Explicating Factors explaining

'Organizational' Innovation and its Effects

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Abstract

This paper shows how the probability of attempts at organizational innovation and its effects can be explained by firm age and size and other determinants. The integrated firm-level dataset obtained from the latest two Norwegian Community Innovation Surveys (CIS3 & 4) and annual accounts is used to investigate these complex relationships. The analysis employing Heckman two-step estimation to correct potential sample selection bias demonstrates that firm age and size have different impacts on the firm's decision to undertake organizational innovation and on the effects of such innovation on firm performance. Older and larger firms are found to be more inclined to make an attempt at organizational change; while, concerning the outcome, smaller firms are more able to benefit from such an attempt. The results further reveal that different types of organizational change do foster firm performance where even greater effects can be led by persistence of organizational innovation as well as complementarity of organizational and technological innovation. In addition, it is evidence that past economic performance and high costs of innovation influence the firm's decision to pursue organizational change.

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1. INTRODUCTION

Recent decades have seen a remarkably increase in concern with innovation among interdisciplinary scholars (see Fagerberg, 2004; Fagerberg and Verspagen, 2006; Fagerberg et al., 2008). Despite the great importance of organizational innovation, e.g., in economic 'forging ahead' and 'catch-up' at different points in time (Bruland and Mowery, 2004), technological innovation such as in terms of new or significantly changed products and processes, for instance through–but not limited to–R&D (Research and Development), has hitherto received more attention and been taken into account in a vast number of analyses in the area as mainly owing to the availability of statistics. Taking advantage of a novel dataset obtained from an integration of the firm-level Norwegian CIS 3 & 4 (Community Innovation Survey) and firm's financial accounts, this paper endeavors to investigate how firms make their decision upon and benefit from organizational innovation, defined as a non- or less-technological, customary and institutional way of change in how the firm organizes the works. Innovation of this sort is of crucial importance to the firm's survival and competitiveness accompanying key technological innovations affecting the firm's development and economic success (Chandler, 1962; Nelson 1991). Organizational innovation nonetheless can be constrained by many factors such as, in particular, firm age and size associated with a high resistance to the change of 'organizational routines' in the firm (Nelson and Winter, 1982), i.e., organizational rigidity or, to put in Hannan and Freeman's (1984) term, 'structural inertia'. The study takes accounts of these critical factors and other determinants in analyzing: (i) the firm's decision on attempting organizational innovation; and (ii) the consequence on its performance.

The paper is organized as follows. Section 2 gives some notes on organizational innovation. Section 3 provides theoretical background and hypotheses. In section 4 data and method used in this study are presented. Section 5 discusses descriptive statistics and empirical findings from the econometric analysis. Section 6 makes final remarks and concludes the paper.

2. SOME NOTES ON ORGANISATIONAL INNOVATION

More than half a century ago Schumpeter (1934, 1950) developed a broad notion of innovation as the introduction of new products, new processes, new sources of supply, new markets' exploitation and new ways of organizing business.[2] This remains valid today especially in a majority of industrialized countries in which their certain 'national systems of innovation' are composed of and significantly fostered by all these essential innovative changes (Freeman, 1987, 1995). Both technological and non-technological aspects of innovation are of importance (Chandler, 1962; Nelson 1991). The effort to implement technological innovation will meet only limited success unless accompanied by organizational change and vice versa as they are in fact interdependent (Freeman, 1995). Prior research shows that 'organizational' innovation, together with certain key technological innovations, have helped to improve firms' performance and growth in many leading and catching-up countries (such as the US, Germany and Japan) from the first industrialization through different 'business cycles' (Schumpeter, 1939) or, to use Freeman and Louca's (2001) label, 'techno-economic paradigm'.[3] More recent evidence confirms that organizational innovation is also crucial in our epoch as it complements a key technological driver like Information and Communication Technology (ICT) in elevating performance and growth of the firm (Bresnahan et al., 2002; Brynjolfsson and Hitt, 2000, 2003; Brynjolfsson et al. 2002; Sapprasert, 2007).

It is important to flag here that unlike in, for instance, Damanpour (1991) and Sorensen and Stuart (2000), 'organizational innovation' in this study is defined more narrowly as new or significant change in the firm structure and management methods,[4] what often termed by researchers in management/organizational studies (Evan, 1966; Daft, 1978; Damanpour, 1987, 1991; Kimberly and Evanisko, 1981; Teece, 1980) as "administrative innovation" as opposed to "technical innovation" (having organizational innovation considered as innovation of any sort in the organization), or what Edquist et al. (2001) refer to as "organizational process innovation" (*vis-à-vis* "technological

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[2] See a discussion in, e.g., Fagerberg (2003, 2004).

[3] See a discussion especially in Bruland and Mowery (2004).

[4] This is largely corresponding to the CIS4's definition of organizational innovation. See below.

process innovation", leaving aside product innovation). Put another way, 'organizational innovation' in this paper denotes an innovative change in the organization in a customary and institutional manner that is related more to organizational nature, structure, arrangements, practices, beliefs, rules and norms, rather than to its technical facets (see, e.g., Pettigrew and Fenton, 2000).[5]

As argued above, organizational innovation has received much less attention than the technological aspect of innovation. For instance, if one looks at scholarly contributions in the area of innovation studies (Fagerberg and Verspagen, 2006; Fagerberg et al., 2008), one may observe that most of the prominent works have failed to take into consideration the importance of organizational innovation. This is in large part due to the availability of statistics. While technological innovation is widely examined through reliance on patent and R&D data for example, how can one possibly measure organizational innovation that is less tangible in character? Fortunately, a very recent attempt by the CIS yields data that can be used to analyze this neglected phenomenon (see below).

