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Do product imitation and innovation require different patterns of organizational innovation? Evidence from Chinese firms

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ABSTRACT

While organizational innovation is considered crucial for firms performance, its role as a type of intangible innovation in new product development remains under-explored in the literature. As such, this paper explores the impacts of organizational innovation on both product innovation and imitation for Chinese manufacturing firms based on original survey data. Latent class analysis is used to identify the classification of organizational innovation and their various characteristics. The results indicate a five-pattern of organizational innovation that range from low to high levels for the sample firms. Further, the multinomial treatment effects estimation suggests that middle- to high-level organizational innovation has a significant impact on product imitation intensity, demonstrating that knowledge management and standardization play important roles in facilitating product imitation. However, only a superior level of organizational innovation shows a significant effect on the intensity of product innovation, implying that the transition from product imitation to innovation requires a comprehensive improvement in organizational design.

1. Introduction

Innovation stems from a new technological concept or idea, reflecting the critical way in which organizations respond to either technological or market challenges. As one of the five innovation activities proposed by Schumpeter (1934), organizational innovation has drawn comparatively less attention among researchers than technological innovation, product innovation, process innovation, and market innovations in the literature. Organizational innovation is intangible in character, and, therefore, while some studies identify it as a facilitator for the effective use of technology and an intermediate source of competitive advantage, this type of innovation *per se* and its impacts are still under-explored due to the difficulties of identifying adequate survey data, established definitions, and measurement approaches (Sapprasert & Clausen, 2012). This potentially constrains our understanding of the interactions between the different innovative activities, especially that of the impacts of non-technical innovation on the technological innovation (Damanpour, 1991; Damanpour & Aravind, 2012; Kimberly & Evanisko, 1981).

In any case, the successful catching-up experiences of East-Asian economies highlight the importance of organizational innovation. For example, the Original Equipment Manufacturing arrangement in the Korean electronics industry represents a process for integrating the market demands into the technological frontier accompanying organizational change, and gradually realizing the transition from imitation to innovation (Fagerberg & Godinho, 2006). Further, Westney (1987) states that the successful imitation of foreign social patterns in Meiji requires organizational transformation. Organizational changes thus enabled Japanese firms to simultaneously maintain scale economies and flexibility during the catching-up process. As an emerging economy, China is facing a similar situation, with Chinese firms experiencing immense organizational changes during the past few years, triggered by both market competition and foreign advanced practices. Hence, it is important to understand how organizational change corresponds to Chinese firms performance in terms of both imitation and innovation.

From an empirical viewpoint, China is a particularly interesting case to analyze because of its fast-growing economy, as well as its controversial imitation activities in the international market. A major concern of policy makers in China is how to motivate Chinese firms to transform from imitation to innovation. While it can be argued that the success of such a transformation process is crucial for China's development, the current debate rather focuses on technological aspects. As such, organizational innovation has not attracted enough attention of policy makers. Further, the effectiveness of different types of organizational innovation on new product development in China is not yet

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clear.

Hence, this article investigates the following two research questions: (1) what are the characteristics of organizational innovation for Chinese firms? and (2) how does organizational innovation influence the performance of product imitation and innovation?

Analyzing the causal relationship between organizational innovation and new product development at the firm level presents two challenges. First, it is necessary to properly define and measure organizational innovation, for example, to adopt an appropriate indicator or approach to capture its multi-dimensional factors, such as structure, procedure, and intra-organizational innovation (Sapprasert & Clausen, 2012). Second, it can be argued that there might be a reverse causal relationship between product innovation and organizational innovation. The implication is that any empirical analysis on the relationship between organizational innovation and firm performance should disentangle the impact of product innovation from that of organizational innovation.

This article thus contributes to the micro-level evidence on organizational innovation in three ways. First, we associate the patterns and magnitude of organizational innovation with the various firm strategies in product imitation or innovation. To the best of our knowledge, this is the first study that quantitatively investigates the impact of the various patterns of organizational innovation on product imitation or innovation performance at the firm level. This analysis is important because it provides policy implications for stimulating firms to transit from imitation to innovation. Previous research on product imitation or innovation strategies primarily investigates only one organizational dimension, such as organizational culture, intellectual property, human resources, or knowledge networks (Cappelli, Czarnitzki, & Kraft, 2014; Naranjo-Valencia, JiménezJiménez, & SanzValle, 2011). Second, the investigation is based on a comprehensive measure of organizational innovation. Following the Oslo Manual (OECD, 2005) and Armbruster, Bikfalvi, Kinkel, and Lay (2008), we conducted a survey by considering a broad definition of organizational innovation that encompasses five dimensions of organizational concepts, namely, organization of work, organization of production, knowledge management and standardization, payment schemes, and human capital management. These measures not only reflect the changes in organizational concepts within a defined period, but also the extent of the used potential. In this way, we identify five patterns of organizational innovation, document their characteristics, and measure the novelty and magnitude of organizational innovation. Finally, we combine latent class analysis (LCA) and the multinomial treatment effects (MTE) model to identify the patterns of organizational innovation and their impacts on product imitation and product innovation. Compared to other cluster analyses, LCA analyzes the multidimensional aspects of organizational innovation in one framework, without predetermining the structure, thus enabling us to identify patterns of organizational innovation more efficiently and define its characteristics. The combination of these two methods can exclude the endogeneity between organizational and product innovation, therefore generating better-performed estimators. Therefore, this study offers a better understanding of the interaction between organizational innovation and new product development.

The rest of this article is organized as follows. Section 2 reviews the related literature on the relationship between organizational innovation and product innovation. Section 3 proposes the econometric models for analyzing the classification of organizational innovation and its impact on product imitation and innovation. It also explains the data and measurements. Section 4 presents the estimation results. Section 5 discusses the empirical findings and concludes the article.

2. Literature review on organizational innovation and new product development

The current literature on organizational innovation has not yet presented a coherent theoretical framework of this topic (Černe, Kaše, & Škerlavaj, 2016; Damanpour, 2017). Referring to Schumpeter (1934), organizational innovation can be described as "new ways to organize business," that is, adopting of an idea or behavior that is new to the organization. Various studies interpret "organizational innovation" in different ways. The literature includes three broad streams of view on this subject (Alves, Galina, & Dobelin, 2018; Damanpour, 2017; Lam, 2006). The first research stream analyzes the concept from the evolutionary perspective (Kogut & Zander, 1993; Nelson & Winter, 1982; Pentland & Hærem, 2015). That is, organizational innovation is a product of the search for better practices among neighboring organizations and introducing these to the focal organization—a "local search" that results in an incremental change in organizational routines and skills (Cohen & Bacdayan, 1994). The transfer and recombination of organizational capabilities to adapt to environmental changes are the foci of organizational innovation; hence, the continuous recombination of resources leads to improvements in the product or manufacturing process. Organizational learning is needed when the competitive value of codifying knowledge leads to the selection of organizing principles that are not functional in all competitive environments (Glynn, 1996).

