imitate competitors' adoption decisions (Abrahamson, 1996). They introduce innovations into their own firm because of a bandwagon pressure caused by the sheer number of organizations that have already adopted this innovation (Abrahamson, 1991). Though interesting, these studies does not consider firms' openness as a goal-oriented decision.

[1] As France's Community Innovation Survey for 2004–2006 indicated (CIS, 2006), 47.6% of French manufacturing firms pursue OI, compared with only 46.1% focused on technological innovations (products and process).

By contrast, the second perspective, the open innovation framework suggest that firms rationally use " purposive inflows and outflows of knowledge to accelerate internal innovation" (Chesbrough, 2006: 1). For example, Mol and Birkinshaw (2009) and Ganter and Hecker (2013) both show that the voluntary acquisition and use of external knowledge sources stimulate OI adoption. In parallel, open innovation research demonstrates that the benefits of openness can be subject to decreasing returns (Laursen & Salter, 2006), depending on the firm's capacity to assimilate, transform, and exploit external knowledge (Cohen & Levinthal, 1990; Lichtenthaler, 2011; Zahra & George, 2002). Other studies stress the crucial role of dimensions other than external knowledge sources, such as investments in absorptive capacity (ACAP) and/or internal integration mechanisms (Chiaroni, Chiesa, & Frattini, 2010; Clausen, 2013; Huang & Rice, 2012; Lichtenthaler & Lichtenthaler, 2009). The impact of these dimensions and their potential relationship with firms' innovation remain ambiguous though. Some authors assert that firms with a high level of absorptive capacity benefit more from external knowledge (Escribano, Fosfuri, & Tribó, 2009), whereas others demonstrate a substitution effect between absorptive capacity and openness (Laursen & Salter, 2006).

This paper aims at bridging the institutional and open innovation perspectives to investigate the "true" antecedents of openness when OI adoption is concerned and examine two related questions: 1) Do these two perspectives provide rival or complementary arguments? 2) To what extent their arguments are adequate to explain OI adoption? 3) Is OI the result of external pressures, the result of a deliberate knowledge search or both?

We base our empirical analysis on a unique French data set, the Organizational Change and Computerization (*Changement Organisationnel et Informatisation,* or COI), for 2003–2006. In our cross-sectional study, we use a representative sample of more than 4300 manufacturing firms. The COI database provides detailed information about the OI that firms adopt, their external knowledge sources, their internal absorptive mechanisms and their institutional environment.

Our assessment centres on a specific exemplar of OI, namely, Lean management (Reichstein & Salter, 2006), which refers to a new form and practices of workplace organization that focus on reducing waste without compromising on quality (Ohno, 1988; Womack, Jones, & Roos, 1990). As a well-established or significant OI (Armbruster, Bikfalvi, Kinkel, & Lay, 2008; Hamel, 2006), Lean management provides a useful proxy in many innovation

studies (Damanpour, Walker, & Avellaneda, 2009; Mazzanti, Pini, & Tortia, 2006; Mol & Birkinshaw, 2009; OECD, 2005; Reichstein & Salter, 2006). Furthermore, the COI survey provides detailed information about Lean management practices in 2006 and how they have changed since 2003. Accordingly, we can compute an "objective" measure of innovation that involves the concept of newness at the firm level (Aiken & Hage, 1971; Rogers, 1995), unlike previous approaches that mainly address the firm's innovation perception.

For our empirical tests, we turn to a zero-inflated Poisson (ZIP) model, which is appropriate for count data that include excess zeros in the left tail of the distribution, and predict the number of OI adopted by firms in 2006. The results show that OI is not only influenced by external pressures but also by an active external search strategy. Thus, openness, which mainly has been applied to technological innovation, is also adequate for manufacturing firms that seek to adopt OI. That is, up to a certain limit, the more open the firm, the more it implements OI. We also find a positive effect of absorptive capacity on the number of OIs adopted by firms. However, the results ultimately demonstrate a substitution effect between external search activity and absorptive capacity in an OI context, which might explain why French manufacturing firms still face obstacles to adopt OI.

With these findings, we make three main contributions. First, this study broadens research into the antecedents of a neglected type of innovation, OI. We provide a more nuanced characterization of the external antecedents of OI and reconsider the conclusions of studies that tend to privilege the open innovation perspective without controlling for mimetic or coercive effects. Second, this study is based on a quantitative exploration and in that sense offers a new path for research by showing that open innovation can be extended to apply to new contexts (Huizingh, 2011), in particular non-technological innovations. Third, following the call for more research from Lane, Koka, and Pathak (2006), we propose an operationalization of absorptive capacity in a non-exclusive R&D context using metrics that capture the different dimensions of the ACAP process. From a managerial perspective, a better understanding of the drivers of OI offers useful guidance in support of firms' innovation and growth.

Therefore, in Section 2, we describe the theoretical bases of our empirical analysis. After we present the data and empirical models in Section 3, we detail our results in Section 4. Finally, in Section 5, we discuss the main theoretical and managerial implications of our findings and propose several paths for further research.

2. THEORETICAL AND EMPIRICAL BACKGROUND

2.1. Organizational innovation adoption

In most innovation typologies, OI is classified within the category of non-technological process innovations (Abernathy & Utterback, 1978; Edquist, Hommen, & McKelvey, 2001; Evan, 1966). It operates in organizational social systems, and it contains no technological elements as such (Edquist et al., 2001; Meeus & Hage, 2006). Unlike market-driven product and service innovations, OI has an internal focus and aims to increase the efficiency and effectiveness of the organizational process (Boer & During, 2001; Utterback & Abernathy, 1975).