3. THEORETICAL BACKGROUND AND HYPOTHESES

A central tenet of evolutionary economics highlights 'organizational routines' as the fundamental ways of doing things in the firm (Nelson and Winter, 1982). As time goes by, some best practices or prevailing routines in the firm may become less effective or even no longer acceptable, especially by comparison with that of competitors (Dosi and Nelson, 1994). Organizational transformation is thus crucial (Romanelli and Tushman, 1994), i.e., old routines need to be replaced by something new if the firm is not to be driven out of business. To survive and remain competitive, the firm has to search for better solutions and/or make changes in particular when its performance falls below its 'aspiration level' or a new window of opportunity opens up (Cyert and March, 1963; Greve, 2003). Although change in routines is clearly important to all firms, there exists considerable heterogeneity among them (Nelson and Winter, 1982). Firms have diverse characteristics that in turn make them different in how they decide on attempting routine

[5] See also a discussion on the 'organizational innovation' studies in, e.g., Lam (2004) and Sapprasert (2008).

change and benefit from such an attempt. This firm-level study, in line with Becker et al. (2005), applies the concept of 'organizational routine' to the analysis of organizational change with a focus on the influence of various factors on the firm's 'innovation-decision process' (Rogers, 2003) and its consequences.

3.1 Age, Size, Organizational Innovation and Effects

Inertia theory (Hannan and Freeman, 1984) indicates *inter alia* that age and size are associated with strong structural inertia, the force that hinders organizational change. Inertia increases monotonically with age as the firm's working relationships become more formalized, routines become more standardized and structure become more stabilized (Kelly and Amburgey, 1991). Size increases inertia because being larger makes the firm more rigid and inflexible (Downs, 1967). Inertia arisen from these attributes in turn makes the firm resistant to change (Carroll and Hannan, 2000).

<INSERT FIGURE 1 ABOUT HERE>

Although firm age and size may increase inertia as the theory suggests, when looking separately at their relationships with: (i) the firm's tendency to attempt organizational innovation; and (ii) the effects on firm performance, these two organizational factors possibly matter differently due their other properties (see Figure 1). First, size and age typically are associated with some features that may trigger efforts at organizational innovation. Kimberly and Evanisko (1981) argue that firm size not only necessitates but also facilitates the firm's innovative behavior. Larger firms might be more inclined to undertake organizational change because of their higher level of financial and other resources. Put another way, since larger firms in general have a greater capability to innovate (Schumpeter, 1950), they probably are more ready and likely to do so,[6] not only technologically but also organizationally (Kimberly and Evanisko, 1981; Damanpour, 1987). Further, it also is possible that age supports

[6] There is a large body of literature on the so-called 'Schumpeterian Hypotheses" dealing with the issue on how firm size matters for innovation (See, e.g., Scherer, 1980; Kamien and Schwartz, 1975, 1982; Cohen and Levin, 1989 for reviews). One standard justification from this Schumpeterian tradition is that larger firms have a greater propensity to innovate due to their better access to financial resource.

organizational innovation as the greater maturity of routines in older firms may serve as a more powerful impetus to innovation than in those younger that possess immature and undefined routines. While younger firms remain busy dealing with many basic business operational issues during their childhood (such as maintaining cash-flow, formalizing relationships and so on) or paying more attention on innovating new products or processes in entering the market, older firms can be expected to be relatively less occupied and ready for reorganization.

This line of reasoning suggests that, although organizational age and size are often seen to be associated with inertia which "often blocks structural change completely" (Hannan and Freeman, 1984, p. 155), this is not always the case as it also depends on type of change (e.g., core vs. periphery), environmental dynamics and other conditions (Hannan and Freeman, 1984). It is possible that "the same forces that make organizations inert also make them malleable" (Amburgey et al., 1993, p. 51). That is, there exist other properties of age and size, as discussed above, that could induce the firm's decision to attempt at organizational innovation:

H1: *Firm age increases the probability of attempts at organizational innovation*
H2: *Firm size increases the probability of attempts at organizational innovation*

Second, Hannan and Freeman's (1984) inertia theory suggests that it is difficult to predict the relationship between firm age and size, on the one hand, and the outcome of organizational change, on the other, particularly when one is examining the effects of organizational innovation on firm performance. This paper argues that the inertial properties that limit organizational change, which Hannan and Freeman (1984) point out are more prevalent in large and old firms, do in fact have greater influence on the outcomes of efforts at organizational innovation. Put another way, firm age and size are more likely to impede the effects of organizational innovation on firm performance.