The second research stream defines organizational innovation from the managerial viewpoint, which remarkably overlaps with the administrative or management innovation literature (Birkinshaw, Hamel, & Mol, 2008; Damanpour, 1991). Some studies tend to broadly label all non-technical aspects of changes as organizational innovation, including beliefs, norms, and rules (Min, Ling, & Piew, 2016). Three distinct meta-theoretical constructs are identified: innovation leadership, managerial levers, and business processes. Each construct can be supported by a distinct theory— innovation leadership by the upper echelon theory, managerial levers by the dynamic capabilities theory, and business processes by process theory (Crossan & Apaydin, 2010).

The third research stream defines organizational innovation in a practical and comprehensive way via a series of surveys. According to the Oslo Manual (2005), organizational innovation comprises new or significant changes from three aspects: knowledge management, structure, and a firm's relationship with other firms or public institutions (OECD, 2005). In the Community Innovation Survey (CIS) conducted by the European Statistical Agency, organizational innovation is viewed as a firm structure or management method that aims to improve a firm's use of knowledge, quality of goods and services, or efficiency of work flows.

Previous studies have associated specific organizational factors (e.g., organizational culture, structure, and team management) with new product development (Glynn, Kazanjian, & Drazin, 2010; Uzkurt, Kumar, & Ensari, 2013; Walker, Chen, & Aravind, 2015). For instance, Olsson et al. (2009) identify six organizational factors that relate to the performance of product innovation: user understanding and involvement, resources, a risk-taking permission environment, learning and reuse of knowledge, balancing creativity and structure, and leadership. Among these, the most important factor is the risk-taking environment. Organizational innovation is reflected in a flexible and creative learning culture that fosters firm-level innovation and overall competitiveness. However, the role of organizational structure in new product development is controversial. The dominant view advocates flexible structures: firms that face fewer structural constraints and internal bureaucracies tend to seize more opportunities in changing environments (Calantone, Harmancioglu, & Droge, 2010). Higher strategic flexibility strengthens technological capability in terms of exploration, which in turn leads to more explorative product innovation (Zhou & Wu, 2010). However, Cosh, Fu, and Hughes (2012) argue that centralization, combined with informality, leads to superior innovation performance in technically turbulent environments. The structure–creativity balance can be described as a balance between divergent and convergent knowledge orientation.

Hence, the existing empirical evidence on the causal relationship between organizational innovation and product innovation is mixed. Some studies document the positive effects of organizational innovation on product innovation and confirm a complementary relationship between the two innovation types among Spanish, French, and Swiss firms (Ballot, Fakhfakh, Galia, & Salter, 2015; Cozzarin, 2017). The effect is particularly prominent for smaller firms, whose product innovation relies more on external knowledge (Gallego, Rubalcaba, & Hipp, 2013). Particularly, organizational innovation—especially procedures relating to knowledge management—exerts a crucial effect on product innovation persistence (Bas, Mothe, & Nguyen-Thi, 2015). However, Camisón and Villar-López (2014) find that the direct effect of organizational innovation on product innovation capabilities is not significant. Further, the introduction of product innovations can diminish the performance of organizational innovation (Hervas-Oliver & Sempere-Ripoll, 2015). Organizational innovation is detrimental to new product development when the newly introduced knowledge is not compatible with an organization's prior knowledge; as such, the organization may experience knowledge loss or organizational dysfunctions, such as avoidance, resistance, struggle, alteration, and conversion processes (Mariano & Casey, 2015).

Meanwhile, the literature demonstrates that pioneer firms and followers differ in terms of organizational characteristics and design, in areas such as decentralization in decision-making, error tolerance, and social network and knowledge management (Alegre & Chiva, 2008; Jenkins, 2014; Robinson, Fornell, & Sullivan, 1992). This further influences the process of knowledge creation via organizational learning (Alegre & Chiva, 2008). To mitigate risk or reduce costs, in their initial stages, latecomer firms typically choose to imitate; in most cases, products are imitated through reverse engineering, patent purchases via licensing, the purchase of key components in open markets, and joint development through partnerships. Successful imitation requires combining existing resources and carefully considering the target market and culture, while also relying on reorganizing principles by which individual-level and functional expertise is structured, coordinated, and communicated (Luo, Sun, & Wang, 2011; Zander & Kogut, 1995). Firms' formal and informal structures, as well as their external networks, strongly influence the rate and direction of their innovative activities (Teece, 2008). For example, imitating firms are significantly more “extroverted” than innovating firms in terms of undertaking external R&D activities, taking part in cooperation, and hiring medium-educated personnel (Arvanitis & Seliger, 2014). Naranjo-Valencia et al. (2011) propose that, among Spanish firms, the organizational culture is a clear determinant of the innovation strategy: adhocracy cultures foster innovation strategies, while hierarchical ones promote the decision to imitate. Nevertheless, both control-oriented and flexibility-oriented organizational attributes are considered indispensable in the design of innovative organizations (Song & Chen, 2014).

However, the various impacts of organizational innovation on product imitation or innovation performance remain under-explored in the literature. Indeed, there has been a dearth of empirical research that examines this relationship (Arvanitis & Seliger, 2014; Herrmann & Peine, 2011; Naranjo-Valencia et al., 2011). Investigations into the impact of organizational innovation on imitation or innovation performance strategies have mainly adopted the case study approach (Damanpour, 2017). Meanwhile, the inconsistency in empirical findings on the impacts of organizational innovation on product innovation might be due to the fact that the direct impacts can be mediated by process innovation or technological management (Fritsch & Meschede, 2001; Prajogo & Sohal, 2006). The effects of process innovation on product innovation performance improve with the adoption of organizational innovation (Hervas-Oliver, Sempere-Ripoll, & Boronat-Moll, 2014). Furthermore, there might be a reverse causal relationship between product and organizational innovation (Michael L. Tushman, 1990). The diverse measurement constructs regarding organizational innovation also lead to inconsistent results (Wolfe, 1994). Extant studies measure organizational innovation by either examining one aspect of organizational innovation (e.g., organizational structure or beliefs) or summing various index values.

Additionally, as existing studies tend to independently assess the multidimensional factors that organizational innovation includes, they hardly measure the magnitude and novelty of organizational innovation or identify its patterns. The predominant approach to measuring organizational innovation is based on using a binary variable, such as in Sapprasert and Clausen (2012), Ballot et al. (2015), and Cozzarin (2017). These studies use CIS data, which defines organizational innovation as any new practice in a knowledge management system, organizational work, or external relationship. Accordingly, organizational innovation is separately measured by either one or three binary variables. One exception is Camisón and Villar-López (2014), who decompose nine variables in the three dimensions of organizational innovation defined by the Oslo Manual (OECD, 2005) : business practices, workplace organization, and organizational methods in external relations. These variables are not directly assessed but rather analyzed using a partial least squares regression.

This paper fills the gap by exploring the relationship between organizational innovation and firm performance in product imitation or innovation of Chinese manufacturing firms. MTE model is applied to correct the endogenous bias caused by the bidirectional causality between organizational innovation and new product development. Meanwhile, LCA is applied to identify the classification of organizational innovation so that the multi-dimensional aspects of organizational concepts can be assembled in one framework without predetermining the structure of combination.

3. Research methodology

3.1. Empirical models

In this section, we first analyze the classification of organizational innovation in Chinese firms, as well as their characteristics, using LCA. Then, we respectively analyze the impact of organizational innovation on product imitation and innovation using the multinomial treatment effects model.