OI also encompasses new management practices, organizational strategies, processes, policies, and structures, in the pursuit of organizational goals, whether in the form of traditional (financial) or softer (organizational members' satisfaction, motivation, rewards) performance goals (Birkinshaw et al., 2008; Daft, 1978; Damanpour & Aravind, 2012).[2] The notion of newness also appears at the core of the OI definition, and most innovation studies address it at the firm level, from the adopting organization's perspective (Aiken & Hage, 1971; Evan & Black, 1967; Knight, 1967; Mohr, 1969). Thus, if practices, processes, or structures are perceived as new by the adopting organization, they constitute an OI, "even though it may appear to others to be an imitation of something that exists elsewhere" (Van de Ven, 1986: 592). In this study, we focus on the adoption of OI by firms, whether it is generated internally or acquired from the organization that has pioneered it or by imitating it on their own (Damanpour & Aravind, 2012). Adoption can be understood as a decision through which an organization (or an organizational unit) selects, adapts, and implements new technologies, products, or organizational and managerial practices and assimilates them into its operations and activities.

[2] Among the several related terms that refer to non-technological innovation (organizational, administrative, managerial, management innovation), we chose "organizational innovation" for three reasons. First, it covers the various dimensions included in the general concept (e.g., new managerial practices, new organizational structures) better than terms such as managerial or administrative innovations, which imply a focus on managerial or social dimensions, respectively. Second, it comes closest to the typology of innovation offered by Schumpeter (1934), who lists "new way of organizing," as well as widely accepted typologies by Edquist et al. (2001) and Meeus et al. (2006). Third, it is the term that appears in the Oslo Manual (OECD, 2005) and CIS surveys.

2.2 The institutional perspective: the role of external pressures on organizational innovation adoption

Innovation is a complex process, in which new knowledge plays a crucial role. It results from the combination of existing and new knowledge (Fabrizio, 2009). External actors, as important knowledge sources, are pivotal to innovation success (Rosenberg, 1982). The institutional theory has led to significant insights regarding the importance of pressures from external actors to the study of OI adoption. According to this theory, the decision to adopt new organizational practices has more to do with the institutional environment in which a firm is situated than rational organizational and technological criteria. In the case of OI adoption, positive effects should be observed when firms' face pressures to be isomorphic with their environment (i.e., when its suppliers, customers, competitors also use the innovation).

Some scholars have attempted to identify the mechanisms that trigger external influences driving OI adoption beyond the technical efficiency of the innovation[3]. According to the "force selection perspective" (Abrahamson, 1991) or the "coercive isomorphism" (DiMaggio & Powell, 1983), external partners can exert pressure to strongly urge firms to adopt some new organizational practices. DiMaggio and Powell (1983) conclude that a position of dependence of a firm on clients or suppliers is a good predictor of coercive isomorphic. Based on case studies of French Manufacturing firms which have adopted Lean practices, Dubouloz (2012) finds that main clients can strongly encourage their subcontractors to adopt new organizational practices through high quality standards and delivery requirements. For this purpose, they can provide new solutions as "best practices", already tested in other firms. Other authors indicate that suppliers can also significantly influence the probability that an OI will be adopted by firms through persuasive marketing tactics (Frambach & Schillewaert, 2002) or the control of scare resources (Pfeffer & Salancik, 1978).

However, external pressures do not always derive from coercive authority. In line with the "fad and fashion perspective" (Abrahamson, 1991) or "mimetic processes" (DiMaggio & Powell, 1983), some firms imitate actions or organizational practices adopted by other users which appear somewhat better able to cope with economic difficulties and market constraints.

[3] nstitutional theory focusses on three different mechanisms: mimetic, normative and coercive isomorphism (DiMaggio and Powell, 1983). Given the theoretical and empirical difficulty of differentiating the effects of mimetic and normative pressures, we follow Chen et al. (2010) by choosing to focus on mimetic and coercive pressures.

Firms which obtain knowledge from earlier or current adopters can reduce uncertainty and informational asymmetries about OI and its effects (DiMaggio & Powell, 1983; Teece, 1980).

All these arguments inherited from the institutional perspective suggest that:

H1: External mimetic and coercitive pressures from clients or suppliers affect positively the number of organizational innovations adopted by firms

2.3. Open innovation: a new paradigm for organizational innovation adoption

2.3.1. External knowledge sourcing

OI is not only driven by the pursuit of legitimacy or external pressures (Damanpour & Aravind, 2012). The open innovation framework provides a rational approach to the introduction of new organizational practices. Open innovation refers to exchanges of knowledge as tools for enhancing internal innovation and its potential uses (Chesbrough, 2006). Opening firm boundaries then becomes a source of sustainable competitive advantage and a "powerful generative mechanism to stimulate innovation" (Chesbrough, 2012: 22). Two main dimensions of open innovation are identified: (1) outside-in or inbound open innovation, which enables firms to establish relationships with external actors to acquire or explore knowledge, and (2) inside-out or outbound open innovation, such that firms establish relationships with external actors to commercially exploit or sell their knowledge (Chesbrough, 2012; Chiaroni et al., 2010; Gassmann & Enkel, 2006). We focus on inbound open innovation in this paper.

Laursen and Salter (2006) introduce two variables to capture firms' openness: search breadth, or the number of external sources used by firms, and search depth, defined as "the extent to which firms draw intensively from different search sources" (p. 140). Searching both widely and deeply across a vast range of external knowledge sources provides ideas and resources that can be conducive to product innovation. Escribano et al. (2009) also confirm that firms that enjoy more external knowledge flows are more technologically (product and process) innovative. Similarly, Lazzarotti and Manzini (2009) argue that the number and diversity of firm partners (e.g., universities, suppliers, consumers, competitors, consultants, other enterprises in the same group) determine the level of innovation openness. However, there also may be "tipping points," after which openness to external knowledge sources leads to decreasing innovation performance (Huang & Rice, 2012; Laursen & Salter, 2006).