As discussed above, older firms are said to have more standardized routines and rigid internal structures (Stinchcombe, 1965, Hannan and Freeman 1984). They may then be more reluctant to unlearn past routines, less able to transform their structures and as a result have a higher probability to get stuck in a 'competency trap' (Levinthal and March,

1993) or remain path dependent (Arthur, 1994; David, 1994). Although it is managerial authority that leads to most undertakings in the firm (Witt, 1998; Knott, 2001), this is often subject to limit in practice when it comes to organizational change (Leibenstein, 1987). This implies that, unlike youngsters that commonly are more adaptive, older firms that usually stay committed to the past would not substantially benefit from reorganization, which might have been strategically enacted. Likewise, the effects of organizational change might decrease with size, which typically increases the distance between decision makers and practitioners. And this increasing distance through a hierarchy is likely to vary commands or plans set out by the former (Beckmann, 1977), consequently hindering any organizational change demanded. In a large but lean organizational structure however, there typically exist a number of links among each unit, i.e., complexity (Simon, 1962), which can also hamper organizational innovation. In addition, since organizational members usually prefer the *status quo* and thus oppose change, efforts at organizational innovation in larger firms with more people frequently confront internal opposition or 'political force' (Pfeffer, 1992). These conditions result in greater ossification and inflexibility that may cause larger firms to benefit less from organizational change attempts.

In this sense, the study seeks to explicate Hannan and Freeman's (1984) inertia theory by arguing that size and age, despite being factors that as discussed above increase the odds of organizational change attempts, hamper the effects of organizational innovation on firm performance:

H3: *Firm age decreases the effects of organizational innovation on firm performance*
H4: *Firm size decreases the effects of organizational innovation on firm performance*

3.2 Persistency and Complementarity

A process of 'creative accumulation' is fundamental to the success of innovative firms since what has been learnt or experienced in the past may enable and support certain innovations to be undertaken (Schumpeter, 1950). Firms learn to change by changing (as in conformity with "learning by doing", see, e.g., Arrow, 1962; Nelson and Winter, 1982; Dosi, 1988). And having changed results in acquaintance with change or even makes it

become a ‘modification routine’ (Nelson and Winter, 1982; Aldrich, 1999). Put differently, prior changes lead to more knowledge and competence, and persistence of innovation, which nonetheless is rare especially in technological terms (Geroski et al., 1997; Malerba and Orsenigo, 1999; Cefis and Orsenigo, 2001; Cefis, 2003), thus influences the firm’s innovation process and performance. As business environment keeps shifting, the innovative firm needs to draw on accumulated knowledge and competencies in order to deal with it (Winter 1987; Teece and Pisano, 1994).

In addition, organizational change resets the organizational clock, Hannan and Freeman (1984) and Amburgey et al. (1993), in other words; the alteration of routines, structure, roles and relationships within the organization effectively make the firm new once more. A firm that has changed previously thus may have its organizational clock reset and become young again. In line with H3, it suggests that prior reorganization brings to the firm more benefit from a new round of organizational innovation:

H5: *Persistence of organizational innovation increases the effects of organizational innovation on firm performance*

Further, as was argued above, technological and organizational innovation are complementary factors and both are necessary to enhance firms’ performance. The steam engine alone could not bring about an enormous jump in growth and performance of a vast number of firms back in the first industrialization. Nor can firms in the present ICT era simply plug in computers to achieve product/service quality or efficiency gains (Bresnahan et al., 2002). Change in the organizational aspect is in point of fact not less crucial and has been undertaken jointly with technological innovation through time by a wide range of firms in pursuit of superior performance (Bruland and Mowery, 2004), i.e., only limited success will be met unless technological and organizational innovation are carried out in conjunction so as to gain complementarity effects (Chandler, 1962; Nelson, 1991; Freeman, 1995). This thus suggests an additional hypothesis:

H6: *Technological and Organizational innovation jointly increase the effects of organizational innovation on firm performance*

3.3 Perception: Performance Feedback and Obstacles

Understanding why firms do or do not innovate also is an important item on the evolutionary economics research agenda (Nelson and Winter 1982, Fagerberg, 2003). Just as sunglasses are worn when the sunlight is noticed, firms change in response to managers' recognition of problems (Cyert and March, 1963), i.e., past failures drive change (Levinthal and March, 1981; Greve, 1998). In particular, low performance is one obvious problem that typically induces the firm to change especially when managers' or shareholders' 'aspiration level' of performance cannot be achieved (March and Shapira, 1992; Greve, 2003). Performance shortfalls therefore could be important motives for organizational innovation.

H7: *A decline in growth increases the probability of attempts at organizational innovation*

Finally, as Mohr (1969) points out, a propensity to innovate is determined not only by managers' or shareholders' motivations, but also by the strength of obstacles to innovation and resources available to overcome such obstacles. These obstacles influencing the firm's decision to innovate (Cyert and March, 1963; Kline and Rosenberg, 1986) could be either internal ('weaknesses'; see, e.g., Penrose, 1959) or external ('threats'; see, e.g., Porter, 1980, 1985). For instance, firms commonly view innovation as a costly activity (Sirilli and Evangelista, 1998; Galia and Legros, 2004), placing particular pressure on strategic resources (Wernerfelt, 1984; Barney, 1991), e.g., funds or skilled workers.[7] As the consequences of changing are said to be generally less foreseeable than the consequences of not changing (Greve, 1998), this in turn increases managerial reluctance to pursue organizational innovation.

H8: *Managerial perceptions of obstacles decrease the probability of attempts at organizational innovation*

[7] This is in line with the above argument that resources commonly more available in larger firms correlate with the rate of innovation.