3.1.1. Latent class analysis for classification of organizational innovation

LCA is first used to investigate the classification of firms in terms of organizational innovation, along with their characteristics. LCA is a mixture model, positing that there is an underlying unobserved categorical variable that divides a population into mutually exclusive and exhaustive latent classes (Linda M. Collins, 2010). This model has been used to cluster human behaviors and disease diagnoses in the fields of social, behavioral, and health sciences. We assume that a finite-class space of organizational innovation $S = S_1,\ldots,S_n$ is not directly observable to researchers but attached with five manifest dimensions: organization of work, organization of production, knowledge management and standardization, payment schemes, and human resource management. As Armbruster et al. (2008) point out, the implementation of new organizational concepts serves as an indicator for the intra-firm diffusion of different organizational practices, which can be differentiated into structural organizational innovation and procedural organizational innovation. This idea was applied in the European Manufacturing Survey (EMS) of 2009 and 2012.

Whether firms fall into a certain identifiable latent class in terms of organizational innovation is determined through the measurement model on the observable k factors O_{ik}. Each class has a probability distribution over the possible observable items. The model assumes local independence, that is, the observed variables are independently distributed conditional on the underlying class, as shown in Eq. (1):

$$P(\mathbf{o_i} = \mathbf{a} | S_i = s) = \prod_{k=1}^{K} P(O_{ik} = a_k | S_i = s) \tag{1}$$

Different class memberships are mutually exclusive events, that is, the probability of a firm's certain realization pattern $o_i = a$ can be

Table 1
Variables and measurements for the MTE estimation.

Variable	Index	Measurement	Type
NPD	New product development	Percentage of "new-to the firm" product to sales	Continuous
INO	Product innovation	Percentage of "new-to-the-market" product to sales	Continuous
IMI	Product imitation	Percentage of "new-to-the-firm" but not "new-to-the-market" products to sales	Continuous
ORI	Organizational innovation	Patterns of organizational innovation (based on the LCA estimation)	Categorial
LAB	Size	The number of employees in logarithm	Continuous
PRI	Process innovation	Adoption of any of 12 new production lines specified in the survey	Binary
RII	Process innovation	Number of new production lines adopted by firms	Discrete
SKL	Skilled workers	Ratio of employees who hold a university degree to all employees	Continuous
R&D	R&D investment	Percentage of R&D investment to sales	Continuous
IMP	Imported inputs	Percentage of imported intermediate inputs to inputs	Continuous
EXP	Exporting status	Existence of exports	Binary
AGE	Firm age	Years of establishment	Continuous
ISO	Environmental standard	Use of environmental standard	Binary
INV	Investment	Amount of investment in logarithm	Continuous
IND	The industry dummy	Two-digit level	-
REG	The region dummy	One-digit level	-

written as the sum of all possible classes, S_i:

$$P(\mathbf{o_i} = a) = \sum_{s=1}^{n} P(S_i = s)P(\mathbf{o_i} = \mathbf{a}|S_i = s) \tag{2}$$

The probabilities that a firm has class membership S sums to 1. The probability that a firm has class membership S is obtained by maximizing the conditional probability through an iterative procedure. The parameters to be estimated are class proportions $\pi_s = P(S = s)$ and multinomial parameters $\theta_{ktr} = P(O_{ik} = r|S = s)$.

The LCA parameters are estimated by optimizing the log-likelihood, with the expectation maximization (EM) algorithm. The Akaike information criterion (AIC) and Bayesian information criterion (BIC) are then used to evaluate the goodness of fit for different models in order to determine the appropriate number of unobserved states. Lower AICs and BICs typically indicate better-fitting models.

3.1.2. Multinomial treatment effects model on new product development

Based on the classification of organizational innovation, MTE is applied to identify the impact of the various types of organizational innovation on product imitation or innovation. The model utilizes a two-step estimation structure. In the first step, the patterns of organizational innovation are specified as a mixture multinomial logit model (MMNL) in the selection equation.

$$LS_{ij}^{*} = \boldsymbol{\beta}\mathbf{x_i} + \boldsymbol{\kappa}\mathbf{z_i} + \beta_j l_{ij} + \eta_{ij}$$

$$Pr(\mathbf{S_i}|\mathbf{x_i}, \mathbf{z_i}, \mathbf{l_i}) = \frac{exp(\boldsymbol{\beta}\mathbf{x_i} + \boldsymbol{\kappa}\mathbf{z_i} + \beta_j l_{ij})}{1 + \sum_{j=1}^{n} exp(\boldsymbol{\beta}\mathbf{x_i} + \boldsymbol{\kappa}\mathbf{z_i} + \beta_j l_{ij})}, \tag{3}$$

where $j = \{1,2,...,n\}$ correspond to the various categories of organizational innovation. The class membership $S_j = \{1,2,...,n\}$ derives from LCA estimation. LS^* is the latent class associated with latent factor l_{ij}, which denotes the unobserved characteristics common to firm i's organizational innovation and new product development, independent of η_{ij}. Explanatory variable set x_i includes process innovation (*PRI*), R&D investment (*R&D*), size (*LAB*), skilled workers (*SKL*), imported intermediate input (*IMP*), exporting status (*EXP*), firm age (*AGE*), a region dummy (*REG*), and an industry dummy (*IND*). Table 1 explains these variables and their measurements in more detail.

Instrument variable set z_i is used to identify the patterns of organizational innovation. We adopt the use of environmental standard (*ISO*) as an instrument variable on the premise that the firms which follow the environmental standard tend to manage their environmental programs in a comprehensive, systematic, planned, and documented manner. The environmental standard rubric may include organizational structure, planning, and resources used in development, as well as implementing and maintaining a policy relating to environmental protection. Therefore, the use of environmental standard reflects firms' willingness to change their management practices in response to changes or regulations in business environment, and can directly affect their patterns of organizational innovation; however, it does not directly relate to new product development. The specification of MMNL relaxes the independence of the irrelevant alternatives (IIA) property of multinomial logit model, and, therefore, it is more suitable for the analysis.

In the second step, the estimates for product imitation and innovation are obtained by running a linear regression on corrections, as shown in Eq. (4). Unobserved factors l_{ij} enter the regressions for both patterns of organizational innovation and product imitation or innovation. These factors capture the individual-specific factors that induce firms to fall into n exclusive categories. To identify both regressions simultaneously, the dependent variable, product imitation (*IMI*) or innovation (*INO*), is assumed to follow a normal distribution, while l_{ij} is assumed to follow the independent standard normal distribution. The model is estimated using the maximum likelihood estimation, specifically, through the simulated function with Halton sequence random draws[1]. Robustness standard errors are used to correct for heteroscedasticity because they account for uncertainty from finite simulation draws (McFadden & Train, 2000).

$$E(y_i|\mathbf{S_i}, \mathbf{x_i}, \mathbf{l_i}) = \boldsymbol{\beta}\mathbf{x_i} + \sigma_j\beta_j S_{ij} + \sum_{j=1}^{n} \gamma_j l_{ij} \tag{4}$$

3.2. Data source

The data are taken from the 2009 Chinese Manufacturing Survey (CMS). As one of the cooperative teams in the European Manufacturing Survey in 2009, we collected and maintained these data, jointly with the Fraunhofer Institute for Systems and Innovation, Germany. The survey sample covers all manufacturing firms that own a certified Technology Development Center (TDC), authorized by either the central government or local governments. These firms have relatively good research and development (R&D) performance and are more innovative than other firms in China. The data covers 3442 firms, identified at the three-digit industrial level. The survey provides detailed information on their innovation performance in terms of process innovation, product innovation, organizational innovation, and technological innovation, as well as other financial performance measures using variables such as assets, liabilities, capital structure, employment, R&D expenditures, sales, and investment. Firms are identified at the three-digit industrial

[1] see Deb and Trivedi (2006a) and Deb and Trivedi (2006b) for more technical details.