Open innovation studies mainly focus on product innovation and R&D activities though, despite evidence that open innovation has become increasingly common in process innovation (Reichstein & Salter, 2006; Robertson, Casali, & Jacobson, 2012; Utterback & Abernathy, 1975). For example, Birkinshaw et al. (2008) assume that OI "emerge in vitro" (p. 840), or at least in non-isolated contexts, following from interactive processes with internal and external actors. With data from the U.K. Community Innovation Survey (CIS3), Birkinshaw and Mol (2006) find that firms adopt new management practices not only when ideas are offered by market participants (customers, suppliers, competitors, consultants) but also when they use internal and professional sources (professional associations, industry bodies). Ganter and Hecker (2013) also validate the crucial role of external sources of knowledge using the German CIS4 survey, and a recent study of Australian business units shows that interorganizational collaborations foster process innovations, including technological and OI (Huang & Rice, 2012). In line with these arguments, we propose:

> ***H2****: Up to a certain limit, firms that are more opened to external knowledge sources is more likely to adopt organizational innovations.*

2.3.2. Internal absorptive capacity mechanisms

Beyond firms' external relationships, open innovation should integrate internal integration mechanisms and investments in absorptive capacities (Huang & Rice, 2012; Lichtenthaler & Lichtenthaler, 2009). Absorptive capability (ACAP) allows a firm to "recognize the value of new, external information, assimilate it, and apply it" (Cohen and Levinthal, 1990: 128). As Chiaroni et al. (2010) argue, open innovation involves not only interorganizational networks but also ACAP dimensions, such as organizational structures, evaluation processes, and knowledge management systems. Organizational structures constitute internal mechanisms for accessing and integrating external sources of knowledge into innovative processes, such as through internal open innovation units and internal champions (Chesbrough & Crowther, 2006). The evaluation processes entail the capability to evaluate innovation opportunities, based mainly on firms' internal R&D, which is a prerequisite for evaluating and absorbing external knowledge (Cohen & Levinthal, 1990; Lazzarotti & Manzini, 2009). Finally, knowledge management systems can support the diffusion, sharing, and transfer of knowledge within the firm and with external actors.

However, the relationship between ACAP and innovation is relatively less well documented in relation to non-technological innovations (Kostopoulos, Papalexandris, Papachroni, & Ioannou, 2011). Among a large sample of Australian firms, Huang and Rice (2012) confirm that inter-organizational collaborations, evaluation processes, and organizational structures co-vary positively and significantly with product and service innovation performance. Clausen (2013) examines the link between absorptive capacity and the intensity of innovation cooperation and finds that some ACAP dimensions (internal R&D, human capital, and training) are positively associated with search breadth. Other studies that use single-dimensional measures of ACAP confirm that R&D expenditures (Battisti & Stoneman, 2010; Polder, Van Leeuwen, Mohnen, & Raymond, 2010) or prior knowledge (Wischnevsky, Damanpour, & Méndez, 2011) could be important drivers of OI.

Despite the availability of various ACAP measures that attempt to adapt to various research authors' needs and interpretations (Lane et al., 2006), there is a broad consensus that ACAP is a multilevel, multidimensional construct (Lane et al., 2006; Murovec & Prodan, 2009; Roberts, Galluch, Dinger, & Grover, 2012; Zahra & George, 2002). Accordingly, Flatten, Engelen, Zahra, and Brettel (2011) argue that the use of single, static proxies may have contributed to conflicting, misleading findings about the nature and contributions of ACAP. Therefore, an accurate operationalization should identify the different components and sub-components of ACAP and determine their potential measures. Following the Lane et al. (2006) suggestions to operationalize ACAP, we have examined the components included in the three dimensions (identify, assimilate and apply) that underlie this concept in the Cohen and Levinthal's three seminal studies (1989, 1990, 1994). (see Table 1). In general though, we predict a positive effect of ACAP on OI.

H3: Internal absorptive capacity mechanisms increase the number of organizational innovations adopted by firms.

TABLE 1. ACAP: operationalization issues

ACAP dimensions (Cohen & Levinthal, 1989, 1990, 1994))	Components	Cohen and Levinthal's citations	Measures for the ACAP components
VALUE Refers to a firm's ability to recognize the value of new knowledge and to acquire it	- Prior knowledge	- "A firm without a prior technological base in a particular field may not be able to readily acquire one" (1994: 236)	- Cumulative number of events experienced by the firm, related practices adopted (Lenox & King, 2004)
	- Communication structures	- ACAP depends "on the structure of communication between the external environment and the organization" (1990:132)	- IT infrastructure among the organization (Chiaroni and al., 2010)
ASSIMILATE Refers to the firm's ability to analyse, interpret, understand, share and integrate valuable new knowledge	- Prior Knowledge	- "Prior knowledge permits the assimilation and exploitation of new knowledge" (1990:136)	- Cumulative number of events experienced by the firm or related practices adopted (Lenox & King, 2004);
	- Competent specialists	- "To integrate certain classes of complex and sophisticated (technological) knowledge … the firm requires an existing internal staff of technologists and scientists who are competent in their fields" (1990:135)	- Presence of competent specialists
	- Organic structure	- "The organic structure of Burn and Stalker (1961) is more adaptable for ACAP" (1990:132)	- Decentralization (Lane & Lubatkin, 1998)
	- Staff with various relevant background knowledge	- "The staff should have a relevant background knowledge" (1990:132)	- Education level of employees (Escribano et al., 2009; Kostopoulos et al., 2011)
	- R&D activity	- "R&D enhances the firm's ability to assimilate and exploit information" (1989:21)	- Intensity of internal R&D or R&D expenditures (Cohen & Levinthal, 1989, 1990)
	- Communication structures	- ACAP depends on "transfers of knowledge across and within subunits … on the structure of communication among the subunits of the organization" (1990:132); "Communication is crucial for making novel linkages and associations" (1990:133)	- IT infrastructures (Chiaroni et al., 2010);
APPLY Refers to commercially applying assimilated external knowledge or to the firms' ability to create something new from assimilated knowledge	- Prior knowledge	- "Prior knowledge permits the assimilation and exploitation of new knowledge" (1990:136)	- Cumulative number of events experienced by the firm or related practices adopted (Lenox & King, 2004)
	- R&D activity	- "R&D enhances the firm's ability to assimilate and exploit information" (1989:21)	- Intensity of internal R&D or R&D expenditures (Cohen & Levinthal, 1989, 1990)