4. DATA AND RESEARCH METHODOLOGY

A unique firm-level dataset from an integration of annual financial accounts (1999 – 2004) and the latest two Norwegian Community Innovation Surveys, CIS3 (1999 – 2001) and CIS4 (2002 – 2004) that include information on 'organizational' innovation is employed in this analysis. Of nearly two thousand respondent firms in manufacturing, service and other industries contained in the dataset,[8] more than one third report efforts to undertake organizational innovation in the main period concerned, 2002 – 2004 (see Table 1 and discussion below). To examine the determinants and effects of organizational innovation, the following models are constructed:

ORG = SIZE + AGE + IND + PASTORG + PASTPERF + HAMPi (1)

EFORG = SIZE + AGE + IND + PASTORG + INCOMP (2)

ORG = A dummy for the attempt at organizational innovation (2002 – 2004)

EFORG = Factor score for six types of effects of organizational innovation (2005; see below)

SIZE = Firm size in terms of number or employees (LogEmp) and turnover (LogTurn)

AGE = Firm age (LogAge)

IND = A dummy for industrial classifications (NACE)

PASTORG = A dummy for past attempt at organizational change (1999 – 2001)

PASTPERF = Past performance in terms of profitability growth (1999 – 2001)

HAMPi = Hampering factors (2002 – 2004; value from 0-3)

INCOMP = A dummy for joint contribution of technological and organizational innovation (2002 – 2004; see below)

As only the firms that attempted organizational innovation during 2002 – 2004 were allowed to answer the question in the CIS 4 on its effects (only organizational innovators are included in equation 2), this data is possibly affected by sample selection

[8] Since greater than 30 percent of samples in financial accounts, CIS3 and CIS4 data overlap, the integrated dataset is deemed well representative.

bias, and Heckman's (1979) two-step estimation thus was employed (see, e.g., Zucker et al., 1998; Hall, 2002; Catozzella and Vivarelli, 2007).[9] In this respect, the first (selection) equation explains whether, and the extent to which, firm size and age and other determinants affect firm's decisions to undertake organizational innovation while the second (outcome) equation examines the influence of these factors outcome the outcome of such undertakings.

The variables of interest in this Heckman two-step procedure are organizational innovation, its effects, firm size, firm age and other relevant factors. The measure of organizational innovation (ORG), employed as a dependent variable in the selection equation (Stage 1), is obtained from the answers to the question in the CIS4 asking whether or not the firm has introduced organizational innovation, i.e., new or significant change in firm structure or management methods seeking to improve the firm's use of knowledge, quality of goods or services, or workflow efficiency. Three types of organizational innovation concerned in this question are: (i) new or significantly improved knowledge management system implemented to better use or exchange information, knowledge and skills within the firm (ORGSYS); (ii) major change to the organization of work within the firm, such as change in the management structure or integrating different departments or activities (ORGSTR); and (iii) new or significant change in the firm's relations with other firms or public institutions, such as through alliances, partnerships, outsourcing or sub-contracting (ORGREL). On the basis of these three proxies, a dependent variable ORG for Stage 1 (Probit) is constructed.[10] ORG equals one if the firm has a positive answer for at least one of the foregoing three aspects of organizational innovation, and zero otherwise.

The variable used to assess the impact of these three types of organizational innovation is based on the following question in the CIS4 inquiring in 2005 about the

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[9] Since the results show no sign of selection bias, the OLS estimation is also used in the second stage experiment. Three types of organizational innovations (ORGSYS, ORGSTR are ORGREL) are added in order to separately examine their potentially distinct impacts. See below.

[10] ORG is applied because this Heckman estimation can have only one dependent variable in binary format (0 or 1) in the selection equation (stage 1). This means that ORG cannot be a measure of the 'scale' of organizational innovation and thus has considerable heterogeneity.

effects of such innovation.[11] As mentioned above, only the firms that have carried out organizational innovation, i.e., for which ORG = 1, shall also respond to this question on its effects. This question asks the firm to rate (from 0 – 3) the importance of six types of effects: (i) reduced response time to customer needs; (ii) improved quality of goods or services; (iii) reduced costs per unit output; (iv) improved employee satisfaction and/or reduced employee turnover; (v) increased enterprise capacity; and (vi) higher enterprise profitability. Factor scores (EFORG) for these six measures are calculated (see Table A.1 in the Appendix) and used as a dependent variable in the outcome equation (Stage 2) in order to examine how the effects of organizational innovation are influenced by the explanatory factors discussed hereafter.

First, firm age and size are said to be crucial determinants of organizational change (see, e.g., Hannan and Freeman, 1984; Carroll and Hannan, 2000). Consistent with the earlier discussion, they are hypothesized to have different impact on the firm's decision to pursue organizational change and the effects of such change, and thus are taken into account in both equations. In doing so, as Penrose (1959) suggests, firm size and age are considered as separate determinants of change since aged firms are not necessarily large, and vice versa.[12] Firm age (LogAge) is calculated as the log value of the period between the year the firm was established and 2001 (the last year before entering the period of main interest 2002 – 2004). Firm size is measured on the basis of information on the number of employees (LogEmp) and firm's total turnover (LogTurn) in 2001.[13]

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[11] It is important to emphasize that, although the information on organizational innovation and its effects both comes from the CIS4 (2002 – 2004) which may be considered to provide somewhat little time for the effects to be realized and have a 'causality' problem, the question on the effects of organization innovation was designed to be explicit by asking the respondent firms to evaluate in 2005 'the effects of organizational innovation introduced' during 2002 – 2004. The Norwegian CIS4 questionnaire was sent out about 6 months after the reference year (2004).