Table 2
Organizational concepts for the classification of organizational innovation.

Dimension	Organizational concept
Organization of work	Teamwork in production
	Task integration (planning, controlling, or monitoring tasks by machine operator)
	Temporary cross-functional project teams
Organization of production	Customer- or product-focused lines/cells in the factory (instead of task-/operation-structured shop floor)
	Internal zero-buffer principle (e.g., kanban)
	Total cost of ownership (TCO) (Assessment of investments reflecting the entire life cycle costs
Standardization, knowledge management	Quality circles
	Knowledge base systems (documenting currently not fully exploited employees qualifications
	ISO 9000 quality management
Working hours, payment schemes	Collective arrangement for flexible working hours (e.g., working hours accounts)
	Wage systems with team performance incentives
	Financial participation by employees eligible for all employee groups (e.g., Profit sharing schemes, share (options) plans, etc.)
Human resource management, leadership	Regular individual appraisal interviews
	Personnel training programs as a special function in human resources
	Possibility for employees to work at home (teleworking)

Notes: Firms identify which organizational concepts are currently used in their firms and the extent of the used potential.

level, but aggregated at the one-digit industrial level, which generates eight sectors.

3.3. Measures

Organizational innovation covers diverse aspects of the concepts. Following Armbruster et al. (2008), to understand the adoption and performance of organizational innovation at a conceptual level, we measure it using five aspects, as stated before. Specifically, we use 15 organizational concepts to describe organizational innovation. Detailed explanation of these 15 concepts is given in Table 2. This approach makes it possible to not only measure the changes in organizations over a defined time period, but also provide an analysis of the adoption ratios of these concrete organizational concepts for various company types. Organizational innovation can be divided into two broad categories: business process or organizational structure. Procedural teamwork includes teamwork in production, task integration, and internal zero-buffer principle. The structural aspect includes customer-/product-focused lines. The purpose of organizational change includes flexibility, quality, development process, and productivity by minimizing storage costs. Further, well-established total quality management (TQM) and standardization within firms significantly improve the performance of product innovation for Korean and French firms (Pekovic & Galia, 2009; Prajogo & Hong, 2008).

Table 1 explains the variables used in the MTE estimation and their measurements. Product imitation or innovation is measured by the ratio of new products to sales. The distinction between "imitation" and "innovation" can be attained through the differentiation of product innovation into "new-to-the-market" innovation and "new-to-the-firm" but not "new-to-the-market" innovation, where the latter is interpreted as resulting from imitating behaviors, while product innovation is measured by the ratio of "new-to-the-market" products to sales. Process innovation covers 12 types of new production technologies in three dimensions, including automation and linkage, machining and production technologies, and digital factory/IT cross-linkages. This survey investigates whether firms adopt any new types of new production lines and their extent of the used potential (at a low, medium, or high level). Process innovation is measured using a binary variable to indicate whether firms adopt any of 12 new production lines.

The descriptive statistics for each variable are shown in Table 3. Table 4 presents the correlations between the different types of new product developments and the main index variables. The performance of organizational innovation significantly relates to product imitation, profit, process innovation, and R&D investment intensity, while it does not show a significant correlation with product innovation.

Table 3
Descriptive statistics.

Variable	Obs.	Mean	Std. dev.	Min	Max
INO	2275	30.83	24.58	0	100
IMI	2261	16.61	18.73	0	96.5
PRI	3164	0.96	0.18	0	1
LAB	3164	6.87	1.23	3.33	11.77
SKL	3164	19.37	16.95	0	100
R&D	3002	5.89	6.21	0.01	79
IMP	2999	8.38	16.49	0	100
INV	3077	0.06	0.55	0	20.04
AGE	2940	29.05	19.68	4	174
EXP	3164	0.75	0.43	0	1
ISO	2948	0.61	0.49	0	1

4. Results and analysis

4.1. Classification of organizational innovation and its characteristics

LCA is used to estimate the patterns of organizational innovation. Classifications into 2–10 patterns are separately tested. The measurement model for organizational innovation includes 15 variables, categorized under five dimensions. The results show that classification of organizational innovation into five patterns estimation yields minimum AIC and BIC values, and, therefore, it is arguable that sample firms should be classified as such. The characteristics of the five patterns of organizational innovation are shown in Table 5. The table presents the probabilities of firms choosing the corresponding indicator of organizational innovation, where "1", "2", and "3" represent the extent of use, from a low to a high level; "N" stands for missing values.

Based on their performance in the characteristics indices, the five patterns of organizational innovation are denoted as I, II, III, IV, and V. Type V firms perform the best in almost all indicators of organizational innovation. The performance of firms increases from Type I to IV. Compared to Type IV firms, Type III firms perform better on the dimensions of knowledge management system and organization of production. Based on LCA estimations, each sample firm can be allocated to the most probable organizational class. Table 6 shows the average performance of firms in terms of their characteristics by the five patterns of organizational innovation.

The novelty of organizational innovation increases with these five patterns (Type I to Type V). They also correspond to different foci: domestic-oriented (Type I), process-dominant (Type II), international-oriented (Type III), human-resource focus (Type IV), and jack of all trades (Type V). Type V firms have the best performance in most indices: they have the largest size (7.08), highest level of new product development (48.48%), and highest level of product innovation

Table 4
Cross-correlation table.

Variable	NPD	INO	IMI	PRI	ORI	LAB	SKL	R&D	EXP	IMP	INV
INO	0.66***										
IMI	0.31***	−0.26***									
PRI	0.04*	−0.00	0.01								
ORI	0.11***	0.03	0.06**	0.09***							
LAB	−0.05**	−0.10***	0.03	0.08***	0.09***						
SKL	0.09***	0.09***	0.00	−0.01	0.07***	−0.16***					
R&D	0.05*	0.07***	0.00	−0.00	0.01	−0.14***	0.14***				
EXP	0.07***	0.00	0.06**	0.06**	0.07***	0.21***	−0.07***	−0.05*			
IMP	0.08***	0.04	0.05*	0.06***	0.07***	0.14***	0.00	0.01	0.32***		
INV	0.02	0.05*	−0.00	−0.01	−0.00	−0.08***	0.02	0.02	−0.04*	−0.02	
AGE	−0.08***	−0.10***	−0.01	−0.00	−0.04*	0.33***	−0.15***	−0.07***	0.08***	0.00	−0.04*

Notes: Significance levels:
* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