2.3.3. Interaction between external sources and internal absorptive capacity mechanisms

Access to external information can drive innovation success (Laursen & Salter, 2006), but inflows of new ideas and external knowledge are far from automatic or easy (Clausen, 2013). Internal mechanisms are necessary (Chiaroni et al., 2010; Huang & Rice, 2012), if not indispensable (Kostopoulos et al., 2011), to foster recognition of the value, assimilation, and application of external knowledge (Cohen & Levinthal, 1990). That is, external knowledge is "not freely and effortlessly absorbed by the firm" (Fabrizio, 2009: 257). Escribano et al. (2009) thus highlight that firms with higher levels of ACAP benefit more from external knowledge flows. They find complementarity between ACAP and external knowledge sources, which enhances firms' technological innovation performance. Kostopoulos et al. (2011) also show that ACAP mediates the relationship between external knowledge inflows and technological innovation, whereas the direct effect of external knowledge was not significant.

However, Laursen and Salter (2006) find a substitution effect between openness and ACAP. For these authors, external knowledge does not enter the firm freely, and knowledge searches can be time consuming, expensive, and laborious. Developing high ACAP also is costly (Clausen, 2013), so firms, especially small ones, might lack the necessary resources to develop both external and internal new knowledge routines. Accordingly, we predict a substitutive effect:

> ***H4****: External knowledge flows coupled with internal absorptive capacity mechanisms decrease the number of organizational innovations adopted by firms.*

3. DATA AND METHODS

3.1. Sample

The French "Organizational Change and Computerization" (COI 2006) survey was created by researchers and statisticians from INSEE (National Institute for Statistics and Economic Studies) and DARES (Ministry of Labor). The 2006 version provides a rich source of information on new Lean management practices adopted by firms since 2003. Respondent firms also indicated the external and internal conditions in which they decided to adopt ICT and Lean practices. The COI survey included 14508 firms with more than nine employees, across all sectors, but for our cross-sectional analysis, we restrict the sample to 4319 manufacturing firms. The

structure of this sample is consistent with the initial COI 2006 database, in terms of industrial affiliation and firm size.

Compared with CIS data, COI data offer several advantages. Most notably, they provide a more objective measure of innovation, in line with a firm-level concept of newness (Aiken & Hage, 1971; Van de Ven, 1986). Each respondent firm indicated whether it used new Lean management practices in 2003 and 2006. Moreover, the variables are available for all firms, whether they are considered innovative or not.

3.2. Measures

We provide a detailed description of the variables in our empirical analysis in Table 2.

3.2.1. Dependent variable

Lean management (Womack et al., 1990), inspired by the Toyota Production System (Ohno, 1988), is one of the most notable OIs from the past two decades (Armbruster et al., 2008; Reichstein & Salter, 2006). It encompasses several specific practices, including just-in-time (JIT) sourcing, quality systems, self-directed work teams, pull production systems, quick changeover techniques, and lot size reduction (Shah & Ward, 2003). Lean practices often serve as proxies for OI in empirical studies (Damanpour et al., 2009; Mazzanti et al., 2006; Mol & Birkinshaw, 2009; OECD, 2005). Thus, we derived our OI measure from seven Lean management indicators: (1) certification or accreditation of a quality system (ISO9001), (2) certification for environment or ethical labelling (ISO 14001) (3) set of problem solving tools, (4) independent work groups or teams, (5) JIT production, (6) traceability tools, and (7) supply chain management tools and applications. These indicators align with the key practices identified in lean management literature (Shah & Ward, 2003). The dependent variable *opi_int_r* refers to the number of Lean practices adopted by firms between 2003 and 2006. We computed, for each firm, the sum of practices in use in 2003 and then in 2006, then calculated the difference. Each firm receives a score from 0 to 7. Noting the few firms in the three classes on the right tail of the distribution, we grouped them into a single class, such that each firm earned a score from 0 to 3.

TABLE 2
Variables used in the empirical analysis

Variables	Label	Description	Codification
Dependent variable			
Intensity of organizational innovation adoption	*opi_int_r*	Adoption intensity of seven new Lean management practices (certification for quality, certification for environmental labelling, set problem solving, independent work groups, JIT production, traceability tools, supply chain management tools) during 2003–2006. 0 = no Lean practice adopted; 1 = one Lean practice adopted; 2 = two Lean practices adopted, and 3= three Lean practices adopted or more than three.	Ordinal 0-3
Independent variables			
Openness intensity	*Breadth*	Sum of five external sources of knowledge: clients or customers, consultants, private partners (private businesses or laboratories), public partners (CNRS, universities, other public bodies), and external advice services to improve design or R&D. Each source is first coded as a binary variable (0 = no use, 1 = use). The addition of all source scores leads to an overall score from 0 (no knowledge sources used) to 5 (all knowledge sources used).	Scale 0-5
Absorptive capacity	*value*	Equal to 1 if the firm has been classified in the ACAP "value" dimension from Cohen and Levinthal and 0 otherwise.	Dummy 0-1
	assap (ref.)	Equal to 1 if the firm has been classified in the "assimilate and apply" dimensions from Cohen and Levinthal and 0 otherwise.	Dummy 0-1
Client concentration	*concen6*	Whether three main clients constitute more than 50% of turnover, equal to 1 if they do and 0 otherwise.	Dummy 0-1
Supplier concentration	*consup6*	Whether three main suppliers weight more that 50% of total purchases and 0 otherwise.	Dummy 0-1
Mimetic effects	*Mimetism*	Percentage of firms which have adopted new Lean practices in 2006 among the total number of firms in the sample which operate in the same industry	Continuous
Lack of resources	*r_diff*	Equal to 1 if the firm perceives a lack of human or financial resources in 2006 and 0 otherwise.	Dummy 0-1
Technological focus	*techno_prio*	Equal to 1 if technological modernity is of great (high or very high) importance for the firm and 0 otherwise.	Dummy 0-1
Control variables			
Size	*lg_effl*	Logarithm of the number of employees.	Logarithm
Low-tech industries	*low_tech*	Equal to 1 if the firm belongs to low-tech manufacturing sectors and 0 otherwise.	Dummy 0-1
High-medium tech industries	*high_medium_ tech (ref.)*	Equal to 1 if the firm belongs to high or medium-tech manufacturing sectors and 0 otherwise.	