[12] See Table A.2 in the Appendix for a simple correlation test between firm age and size (in terms of both total turnover and number of employees).

[13] Having both of these proxies is advantageous since they possibly explain firm size in different dimensions. That is, while LogEmp deemed to be more related to a scale of human resource might better depict a degree of complexity/hierarchy of the firm structure, LogTurn represents size of firm in terms of financial capacity. A simple correlation test conducted shows that turnover does not necessarily strongly correlate with number of employees (see Appendix).

Industrial classifications (IND) and past organizational change (PASTORG) dummies are also employed in both Stages 1 & 2. The former, as commonly used, shows how industrial characteristics may affect the firm's propensity to innovate as well as its effects. PASTORG has a value equal to one if the firm has during 1999 – 2001 introduced change in at least one of the following types: corporate strategies; management techniques; and organizational structures. In the first stage regression, PASTORG controls for the influence of prior organizational change on the probability of another attempt at organizational change by the firm during 2002 – 2004 (ORG). Second, since only organizational innovators during 2002 – 2004 (ORG = 1) are included in Stage 2, PASTORG is used in the outcome equation to assess the extent, if any, to which prior and current efforts at organizational change together (between 1999 – 2001 and between 2002 – 2004, i.e., persistence of change) increase the effects of organizational innovation felt in 2005 (EFORG).

Two additional variables (PASTPERF & HAMP) hypothesized to influence the firm's decision to carry out organizational innovation (ORG) are included in the selection equation (Stage 1). PASTPERF, measured as profitability growth during 1999 – 2001, captures the recent change in firm economic performance on efforts at organizational innovation. HAMP represents three types of obstacles to organizational change, which include high innovation costs, a lack of funds and a lack of qualified personnel. These three proxies are constructed from the firm's rating (from 0 – 3) of the importance of different impediments to innovation.[14] Finally, since all firms included in Stage 2 are organizational innovators during 2002 – 2004, a dummy for product and process innovations (INCOMP) undertaken during 2002 – 2004 is used to the joint contribution of technological and organizational innovation in the outcome equation (Stage 2). This variable applied to examine their complementarity effect on firm performance (EFORG) equals one if the firm has introduced at least one product or process innovation during 2002 – 2004.

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[14] These three variables were selected on the basis of their relevance to organizational innovation (those related to only technological innovation were excluded, e.g., a lack of information on technology and uncertain demand for innovative goods and services), their significance during models tests (not reported here; available upon request) and their uniqueness in the results of a factor analysis (not reported here; available upon request).

5. ANALYSIS

The descriptive statistics in Table 1 show that more than one third of the firms in the sample are organizational innovators, having introduced at least one type of organizational innovation during 2002 – 2004, with a higher percentage of larger firms, as compared to that of smaller firms, in terms of either total turnover or number of employees (supporting H1) whereas it is less clear-cut and yet to be further examined whether age monotonically increases the rate of organizational change (H2). The results from Table 1 also indicate that, with small exceptions in large and old firms, the greater the number of organizational innovation considered, the lower the percentage of organizational innovators. And for the three types of organizational innovation included in the CIS4 measures, change in the firm's structure (ORGSTR) is the most common followed by change in the firm's knowledge management systems (ORGSYS) and in the firm's external relations (ORGREL), respectively.

<INSERT TABLE 1 ABOUT HERE>

Table 2 contains descriptive statistics on other variables in the dataset. The results demonstrate that more than half of the firms had carried out organizational change during 1999 – 2001, and many of these firms made another attempt at organizational change during 2002 – 2004. As opposed to prior research, which found low persistence of technological innovation (see, e.g., Geroski et al., 1997; Cefis and Orsenigo, 2001), almost one fourth of sampled Norwegian firms are persistent in organizational innovation during 1999 – 2004. However, this study finds that technological innovation (product/process) was more common than organizational innovation within the sample during 2002 – 2004 (47 percent of firms reported undertaking technological innovation, as compared with the 35 percent that undertook organizational innovation). When comparing across sectors, not surprisingly, a greater share of manufacturing firms engaged in technological innovation while a greater share of service firms were active in

organizational innovation during 2002 – 2004.[15] Finally, despite no sharp effect from firm age, larger firms are more likely to pursue both organizational and technological innovation during 2002 – 2004 (Kimberly and Evanisko, 1981; Damanpour, 1987), and are more likely to engage in organizational innovation during both time periods 1999 – 2001 and 2002 – 2004, i.e., more persistent in organizational innovation.