(32.94%); they also adopt new production lines (8.04), albeit at a level slightly lower level than Type II firms (8.88). Type V firms also have the highest ratio of R&D investment (6.00) and largest share of exports (0.81), invest more (7.37), and are youngest (27.47 years of establishment). Type II firms focus more on process innovation (with 8.88 new production lines, on average) and have a relatively high level of product innovation (32.78); however, they tend to have a lower level of R&D investment and the lowest profits. These firms rely on updates to their production lines and their efforts regarding organizational innovation and R&D investments are limited; hence, their average profits lag and are the worst among the five firm types (2.64). Type IV firms feature the highest level of skilled workers (20.56), but have a lower level of process innovation (3.72); therefore, they tend to have a relatively low level of product innovation (30.02)—a value slightly better than that of Type I firms. Type III firms are more outstanding in international trade, as they have the highest level of imported inputs (10.11) and a relatively high share of exports (0.77); however, on average, they also invest the least in R&D activities (5.73). Type I firms fare the worst in terms of innovation performance and are generally older (30 years) and smaller (6.71). They also have the lowest rate of new product development (29.18) and their process innovation and skilled worker values are distinctly lower than those of other firm types (3.17 and 17.15, respectively). Type I firms are also more domestically oriented and have the lowest levels of both imports and exports (6.97 and 0.69, respectively); however, they generally tend to invest more than other firm types, save for Type V firms and their R&D investments are higher than those of Type II and III firms. These findings suggest that such firms focus heavily on capital operations and are less concerned about workforce skills.

As the aim of this paper is to investigate the relationship between organizational innovation and new product development, it is useful to first explore whether they are correlated. Fig. 1 shows the linear relationship between new product development and organizational innovation. Specifically Fig. 1 (a) indicates a positive correlation between the ratio of product imitation and levels of organizational innovation, with a narrow confidence interval. The correlation between productinnovation and organizational innovation follows a similar trend but with a much wider confidence interval, as shown in Fig. 1 (b), and, therefore, a more detailed analysis is required in order to identify the different impacts of organizational innovation on new product performance.

4.2. Impacts of organizational innovation on new product development

In this section, we empirically investigate the impact of organizational innovation on product imitation and innovation using Chinese Manufacturing Survey data. First, we conduct an ordinary least squares (OLS) regression on new product development, and the results are shown in Table 7. Columns (1), (3), (5), and (7) report the results on product imitation, while columns (2), (4), (6), and (8) present the ones on product innovation. The independent variables include process innovation (*PRI*), share of skilled workers (*SKL*), ratio of R&D investment (*R&D*), size (*LAB*), and years since established (*AGE*). Control variables are the region and industry dummies. The imported intermediate input (*IMP*), exporting status (*EXP*), and investment (*INV*) are included into the regressions gradually. Robust standard errors are used to control for heteroscedasticity.

As shown in Table 7, Type IV firms significantly conduct more product imitation than under other patterns, while Type V firms conduct significantly more product innovation. Bigger firms show positive signs for conducting product imitation, as illustrated in columns (1), (3) and (5), while smaller firms tend to conduct more product innovation, as illustrated in columns (4), (6) and (8). Skilled workers (*SKL*) and R&D investment (*R&D*) demonstrate significantly positive effects on product innovation, while they do not show significant impacts on product imitation. The exporting status shows significantly positive effects in the product imitation regressions, while there are not significant for product innovation. Older firms present significantly worse performance in product innovation, but no significant effects on product imitation. Process innovation (*PRI*) does not show any significant effects on neither product imitation nor innovation.

To deal with the endogeneity between organizational innovation and new product development, the impacts of organizational innovation on product imitation and innovation are estimated separately using an MTE model, as per Eqs. (3) and (4). The results are shown in Tables 8 and 9.

In Table 8, columns (1)–(4) report the results of the MMNL estimation. The baseline category is Type I firms. The likelihood ratio test (*lrtest*) is applied to examine the exogeneity of organizational innovation with respect to the intensity of product imitation. This test essentially reviews the joint hypotheses that the γs are equal to zero, using a $\chi^2(4)$ distribution. As shown in Table 8, *lrtest* rejects the null hypothesis of exogeneity on the organizational innovation of firms, and, hence, the first step on the correction of the selection is valid. The latent factors, $\gamma OI2$ and $\gamma OI4$, are statistically significant. The unobserved characteristics that make firms more likely to be classified as Type II rather than the baseline category (Type I) have a positive effect on product imitation (0.328), while the unobserved characteristics that potentially cause firms to be classified as Type III, IV, or V are negatively correlated with the intensity of product imitation (−0.178, −0.200 and −0.311 respectively). The use of an environmental standard (*ISO*) is found to have a significant effect on firms' classification into patterns II, IV, and V (0.704, 0.105, and 0.114, respectively). These results imply that ISO can be used to identify the various patterns of organizational

Table 5
Classification of organizational innovation: LCA estimation.

OI	Organization of work											
	Teamwork in production				Task integration				Temporary cross-functional project teams			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.428	0.028	0.389	0.156	0.786	0.015	0.177	0.022	0.657	0.047	0.257	0.040
II	0.081	0.520	0.347	0.052	0.350	0.353	0.274	0.023	0.241	0.299	0.387	0.073
III	0.012	0.024	0.356	0.608	0.111	0.08	0.488	0.321	0.110	0.121	0.542	0.227
IV	0.181	0.009	0.115	0.696	0.523	0.009	0.133	0.335	0.472	0.033	0.235	0.261
V	0.004	0.000	0.021	0.975	0.037	0.004	0.092	0.867	0.041	0.014	0.187	0.758
	Organization of production											
	Customer/product-focused line				Internal 0-buffer principle				Total cost of ownership			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.563	0.036	0.283	0.119	0.928	0.012	0.050	0.010	0.856	0.024	0.093	0.028
II	0.112	0.538	0.307	0.043	0.483	0.250	0.233	0.035	0.412	0.321	0.254	0.013
III	0.074	0.038	0.394	0.494	0.236	0.088	0.448	0.228	0.195	0.123	0.48	0.203
IV	0.273	0.009	0.114	0.604	0.777	0.004	0.077	0.142	0.697	0.009	0.099	0.195
V	0.023	0.000	0.063	0.914	0.092	0.005	0.111	0.792	0.050	0.015	0.104	0.831
	Standardization, knowledge management											
	Quality circles				Knowledge base systems				ISO9000 quality management			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.821	0.017	0.115	0.047	0.944	0.015	0.036	0.005	0.206	0.025	0.237	0.532
II	0.388	0.323	0.262	0.027	0.523	0.204	0.234	0.040	0.065	0.578	0.223	0.134
III	0.134	0.050	0.385	0.432	0.296	0.163	0.441	0.101	0.041	0.012	0.113	0.833
IV	0.681	0.007	0.035	0.277	0.814	0.009	0.084	0.094	0.060	0.001	0.024	0.915
V	0.021	0.004	0.058	0.918	0.068	0.027	0.189	0.716	0.029	0.001	0.009	0.961
	Working hours, payment schemes											
	Flexible working hours				Team perform incentives wage				Financial participation			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.739	0.036	0.185	0.039	0.440	0.063	0.407	0.090	0.870	0.021	0.072	0.037
II	0.459	0.253	0.236	0.053	0.129	0.390	0.426	0.055	0.704	0.109	0.106	0.081
III	0.291	0.125	0.386	0.198	0.037	0.057	0.535	0.372	0.567	0.153	0.213	0.067
IV	0.605	0.006	0.125	0.263	0.153	0.018	0.186	0.643	0.774	0.011	0.079	0.136
V	0.127	0.035	0.120	0.720	0.009	0.004	0.050	0.937	0.320	0.058	0.124	0.497
	Human resource management, leadership											
	Regular appraisal interviews				Personnel training program				Work-at-home			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.554	0.077	0.291	0.078	0.266	0.084	0.535	0.115	0.954	0.020	0.020	0.005
II	0.173	0.493	0.279	0.056	0.085	0.503	0.378	0.034	0.785	0.090	0.034	0.092
III	0.047	0.083	0.541	0.329	0.019	0.037	0.425	0.519	0.649	0.228	0.110	0.013
IV	0.284	0.005	0.190	0.520	0.075	0.008	0.148	0.770	0.904	0.036	0.026	0.033
V	0.017	0.007	0.059	0.918	0.015	0.002	0.029	0.954	0.387	0.121	0.103	0.389