3.2.2. Independent variables

As it has been already emphasized, external pressures may represent important factors that affect organizational practices. Moreover, if we do not introduce variables for these effects, this will generate cross-sectional heterogeneity between firms.

The degree of dependence, which can be measured with respect to the number of customers or suppliers, is a characteristic that may predict the existence of coercive isomorphism (DiMaggio & Powell, 1983). When the firm is dependent on few clients and/or suppliers, these latter may urge firms to adopt new practices and processes in order to improve their quality, delivery or to reduce their costs. Following Chen, Watson, Boudreau, and Karahanna (2011) coercitive pressures are measured by using an "inducement-based mode" knowing that an organization may develop the dependence on certain customers and suppliers when these supply-chain partners account for most of its sales and purchases, and are hard to be replaced by others. We introduce two variables. *Concen6* takes on value 1 if the three main clients of the firm weight more than 50% of total sales and 0 otherwise. Similarly, *Consup6* equals 1to 1 when the three main suppliers weight more that 50% of total purchases and 0 otherwise.

Following Bocquet, Brossard, and Sabatier (2007) and Chen et al. (2011), mimetic effects are measured through a "frequency-based mode", that is to say the number of current adopters. We calculate the percentage of firms which have adopted new Lean practices in use in 2006 among the total number of firms in the sample which operate in the same industry. This variable is labelled *mimetism*.

In accordance with an open innovation view, our exploratory factors include both external sources of knowledge and absorptive capacity. The *breadth* variable, reflecting firms' openness, is based on five external knowledge sources that firms might use: customers, private R&D partnerships and suppliers, public R&D partnerships, consultants, and external design advice services. In line with Laursen and Salter (2006) measure, we compute the sum of sources used by each firm in 2006, so the measure can take a value from 0, if the firm uses no external knowledge sources, to 5 if it uses all of them.

The ACAP variables results from a cluster analysis. Following Escribano et al. (2009) and Kostopoulos et al. (2011), we used a principal component analysis to capture its multidimensionality. Because OI is relatively less associated with technological elements (Edquist et al., 2001), an R&D proxy is not sufficient to measure it. Instead, we used seven sub-variables

to capture the full dimension of ACAP. An *rdint* variable equals to 1 if there is an internal group dedicated to R&D. In addition, we used *sumopi03* to summarize the prior adoption of organizational practices, according to the sum of Lean practices in use in 2003, and thereby reflect the path-dependent nature of ACAP (Cohen & Levinthal, 1990; Zahra & George, 2002) while also accounting for the firm's skills and capacities. *Specia6* equals 1 if the number of specialists[4] is greater than the sample median, because that value implies that the firm has relevant specialists who are competent in their field (Cohen & Levinthal, 1990). If the firm is to value and assimilate new knowledge and ideas, it needs ICT (Chiaroni et al., 2010; Cohen & Levinthal, 1990), so we used three variables to measure the IT infrastructure (Todorova & Durisin, 2007): extranet network (*extra2006*), intranet network (*intra2006*), and electronic data interchange (EDI) (*edi2006*) system. Finally, we measured centralization with *centra6*, for which we first calculated the sum of decisions made by the firm's top hierarchical positions in 2006, and then compared it with the sample median. *Centra6* equals 1 if the hierarchy manages more than 4 missions.

These seven variables pertain to three factors that summarize the type of ACAP (62.23% of total variance). We then conducted a non-hierarchical cluster analysis on the scores revealed by this factor analysis. To determine the final number of clusters, we used three common criteria: (1) the statistical accuracy of the classification, measured by the ratio of within- and between-cluster variances (Fisher's test); (2) the number of firms per cluster; and (3) the economic significance of the identified clusters. According to these criteria, the version with two clusters of firms is preferable.[5]

To interpret the two clusters, we calculated the mean of each ACAP indicator in each cluster (see the Appendix A), then compared the means for each cluster. The two clusters accordingly can be defined as follows: In Cluster 1 (2164 firms), firms are well-equipped with EDI and extranet and intranet networks, as well as significant prior experience in organizational change. They also are more centralized. Cluster 2 (2155 firms) consists of firms with an internal R&D team and relevant specialists in various fields. Two dummy variables—*value* (reflecting the ACAP "value" dimension from Cohen and Levinthal, 1989, 1990) and *assapp*

[4] The focal specialties were design and R&D, purchases, sales and distribution, manufacture and operations, IT and data systems, human resources and training, and accounting, finance, and management control.

[5] For all comparisons of variances that we report, the Fisher's test was significant at the 0.000 level and indicated a good differentiation of the firms.

("assimilate" and "apply" dimensions from Cohen and Levinthal, 1989, 1990)—thus enter the econometric analysis.