<INSERT TABLE 2 ABOUT HERE>

The results of the econometric analysis are displayed in Table 3. First, considering the lower part of the first two columns (model I with LogEmp & model II with LogTurn), the Heckman Stage 1 (with ORG as a dependent variable) results support H1: firm age increases the chance of organizational innovation during 2002 – 2004 (ORG), as the coefficients for firm age (LogAge) are positive and statistically significant at the 5 % and 10 % level in model I and II respectively. Although H2 on the positive size effect on the change attempt is not confirmed by the econometric analysis,[16] the results in Table 3 are in line with the descriptive statistics in Table 2 and provide some evidence of persistence of organizational innovation, i.e., prior organizational change during 1999 – 2001 influences the probability of another attempt by the firm during 2002 – 2004 (ORG). This can be seen from the significant positive coefficients for PASTORG (Past Organizational Change) in models I and II (significant at the 10 % level)

The results in Table 3 also show the impacts of past performance and hampering factors on the firm's decision to undertake organizational innovation (Cyert and March, 1963; Greve, 1998). The negative coefficients for PASTPERF in both models I and II (significant at the 10% level) corroborate H7, i.e., attempts at organizational innovation during 2002 – 2004 (ORG) are likely to follow a decline in profitability growth (1999 – 2001). Nevertheless, the only innovation impediment that is sufficiently significant as a factor discouraging efforts at organizational innovation is the high reported costs of

[15] As usually argued in the literature on service innovation (see, e.g., Evangelista, 2000; Miles, 2004, Sapprasert, 2007), non-technological and intangible characteristics of services are very significant and linked to organizational change.

[16] Firm size is however consistently reported to positively influence organizational innovation in the descriptive part. See Table 1 & 2.

innovation, the negative coefficients for which are significant at the 10% level in both models I and II, providing partial support for H8.[17]

<INSERT TABLE 3 ABOUT HERE>

Further, the results in Table 3 shed light on how the effects of organizational innovation (EFORG) can be explained by several determinants. Since there is no evidence of significant selection bias (insignificant Mills ratios in both Heckman models I & II), the results from both the Heckman outcome equation (Stage 2 – the upper part of the results for models I and II) and OLS (Ordinary Least Square – models III and IV in the last two columns) estimations are reported and discussed. First, none of these models provides support for H3.[18] The coefficients for firm age are negative but not statistically significant. Older firms thus do not appear to benefit differentially from organizational innovation as hypothesized. The OLS results (significant at the 5 % and 1 % level in models III and IV, respectively) provide some support for H4, however, since larger firms (measured in terms of either employment or turnover) benefit less from reorganization.[19] The results for all models in Table 3 confirm H6 on the complementarity effect. The coefficients for INCOMP, measuring complementarity between organizational and technological innovation, are positive and statistically significant at the 10 % in model I and at the 5 % in models II, III and IV, providing support for the claim that this combined presence improves firm performance (Chandler, 1962; Nelson, 1991). Next, the results from the Heckman outcome equation (statistically

[17] This result is in contradiction with that of Veugelers and Cassiman (1999) using Belgian manufacturing firm data. They find that high innovation costs the firm perceives does not discourage innovation.

[18] Nonetheless in a detailed analysis (results not reported here; available upon request), firm age is found to have significant negative influence on one type of organizational innovation effect, which is improved goods/services quality.

[19] The sign remains negative, though insignificant, concerning the Heckman results (models I and II). The coefficients between firm size (LogEmp and LogTurn) and most types of organizational innovation effects are also confirmed to be significantly negative in a detailed OLS analysis (results not reported here; available upon request).

significant at the 10 % level in both models I & II)[20] indicate a positive relationship between persistence of organizational innovation (PASTORG) and firm performance (EFORG); supporting H5, i.e., firms can benefit more from organizational change by carrying it out more persistently. Finally, the OLS results show that all of the three types of organizational innovation do have significant effects on firm performance.[21] The Norwegian firms received greatest benefit from change in firm structure (ORGSTR), followed by change in knowledge management systems (ORGSYS) and change in external relations (ORGREL), respectively.[22,23]

6. MAJOR FINDINGS AND CONCLUDING REMARKS

Using a novel dataset based on the firm-level Norwegian CIS (1999 – 2001 and 2002 – 2004) and financial accounts, this paper has examined the determinants and performance effects of organizational innovation within the firm. Organizational innovation is greatly constrained by many factors, particularly firm age and size. The study has elucidated and extended the inertia theory (Hannan and Freeman, 1984) by showing *inter alia* that these two crucial factors have distinct impacts on the firm's decision to carry out organizational innovation and on its effects. In doing so, this paper's econometric analysis has taken into account some risk of selection bias, since only the 'organizational innovators', which account for about one third of the sampled firms from manufacturing, service and other industries in Norway, are included in the analysis of the effects of organizational innovation. Heckman's (1979) two-step estimation was employed and supported a rejection of significant selection bias.

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20 The same sign is, however, maintained in the OLS estimation.

21 The results (not reported here; available upon request) from a detailed analysis on different effects (6 types as dependent variables one at a time) of these three types of change also go along the similar line with the evidence discussed here using factor scores (EFORG) as dependent variables.

22 In trying to explain this evidence, one may interpret this difference as a result of the difference in type of change (e.g., core versus periphery). See, for instance, Hannan and Freeman (1984).

23 From all estimations carried out, industrial heterogeneity does not however appear to have any significant influences on the firm's decision on organizational change and its effects. This is in part corresponding to Srholec and Verspagen (2008), which argue that heterogeneity at the firm level is much higher by comparison with industrial and national ones when it comes to innovation activities/strategies.