Notes: The numbers shown in this table are the probabilities with which firms choose the corresponding category. "N" stands for missing values; "1", "2", and "3" correspond to the extent of respectively using organizational concepts from a low to a high level.

innovation in the MTE estimation and it is valid as an instrument variable.

Process innovation has a significant effect for firms on the classification of organizational innovation, especially for patterns II, III, and V. Firm size shows a significant impact on the classification of organizational innovation. Further, a higher share of educated employees, which we associate with the presence of more skilled workers, significantly improves the likelihood of firms to conduct organizational innovation.

In the second step, the impact of organizational innovation on product imitation is estimated using an OLS regression. The results shown in Table 8 column (5) confirm that organizational innovation

Table 6
Characteristics of firms by patterns of organizational innovation.

OI-Pattern	NPD	INO	IMI	RII	LAB	SKL	R&D	AGE	IMP	EXP	INV	N firms
I	39.18	29.52	16.26	3.17	6.71	17.15	5.91	30.24	6.97	0.69	6.84	710
II	42.85	32.78	15.45	8.88	6.76	19.61	5.82	28.43	8.18	0.76	5.25	248
III	44.61	30.51	18.53	5.67	6.88	19.40	5.73	29.25	10.11	0.77	6.69	771
IV	43.89	30.02	18.81	3.72	6.90	20.56	5.95	29.09	7.92	0.74	5.59	901
V	48.48	32.94	19.87	8.04	7.08	20.16	6.00	27.47	8.55	0.81	7.37	534

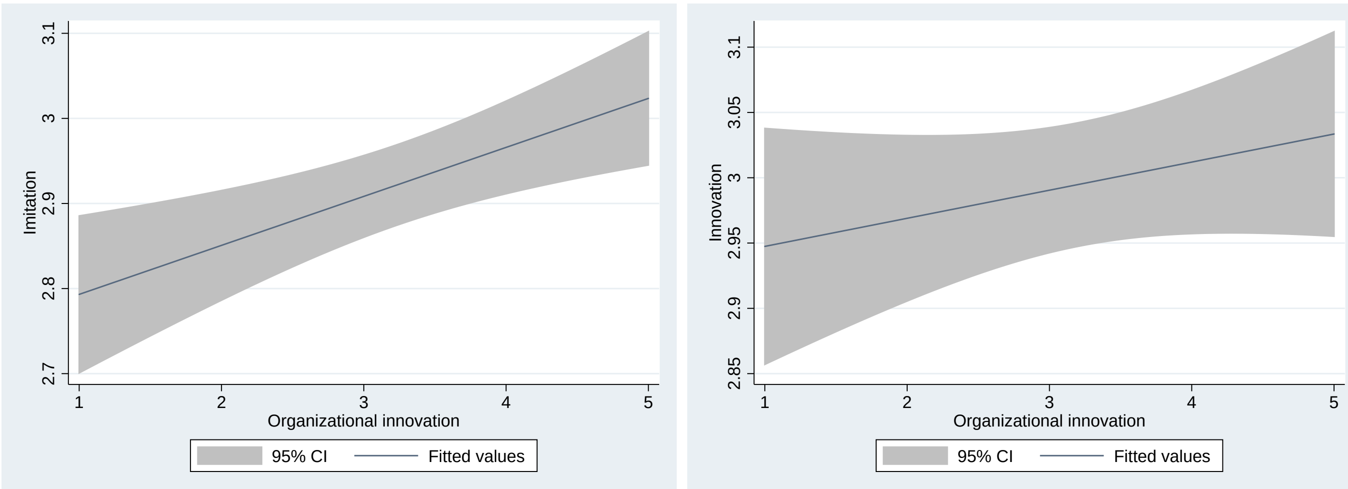

Fig. 1. Relationship between new product development and organizational innovation. (a) Imitation and organizational innovation (b) Innovation and organizational innovation

Table 7
OLS regression on new product development.

	(1) IMI	(2) INO	(3) IMI	(4) INO	(5) IMI	(6) INO	(7) IMI	(8) INO
OI2	−0.923	3.621	−0.205	2.777	−0.359	2.752	−0.399	2.845
	(1.75)	(2.51)	(1.78)	(2.55)	(1.77)	(2.55)	(1.79)	(2.58)
OI3	1.308	1.543	1.856	0.948	1.715	0.923	1.697	0.861
	(1.30)	(1.67)	(1.31)	(1.70)	(1.31)	(1.70)	(1.31)	(1.71)
OI4	2.054	1.251	2.525**	0.760	2.473*	0.752	2.496**	0.754
	(1.25)	(1.58)	(1.26)	(1.61)	(1.26)	(1.61)	(1.27)	(1.61)
OI5	1.315	4.330**	1.468	4.148**	1.304	4.121**	1.308	4.108**
	(1.48)	(1.82)	(1.48)	(1.85)	(1.49)	(1.86)	(1.50)	(1.87)
PRI	1.183	−1.815	0.703	−1.566	0.905	−1.533	0.949	−1.473
	(2.51)	(3.33)	(2.57)	(3.27)	(2.58)	(3.28)	(2.58)	(3.28)
LAB	0.740*	−0.822	0.744*	−0.985*	0.572	−1.029*	0.573	−1.049*
	(0.38)	(0.50)	(0.39)	(0.52)	(0.40)	(0.53)	(0.40)	(0.54)
SKL	−0.021	0.080**	−0.009	0.075**	−0.006	0.076**	−0.007	0.076**
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)
R&D	−0.034	0.264***	−0.032	0.267***	−0.025	0.268***	−0.018	0.274***
	(0.07)	(0.10)	(0.07)	(0.09)	(0.07)	(0.10)	(0.07)	(0.10)
AGE	−0.011	−0.091***	−0.010	−0.093***	−0.011	−0.093***	−0.009	−0.093***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
IMP			−0.005	0.095**	−0.015	0.092**	−0.014	0.092**
			(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)
EXP					2.388**	0.568	2.397**	0.600
					(1.09)	(1.43)	(1.09)	(1.43)
INV							−0.776*	0.411
							(0.42)	(1.05)
REG	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IND	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cons	3.470	35.314***	3.087	36.677***	2.597	36.588***	2.489	36.637***
	(4.00)	(5.49)	(4.06)	(5.56)	(4.07)	(5.57)	(4.08)	(5.60)
N	1925	2037	1867	1977	1867	1977	1859	1969
R-sqr	0.034	0.033	0.037	0.035	0.039	0.037	0.042	0.041

Notes: Robust standard errors between parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Type I of organizational innovation (OI1) is the baseline category.

has a significant impact on the performance of product imitation after incorporating unobservable factors. Particularly, Type III and IV organizational innovations display a positive effect on product imitation (0.281 and 0.347, respectively), while Type II organizational innovation shows negative effects on the intensity of product imitation (−0.259), but the coefficient is not significant. Skilled workers show negative effects on product imitation, and R&D investment yields positive effects on product imitation. Firm size, process innovation, imported intermediate inputs, export, and R&D investment are not significant for product imitation.