Furthermore, *techno_prio* refers to the firm's technology focus. It equals 1 when technological modernity is important for the firm, because this trait could hinder the adoption of OI and enhance its non-adoption (zero-inflated class). The variable *r_diff* provides information about the lack of human or financial resources faced by the firm (1 = the firm perceives such difficulties, 0 = otherwise). Innovative firms tend to express greater awareness of this kind of obstacle than non-innovative ones, but they also are better able to overcome them (Baldwin & Lin, 2002; Galia & Legros, 2004), so we expect a negative impact of *r_diff* on the likelihood of being a non-adopter.

3.2.3. Control variables

We used two main variables to control for firm characteristics that may affect OI adoption. Larger firms are more likely to adopt process innovations, because they have more resources and better access to information (Huang & Rice, 2012; Kimberly & Evanisko, 1981; Schmidt & Rammer, 2007; Wischnevsky et al., 2011). To measure firm size, we used logarithm of the number of employees in 2006 (*lg_effl*). With the dummies *high_medium_tech a*nd *low_tech*, we also control for within-industry heterogeneity.

3.3. Methodology

Poisson regression models provide a standard framework for the analysis of count data, though data often are over-dispersed, in that their variance exceeds their mean, which reduces the usefulness of a Poisson distribution. To account for over dispersion, the modified zero-inflated Poisson (ZIP) regression model is the most appropriate[6]. It concentrates on modelling the variance–mean relationship (Cameron & Trivedi, 2013; Heilbron, 1994; Lambert, 1992; Mullahy, 1986; Winkelmann, 2010). The data for this model come from two regimes: In R_I, the outcome is always a zero count, whereas in R_{II}, the counts follow a standard Poisson process. This over-dispersion does not arise from heterogeneity, as is the case when the Poisson model is generalized to a negative binomial form. Instead, it arises from splitting the data

[6] We have also run a zero-inflated negative binomial regression model (ZINB). To compare the ZIP with the ZINB, the vuong test has been applied. The resulting t-statistics of 8.41 for the ZIP model confirms that it provides the best overall fit. On the basis of this result, this paper proceeds with a discussion of results only for the ZIP model.

into the two regimes. In practice, the presence of over-dispersion may reflect one or both sources (Greene, 2011; Mullahy, 1986). Thus, we model:

$$Prob(y_i = 0 / x_i) = Prob(R_I) + Prob(y_i = 0 / x_i, R_{II}) Prob(R_{II}),$$

$$Prob(y_i = j / x_i) = Prob(y_i = j / x_i, R_{II}) Prob(R_{II}), \quad j = 1, 2, \ldots n.$$

If we let z be a binary indicator of R_I ($z = 0$) or R_{II} ($z = 1$) and y indicate the result of the Poisson model in R_{II}, the observed y is equal to $z \times y^*$. A natural extension of the model with two regimes allows z to be determined by a set of covariates that may differ from the covariates that generate the conditional probabilities of the random process. Therefore,

$$Prob(z_i = 1 / w_i) = F(w_i, \delta),$$

$$Prob(y_i = j / x_i, z_i = 1) = \frac{e^{-\lambda_i} \lambda_i^j}{j!}.$$

The summary statistics of the dependent variable (*opi_int_r*) appear in Table 3, along with the distribution of frequencies, the means, and standard deviations. The distribution clearly shows an excess of zeros relative to a Poisson distribution, with a mean of 0.36. In turn, to handle the problem of excess zeros relative to the Poisson distribution, we propose the following ZIP model:

$$\ln \lambda_i = \beta_1 breadth + \beta_2 breadth\_squared + \beta_3 value + \beta_4 breadth\_value + \beta_5 concen6 + \beta_6 consup6 + \beta_7 mimetism + \beta_8 low\_tech + \beta_9 lg\_effl + \beta_{10} r\_diff + \beta_{10} techno\_prio$$

As Lambert (1992) shows, it is convenient to specify the two-regime model using logit, with the covariates X = {breadth, breadth_squared, value, breadth_value, concen6, consup6, mimetism, low_tech, lg_effl, r_diff, techno_prio}. We computed a Vuong test of the superiority of the model with two regimes compared with a classical Poisson regression model and the zero-inflated negative binomial regression model (ZINB). This test clearly supports the use of the ZIP model (*t*-statistic = 8.41, 95% confidence limit), because the large positive value is greater than the threshold of 1.96.

TABLE 3
Intensity of organizational innovation adoption

0	3278 (75.90%)
1	654 (15.14%)
2	251 (5.81%)
3	136 (3.15%)
Number of observations	4319
Mean	0.36
Standard deviation	0.011

4. RESULTS

We present the overall descriptive variable statistics in Table 4 and in Appendix B. Then we provide the ZIP model results in Table 5.

TABLE 4
Descriptive statistics

Variables	Full sample	OPI=1
OPI	24.10	
Opennes intensity	1.84*	2.31*
Absorptive capacity	50.10	51.87
Client concentration	38.52	41.40
Supplier concentration	31.89	29.20
Mimetism	14.44*	16.16*
Low-tech industries	41.41	38.81
Size	4.64*	5.06*
Lack of resources	10.77	15.59
Technological focus	78.14	84.15
Number of observations	**4319**	**1041**

*NOTE : * mean*

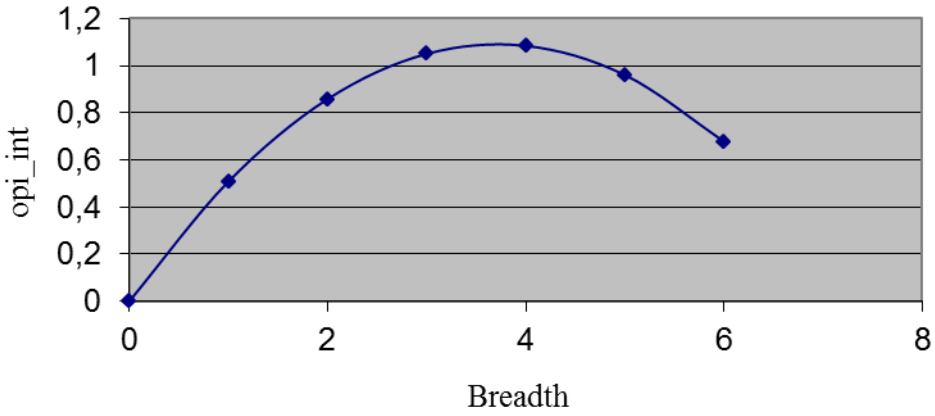
Our results largely confirm most of the hypotheses. This clearly indicates the proficiency of each argument inherited from the institutional and the open innovation perspectives. It is then possible to conclude that OI adoption is not only influenced by external pressures but also by an active external search strategy.