The major findings shed light on the complex relationships among the determinants and effects organizational innovation. First, firm age, regarded as a very complicated determinant in organizational ecology research (see, e.g., Carroll and Hannan, 2000), does not significantly influence the effects of organizational innovation, but does exercise some influence over the likelihood that such innovation is undertaken, that is, older firms appears to be more likely to pursue organizational innovation. In addition, the study finds some evidence of repeated or persistent organizational innovation among Norwegian firms, i.e., firms that attempted organizational change during 1999 – 2001 are more likely to do so in the subsequent period (2002 – 2004). The results also suggest that attempts at organizational innovation are more likely when profitability growth declines. On the other hand, such attempts are discouraged by high reported "costs of innovation".

Although the descriptive statistics suggest that the larger the firm the more likely the attempts at organizational innovation, the econometric results shed little light on how or why firm size matters for the decision to pursue organizational innovation. Nevertheless, the study finds that firm size does matter for the effects of organizational innovation undertaken, that is, smaller firms do appear to receive greater performance benefits from organizational change. Furthermore, all three types of organizational change considered positively affect firm performance and the effects appear to be to a larger extent within firms with a prior history of efforts at organizational innovation. The effects of organizational innovation also appear to be strengthened by the combined presence of technological and organizational innovation. Put differently, firms can better reap the fruits of reorganization by doing it more persistently and jointly with technological innovation.

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Table 1: Firm age & size, sector and organizational innovation

	No. of firms	Organizational innovator* 2002 – 2004 (%)	ORGSYS (%)[1]	ORGSTR (%)[2]	ORGREL (%)[3]	1 type of change (%)**	2 types of change (%)	3 types of change (%)
Sector								
Manufacturing	947	0.35	0.18	0.28	0.12	0.16	0.15	0.03
Services	580	0.37	0.20	0.28	0.15	0.17	0.13	0.07
Others	210	0.29	0.17	0.22	0.09	0.14	0.12	0.03
Age***								
Age1	557	0.41	0.22	0.32	0.16	0.18	0.16	0.07
Age2	591	0.32	0.14	0.25	0.11	0.17	0.12	0.03
Age3	589	0.33	0.19	0.25	0.12	0.14	0.16	0.03
Size***								
Emp1	611	0.27	0.14	0.20	0.09	0.13	0.10	0.03
Emp2	477	0.32	0.17	0.23	0.10	0.17	0.10	0.04
Emp3	649	0.46	0.23	0.37	0.18	0.19	0.21	0.06
Turn1	585	0.28	0.14	0.20	0.09	0.14	0.11	0.03
Turn2	589	0.33	0.16	0.25	0.10	0.18	0.11	0.04
Turn3	563	0.46	0.25	0.37	0.19	0.17	0.22	0.07
Total	1737	0.35	0.18	0.27	0.13	0.16	0.14	0.04

*An organizational innovator is defined in line with the CIS4's definition of organizational innovation as the firm that has implemented new or significant changes in firm structure or management methods that are intended to improve the firm's use of knowledge, quality of goods and services, or efficiency of work flows.

**1, 2 and 3 types of change are the firm's categories in terms of the number of types of organizational innovation in the firm during 2002 – 2004 (count value for three types of organizational innovation, thus ranging from 1 – 3). The firms that have introduced one, two and three types of organization innovation are classified into the first, second and third category, respectively.

***Age & Size classifications are based on the samples distribution: Age1 = 1-14, Age2 = 15-24, Age3 = 25 year old and over; Emp1 = 10-49, Emp2 = 50-109, Emp3 = 110 employees and over; Turn1 = 1-49.999, Turn2 = 50.000-199.999, Turn3 = 200.000 NOK and over.

1) ORGSYS refers to new or significantly improved knowledge management systems to better use or exchange information, knowledge and skills within the enterprise (during 2002 – 2004).
2) ORGSTR refers to major change to the organization of work within the enterprise, such as change in the management structure or integrating different departments or activities (during 2002 – 2004).
3) ORGREL refers to new or significant change in the firm's relations with other firms or public institutions, such as through alliances, partnerships, outsourcing or sub-contracting (during 2002 – 2004).

Table 2: Firm age & size, sector, organizational & technological innovation and persistence

	No. of firms	Organizational innovator* 2002 – 2004 (%)	Past Organizational Change[1] (%)	Organizational Innovation Persistence[2] (%)	Technological Innovation[3] (%)
Sector					
Manufacturing	947	0.35	0.50	0.23	0.54
Services	580	0.37	0.55	0.24	0.42
Others	210	0.29	0.50	0.19	0.26
Age*					
Age1	557	0.41	0.57	0.28	0.49
Age2	591	0.32	0.48	0.19	0.46
Age3	589	0.33	0.50	0.22	0.45
Size*					
Emp1	611	0.27	0.46	0.16	0.41
Emp2	477	0.32	0.46	0.21	0.48
Emp3	649	0.46	0.61	0.31	0.51
Turn1	585	0.28	0.44	0.17	0.42
Turn2	589	0.33	0.49	0.20	0.47
Turn3	563	0.46	0.63	0.32	0.51
Total	1737	0.35	0.52	0.23	0.47

*An organizational innovator is defined in line with the CIS4's definition of organizational innovation as the firm that has implemented new or significant changes in firm structure or management methods that are intended to improve the firm's use of knowledge, quality of goods and services, or efficiency of work flows.

***Age & Size classifications are based on the samples distribution: Age1 = 1-14, Age2 = 15-24, Age3 = 25 year old and over; Emp1 = 10-49, Emp2 = 50-109, Emp3 = 110 employees and over; Turn1 = 1-49.999, Turn2 = 50.000-199.999, Turn3 = 200.000 NOK and over.