Table 9 reports the MTE estimation on product innovation. Similar to the estimation of product imitation, *lrtest* rejects the null hypothesis of exogeneity on the organizational innovation of firms (471.57). Latent factor $\gamma OI5$ is statistically significant, implying that the unobserved characteristics that classify firms as Type V relative to the base category (Type I) produce a negative effect on product innovation (−0.207). The latent factors, $\gamma OI2$ and $\gamma OI3$, are statistically positive (0.251 and 0.321). By contrast, $\gamma OI4$ is not significant. These results imply that ISO can be used to identify the various patterns of organizational innovation in the MTE estimation on product innovation.

By considering the effects of unobserved factors, the estimation results show that lower levels of organizational innovation have no

Table 8
Multinomial treatment effects estimation on product imitation.

	Mixture multinomial logit regression				MTE
	(1) OI2	(2) OI3	(3) OI4	(4) OI5	(5) IMI
OI2					−0.259
					(0.19)
OI3					0.281***
					(0.10)
OI4					0.347***
					(0.10)
OI5					0.500
					(0.34)
PRI	0.650***	0.358***	0.010	0.510***	−0.000
	(0.08)	(0.05)	(0.05)	(0.06)	(0.02)
LAB	−0.114	0.136	0.518***	0.372***	−0.038
	(0.17)	(0.12)	(0.12)	(0.13)	(0.03)
SKL	0.007	0.011	0.017**	0.016**	−0.003*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
R&D	−0.064	−0.069	0.302*	0.348*	0.075*
	(0.22)	(0.16)	(0.16)	(0.18)	(0.04)
IMP	0.005	0.004	0.000	−0.010	−0.000
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
EXP	0.000	−0.009**	−0.003	−0.001	0.002
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
AGE	−0.011	−0.015**	−0.013**	−0.014*	0.001
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
ISO	0.704**	0.078	0.105*	0.114*	
	(0.39)	(0.23)	(0.21)	(0.27)	
IND	Yes				Yes
REG	Yes				Yes
Cons	−3.967***	−1.179	−3.156***	−5.332***	2.585***
	(1.36)	(0.85)	(0.83)	(0.97)	(0.20)
lnsigma			−0.305*** (0.12)		
γOI2			0.328** (0.15)		
γOI3			−0.178** (0.08)		
γOI4			−0.200*** (0.08)		
γOI5			−0.311 (0.37)		
lrtest			483.99*** (0.00)		
Obs			1,166		

Notes: Robust standard errors between parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Type I of organizational innovation (OI1) is the baseline category. 60 Hator sequence-based quasi-random draws per observation. Outcome density is specified as normally distributed. The likelihood test is based on a $\chi^2(4)$ distribution.

Table 9
Multinomial treatment effects estimation on product innovation.

	Mixture multinomial logit regression				MTE
	(1) OI2	(2) OI3	(3) OI4	(4) OI5	(5) INO
OI2					−0.161
					(0.13)
OI3					−0.274**
					(0.12)
OI4					0.002
					(0.11)
OI5					0.283***
					(0.11)
PRI	0.625***	0.307***	−0.008	0.456***	0.015
	(0.06)	(0.04)	(0.04)	(0.04)	(0.01)
LAB	−0.237*	0.051	0.379***	0.259***	−0.078***
	(0.13)	(0.09)	(0.09)	(0.10)	(0.03)
SKL	0.007	0.005	0.012**	0.010*	0.003**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
R&D	−0.048	−0.145	0.072	0.177	0.216***
	(0.17)	(0.12)	(0.12)	(0.13)	(0.05)
IMP	0.002	0.006	0.000	−0.007	0.003
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
EXP	−0.003	−0.005	−0.002	−0.003	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
AGE	−0.013*	−0.007	−0.010**	−0.016***	−0.003**
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
ISO	0.866***	0.105	0.182	0.292	
	(0.30)	(0.17)	(0.17)	(0.20)	
IND	Yes				Yes
REG	Yes				Yes
Cons	−3.144***	−0.951	−2.132***	−4.159***	3.126***
	(1.01)	(0.64)	(0.62)	(0.72)	(0.20)
lnsigma			0.042 (0.04)		
γOI2			0.251*** (0.08)		
γOI3			0.321*** (0.10)		
γOI4			−0.004 (0.09)		
γOI5			−0.207*** (0.07)		
lrtest			471.57*** (0.00)		
Obs			1,876		

Notes: Robust standard errors between parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Type I organizational innovation (OI1) is the base category. 60 Hator sequence-based quasi-random draws per observation. Outcome density is specified as normally distributed. Likelihood test is based on a $\chi^2(4)$ distribution.

significant impact on the performance of product innovation. Compared to Type I organizational innovation, the superior level of organizational innovation (Type V) significantly improves the intensity of product innovation, by 0.283. R&D investment yields a significantly positive effect on product innovation (0.216). A higher rate of educated employees significantly improves the intensity of product innovation, by 0.003. Firm size (*LAB*) and age (*AGE*) show negative impacts on product innovation (−0.078 and −0.003, respectively). Process innovation, imported intermediate inputs, and export are not significantly for the intensity of product innovation.

These results confirm that product imitation and innovation require completely different patterns of organizational innovation. As Type V firms exhibit, to a significantly greater degree, the adoption of flexible team management and working hours, a highly integrated work organization, the highest level of quality, and the largest knowledge base system, the results suggest that product innovation—which features tasks with higher uncertainty—requires organic structures and stricter knowledge-management procedures within the organization. To some extent, this finding is similar to and yet extends those of Arvanitis and Seliger (2014), Naranjo-Valencia et al. (2011), and Lukas and Ferrell (2000) by comprehensively comparing patterns of organizational innovation for product imitation to those for innovation. The above-cited studies address the differences between innovating and imitating firms by certain features, such as introversion versus extroversion in knowledge acquisition, advocacy versus hierarchy culture, and customer and competitor orientations versus only a competitor orientation. According to performance gap theory, firms must undertake organizational transformation if they are to attain strategic fit between new product development and the business environment (Walker et al., 2015).