With respect to Hypothesis 1, two out of three variables reflecting external pressures have a significant impact on OI adoption. The estimation results confirm the role of coercive pressures from main clients (ρ=0.202, p<.01)and mimetic pressures from current adopters (p=0.011, p<0.1). The effect of the concentration of suppliers is not significant.

According to the open innovation perspective, there are rational reasons why a firm opens up its innovation process. Our results confirm that a voluntary acquisition strategy of external sources favours OI . More precisely, we note the significant and positive of *breadth* (p= 0.631, p<0.001) on the number of OI adopted by the firm. However, while breadth squared has also a significant effect (p=0.082, p<0.001), its sign is negative. Therefore, there is a threshold above which the use of external knowledge sources generates decreasing returns, in support of H2. Figure 1 indicates the point where openness appears to have negative consequences for OI intensity. What we can refer to as the 'tipping point' (Laursen & Salter,

2006) is at source 4, so that if firms acquire and use more than 4 external sources of knowledge for their OI activities, negative returns set in.

Figure 1. Predicted relationship between organizational innovation intensity (opi_int) and the number of external knowledge sources (breadth)



We also can confirm H3, related to the positive impact of ACAP on OI , because the coefficient for the *value* variable is significant and positive (p=0.296, p<0,01). Firms that are centralized and well-equipped with IT and that have significant prior experience in organizational change are more intensive adopters. Furthermore, in support of H4, the interaction of external knowledge source breadth and ACAP reveals a significant, negative effect (p=-0.101, p<0,05) on the number of new OI adopted by the firm.

For the zero state (i.e., the probability that firms adopt no new organizational practices), the parameters for the lack of resources and technological strategy focus are all highly significant (p<0,001), with negative signs. Therefore, firms that perceive financial or human constraints have a lower probability of not being innovative. Manufacturing firms focused on technological modernity also are less likely to appear in the zero class.

Finally, among the control variables, larger and low-tech manufacturing firms are more likely to introduce new organizational practices.

5. DISCUSSION AND CONCLUSION

This paper advances two perspectives to understand to what extent openness can favour OI . Following Poole and Van de Ven' recommendations (1989), our approach exploits paradoxes created by contradictory assumptions among different perspectives to capture the complexity of innovation adoption. Like Abrahamson (1991), we conclude that such a "para-

dox resolution" is well-adapted to explain the adoption of OI since both the institutional and open innovation perspectives can capture some aspects of OI adoption. This demonstrates that OI adoption is not only driven by the pursuit of legitimacy or external pressures but also by rational decisions. However, despite the existence of different mechanisms of external knowledge acquisition, firms still face internal obstacles hampering OI adoption.

TABLE 5
ZIP model estimation results

	ZIP	
	Parameter estimate (*t*-statistic)	Marginal effects (*t*-statistic)
Count state		
Constant term	-1.641*** (0.184)	
Openness intensity (breadth)	0.631*** (0.071)	0.226*** (0.027)
Breadth_squared	-0.082*** (0.013)	-0.029*** (0.049)
Absorptive capacity	0.296*** (0.113)	0.106 ** (0.04)
Breadth × Absorptive capacity	-0.101** (0.041)	-0.036* (0.015)
Client concentration	0.202*** (0.059)	0.072*** (0.021)
Supplier concentration	-0.006 (0.065)	-0,002 (0,023)
Mimetism	0,011*(0,006)	0,004† (0,002)
Low-tech industries	0.201***(0.063)	0.072** (0.023)
Firm size	0,041*(0,023)	0.015† (0.008)
Lack of resources		0.165 *** (0.033)
Technological focus		0.091*** (0.023)
Zero state		
Constant term	0,593*** (0.127)	
Lack of resources	-0.914*** (0.195)	
Technological focus	-0.504*** (0.130)	
Log-likelihood at convergence, *LL*(β)	-3248,66	
Number of observations	4316	
Number of zero observations	1040	
Vuong test	8.41***	

Notes: Robust standard errors are reported in round brackets.
**** Significant at .001; ** significant at .01; *significant at .05; † significant at .10..*

5.1. Impact of external pressure on OI adoption

As predicted by the institutional perspective, external pressures (both coercive and mimetic ones) play a significant role onOI. First, firms develop a dependence on certain clients that exert coercive pressures (Pfeffer & Salancik, 1978). The threat of sanction by these powerful actors provides strong incentives for conformity to Lean practices (Meyer & Scott, 1992). By compelling firms to adopt such practices, these dominant actors can reap more benefits from their own adoption. Second, in line with previous studies, we find that organization

innovation adoption is subject to mimetic effects (e.g. Teece, 1980; Lee & Pennings. 2002). This suggests that the "advantages" of Lean management practices are now recognized. The legitimacy and criticality of such practices can ease the uncertain conditions faced by potential adopters. However, our results also show that coercive effects are stronger than mimetic effects, revealing that certain firms may still have some doubts about the legitimacy of Lean practices. Another reason is that it takes longer to imitate new organizational practices since they must be tailored to firms' environment and strategy (Teece, 1980). Our measure of mimetic effect, based on current adopters in 2006, may lack to capture this necessary lap of time. This mimetic effect could have proven stronger if measured on earlier adopters.