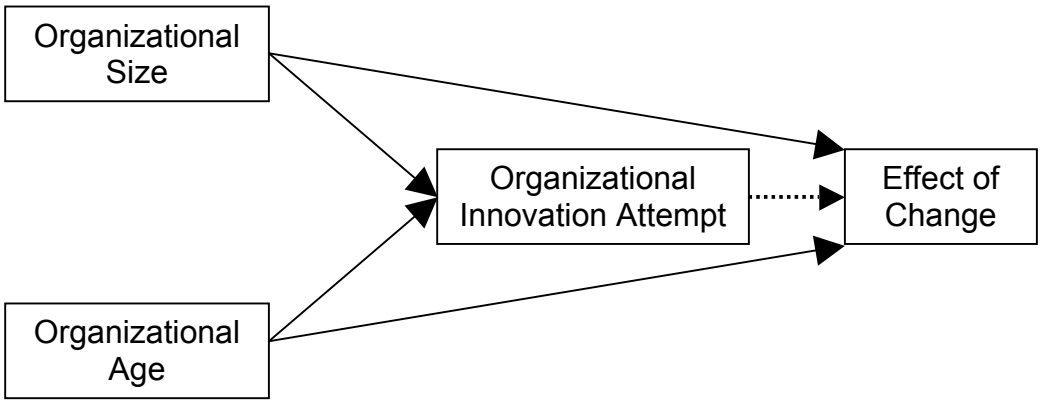
1) Past Organizational Change refers to the organizational change attempt during 1999 – 2001.
2) Organizational Innovation Persistence refers to the organizational change attempts during both periods 1999 – 2001 and 2002 – 2004.
3) Technological Innovation refers to the presence of technological innovation during 2002 – 2004.

Table 3: Factors explaining organizational innovation and its effects

	EFORG (Heckman 2-stage)		EFORG (OLS estimation)	
	(I) LogEmp	(II) LogTurn	(III) LogEmp	(IV) LogTurn
Constant	-0.235 (0.876)	0.007 (0.899)	-1.387 (0.860)	-1.038 (0.878)
Organizational Innovation (in OLS only)				
-*ORGSYS*	-	-	0.395*** (0.074)	0.397*** (0.074)
-*ORGSTR*	-	-	0.711*** (0.088)	0.712*** (0.088)
-*ORGREL*	-	-	0.199*** (0.074)	0.199*** (0.074)
Firm Size				
-*Number of Employees* (LogEmp)	-0.028 (0.030)	-	-0.059** (0.030)	-
-*Total turnover* (LogTurn)	-	-0.035 (0.023)	-	-0.056*** (0.023)
Firm Age (LogAge)	-0.009 (0.055)	-0.004 (0.054)	-0.010 (0.051)	-0.004 (0.051)
Complementarity (INCOMP)	0.146* (0.080)	0.154** (0.080)	0.159** (0.079)	0.169** (0.079)
Persistence (PASTORG)	0.129* (0.078)	0.132* (0.078)	0.095 (0.075)	0.099 (0.075)
Industry Dummies (IND)	Yes	Yes	Yes	Yes
Selection Equation – Heckman Stage 1 (dependent variable = **ORG**)				
Firm Size				
-*Number of Employees* (LogEmp)	-0.025 (0.138)	-	-	-
-*Total turnover* (LogTurn)	-	0.067 (0.106)	-	-
Firm Age (LogAge)	0.581** (0.324)	0.585* (0.326)	-	-
Past Organizational Change (PASTORG)	0.832** (0.375)	0.794** (0.380)	-	-
Profitability Growth (PASTPERF)	-1.513* (0.792)	-1.488* (0.798)	-	-
Hampering Factors (HAMP)				-
-*High Innovation Costs*	-0.493* (0.258)	-0.482* (0.256)	-	-
-*Lack of Funds*	0.364 (0.232)	0.374 (0.234)	-	-
-*Lack of Qualified Personnel*	-0.145 (0.212)	-0.174 (0.215)	-	-
Industry Dummies (IND)	Yes	Yes	-	-
Mills ratio	0.293 (0.567)	0.277 (0.563)	-	-
Wald-Test	591.52***	429.58***	-	-
R^2	-	-	0.180	0.184
Number of Observations	1737	1737	597	597
Uncensored	597	597	-	-

*,**,*** significant at 0.1, 0.05 and 0.01, respectively. Standard errors in the bracket.

Figure 1: The relationships between organizational age, size, innovation and outcome



APPENDIX

Table A.1: Principal Components Analysis for the Effects of Organizational Innovation

Effects of Organizational Innovation	Factor Loadings
	EFORG
Reduced response time to customer needs	0.639
Improved quality of goods and services	0.699
Reduced costs per unit output	0.639
Improved employee satisfaction and/or reduced employee turnover	0.600
Increased enterprise's capacity	0.772
Greater enterprise's profitability	0.734

Note: One factor with eigenvalue greater than 1 detected, which explains 47% of total variance

Table A.2: Correlation Matrix for Firm Age, Turnover and Number of Employees

	Age	No. of Employees
Age	1	-
Number of Employees	0.118***	1
Total Turnover	0.050**	0.595***

*,**,*** significant at 0.1, 0.05 and 0.01, respectively. Standard errors in the bracket.