5.2. Impact of openness on OI adoption

Firms can be engaged in an active external search strategy to introduce new management practices with the intention to enhance their performance (Mol & Birkinshaw, 2009). Using the concept of breadth (Laursen & Salter, 2006), we find that the degree of openness to external sources fosters the adoption of new organizational practices, up to a tipping point, after which its impact becomes negative. These findings are consistent with research by Laursen and Salter (2006), in reference to technological innovations, and Huang and Rice (2012). They reinforce the open innovation model, because firms that are open to external sources benefit from additional external knowledge. But, such external knowledge sources are not always easy to access though (Clausen, 2013). Two difficulties related to attention dynamics (Koput, 1997) might limit the benefits of external knowledge breadth. When there are too many ideas, firms have trouble attending sufficiently to all of them. Because they must focus on a few, firms tend to choose those that are closer to their existing organizational routines (Ocasio, 1997). Furthermore, ideas might arrive at the wrong time or in the wrong place, such that firms lack the capacities to value, explore, and exploit them. In such cases, too much openness can be counterproductive for OI adoption. This discussion underlines the importance of the degree of openness for the beneficial outcomes of breadth. Faced with a vast host of information and knowledge, firms need to be able to select, assimilate, and apply the most pertinent, which requires strong absorptive capacity.

5.2. The ambiguous role of ACAP

Recent conceptual and empirical research (Clausen, 2013; Lichtenthaler & Lichtenthaler, 2009; Robertson et al., 2012) recommend making ACAP an additional dimension of open innovation, with positive effects on innovation adoption. We confirm its positive effect on OI. However, our combined measure of breadth and ACAP has a negative impact, which implies a substitution effect between them (Laursen & Salter, 2006). Because a joint investment in ACAP and openness can be costly and time consuming (Clausen, 2013; Robertson et al., 2012), smaller firms with insufficient resources may be forced to trade off between these two activities. Furthermore, because OI influence firms' performance less readily than technological ones (Damanpour & Evan, 1984; Ettlie & Reza, 1992), firms might be less prone to make significant openness and absorptive capacity investments in this context. The NIH syndrome also might explicate this substitution effect. Defined as "the tendency of project group of stable composition to believe it possesses a monopoly of knowledge of its field, which leads it to reject new ideas from outsiders" (Katz & Allen, 1982: 7), the NIH syndrome implies that firms privilege internal ACAP mechanisms over external knowledge. Some research also suggests that NIH exists at the organizational level, referring more globally to internal resistance to external knowledge (Wastyn & Hussinger, 2011). If NIH syndrome dominates though, open innovation requires significant changes in the organization's culture, which cannot occur quickly or without human resource interventions.

5.3. Limitations and further research

The limitations of this study must be considered before applying its findings. First, we rely on one specific OI, Lean management without any possibility of comparison. However it offers the advantage to test a well-developed concept of OI. Although Lean management is a major OI (Reichstein & Salter, 2006) and a well-accepted proxy (Damanpour et al., 2009; Mazzanti et al., 2006; Mol & Birkinshaw, 2009; OECD, 2005; Reichstein & Salter, 2006), it would be interesting to extend our model to other OIs too. Second, previous research recommends including multiple innovation adoption phases (Damanpour & Schneider, 2006; Pierce & Delbecq, 1977), but we do not differentiate the effects of openness or ACAP on different phases. Instead, we address only the adoption-decision phase. Third, we have endeavoured to introduce an accurate measure of ACAP, consistent with Cohen and Levinthal's (1989, 1990)

original formulations, to account for its multidimensional features. Yet our ACAP operationalization remains constrained by the COI survey data. Additional variables to describe a richer human capital measure would be useful.

Appendix A
ACAP clusters

Cluster		intra2006	extra2006	edi2006	sumopi03	rdint	specia6	centra6
1	Mean	**0.77**	**0.52**	**0.69**	**2.84**	0.39	0.37	**0.76**
	N				2164			
2	Mean	0.43	0.14	0.38	2.26	**0.48**	**0.99**	0.60
	N				2155			
F-test (sig.)		***	***	***	***	***	***	***
Total	Mean	0.60	0.33	0.54	2.55	0.43	0.68	0.68
	N				4319			

NOTES :
We interpret Cluster1 and 2 according to the variables in the cluster analysis. We computed the mean of each variable for each cluster. The mean appears in bold when it is significantly higher in the considered cluster. For example, the dimension VALUE (Cluster 1) use significantly more IT infrastructures among the organization (intra2006, extra2006, edi2006) and prior knowledge (sumopi03) than do Cluster 2 (ASSAP)
****, ** and * indicate significance at 0.01, 0.05 and 0.10 level, respectively.*

Appendix B
Means, standard deviations and correlation coefficients

	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. OI adoption intensity	0.36	0.73	1.00									
2. Openness intensity	1.84	1.47	0.17	1.00								
3. Absorptive capacity	0.50	0.50	0.02	0.05	1.00							
4. Client concentration	0.38	0.49	0.04	-0.07	0.06	1.00						
5. Supplier concentration	0.29	0.45	-0.01	-0.08	0.04	0.07	1.00					
6. Mimetic effects	14.45	5.03	0.06	0.14	-0.00	0.01	-0.03	1.00				
7. Low tech industries.	0.41	0.50	0.01	-0.10	0.04	-0.04	0.03	-0.39	1.00			
8. Firm size	4.64	1.44	0.12	0.18	0.17	0.01	-0.13	0.08	-0.11	1		
9. Lack of resources	0.11	0.31	0.10	0.01	0.01	0.00	0.02	-0.05	0.09	1.00		
10. Technological focus	0.78	0.41	0.08	0.17	0.03	-0.01	-0.03	0.03	-0.05	0.17	0.04	1

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