Furthermore, the results reveal a synergistic relationship between organizational innovation and the performance of new product development. In line with Ballot et al. (2015) and Cozzarin (2017), our results suggest a positive relationship between firms' introduction of new management practices and their new product development. Moreover, the MTE estimation establishes causality between the degrees of organizational innovation and new product development. Hence, firm-level performance in pursuing emerging opportunities (e.g., new product development) is a consequence of organizational transformation.

The results highlight the more important role of skilled workers in product innovation than their role in imitation; these results align with the findings of Arvanitis and Seliger (2014). Meanwhile, trade performance—including both exports and imports—was not found to have a significant effect on product imitation or innovation performance. This finding is consistent with previous research findings with respect to Chinese firms. Wang (2014), for example, demonstrates that, among Chinese firms, exports do not lead to higher levels of innovation or productivity. In line with Gallego et al. (2013)'s finding on small firms in Europe, we demonstrate that firm size has a negative effect on product innovation; however, it does not have a significant effect on product imitation. This result confirms that firm size is relevant to strategies in new product development (Ettlie & Rubenstein, 1987; Forés & Camisón, 2016). Furthermore, both product imitation and innovation benefit from higher levels of R&D investment.

4.3. Robustness checks

Here, we conduct robustness check by changing the measurement for the different variables and the instrument variable. The use of recycling residual heat (*REH*) was chosen to replace *ISO* as an instrument variable as we consider this variable similar in concept to the use of the environmental standard, but it can correct the endogeneity bias from a different perspective. As such, we check the robustness of the MTE estimation on the selection of the instrument variable. The use of residual heat reflects firms' willingness to adopt environment-friendly management practices for purposes of cost reduction and can directly affect their patterns of organizational innovation; nonetheless, it does not relate directly to product imitation or innovation. Furthermore, we change the measure of imported intermediate inputs to a binary variable (*BIMP*) in order to examine the robustness of the results to a change in measure. As such, we keep the trading-variable measures consistent: in the main estimation, exports (*EXP*) are measured by a binary variable and imported intermediate inputs (*IMP*) by a continuous variable.

The results of the MTE estimation for product imitation are shown in Table 10. As before, the likelihood ratio test (*lrtest*) presents a significant sign, suggesting that the first step on the correction of the selection is valid. The latent factors, γ*OI*2 and γ*OI*4, are statistically significant. The unobserved characteristics that make firms to more likely to be classified as Types II and IV rather than the baseline category (Type I) produce a negative effect on product imitation (−0.164 and −0.418, respectively), while the unobserved characteristics that potentially cause firms to be classified as Types III and V are not significant. Additionally, the use of residual heat (*REH*) is found to have a significant effect on firms' classification as Types II, III or IV (1.114, −0.428, and −0.382, respectively). These results imply that *REH* can be used to identify the various patterns of organizational innovation in the MTE estimation for product imitation and that it is valid as an instrument variable.

Table 10
Robustness check on product imitation.

	Mixture multinomial logit regression (1) OI2	(2) OI3	(3) OI4	(4) OI5	MTE (5) IMI
OI2					0.221*
					(0.12)
OI3					−0.155
					(0.13)
OI4					0.387***
					(0.09)
OI5					0.247
					(0.17)
PRI	0.603***	0.341***	0.032	0.393***	0.022**
	(0.06)	(0.04)	(0.04)	(0.04)	(0.01)
LAB	−0.148	0.028	0.325***	0.322***	−0.059**
	(0.13)	(0.09)	(0.09)	(0.10)	(0.03)
SKL	0.012	0.008	0.013**	0.013**	0.003**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
R&D	−0.118	−0.151	0.139	0.280*	0.220***
	(0.19)	(0.13)	(0.13)	(0.15)	(0.05)
BIMP	0.105	0.197	0.107	−0.088	0.043
	(0.27)	(0.18)	(0.17)	(0.21)	(0.06)
EXP	−0.126	0.093	−0.032	−0.079	0.101
	(0.34)	(0.21)	(0.20)	(0.24)	(0.07)
AGE	−0.011	−0.007	−0.009**	−0.021***	−0.004**
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
REH	1.114***	−0.428*	−0.382*	−0.127	
	(0.28)	(0.22)	(0.21)	(0.25)	
IND	Yes				Yes
REG	Yes				Yes
Cons	−3.786***	−1.090*	−2.035***	−4.504***	
	(1.01)	(0.64)	(0.63)	(0.75)	(0.21)
lnsigma			0.012*** (0.05)		
γOI2			−0.164*** (0.06)		
γOI3			0.207 (0.13)		
γOI4			−0.418*** (0.06)		
γOI5			−0.080 (0.17)		
lrtest			135.53*** (0.00)		
Obs			1,744		

Notes: Robust standard errors between parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Type I organizational innovation (OI1) is the baseline category. 60 Hator sequence-based quasi-random draws per observation. Outcome density is specified as normally distributed. The likelihood test is based on a $\chi^2(4)$ distribution.

Similar with main estimation results, Type IV organizational innovation shows a significantly positive effect on product imitation, with a similar magnitude (0.387) and so does R&D investment. Different from the previous results, Type III organizational innovation does not show a significant effect on imitation, while Type II shows a significant effect (0.221). Process innovation (*PRI*) and skilled workers (*SKL*) show positive effects on product imitation, while size (*LAB*) and age (*AGE*) present significantly negative effects (−0.059 and −0.004, respectively).

Then, we trim the sample of the product innovation rate by restricting its value between 5 to 95 %, which generates 2097 observations. We then conduct a MTE estimation on the new sample. The results shown in Table 11 generally confirm the findings from the original analysis. The *lrtest* rejects the null hypothesis of exogeneity on the organizational innovation of firms (584.98). Latent factor γ*OI*5 is statistically significant, implying that the unobserved characteristics that lead firms to more likely fall into Type V relative to the base category (Type I) produce a negative effect on their product innovation (−0.219). Similar to the main estimation, Type V organizational innovation presents a significant effect on product innovation (0.285). Size has significantly negative effect, while R&D investment improves the ratio of product innovation by 0.100. Different from full sample regression, process innovation, imported intermediate inputs and exports show significantly positive effect on the ratio of product innovation. Skilled workers and firm age do not show significant effects.

Finally, because, in China, firms with diverse ownership structures typically present remarkable differences in innovation performance and strategy, we divide the sample into two subsamples based on their ownership—state-owned enterprises (SOEs) and private enterprises (PEs)—and conduct LCA and MTE estimations on the two subsamples separately. We first apply MTE model to the subsamples separately using the same classification of organizational innovation as for the full sample (see Table 12), and then the LCA estimation to the subsamples to check whether the patterns of organizational innovation are robust to firm ownership (shown in Tables A1 and A2 in the Appendix).

The results of the MTE estimation on the two subsamples in Table 12[2] confirm the main research findings: in both cases, product innovation requires the highest level of organizational innovation, and Types III and IV organizational innovations have significantly positive effects on product imitation, although they show a slightly different impact on product imitation for SOEs and PEs. As per Table 12, the *lrtest* rejects the null hypothesis of exogeneity on the organizational innovation of firms for all four estimations. Similar to the estimation on the full sample, R&D investment shows significant effects on both product imitation and innovation for both subsamples. Firm size shows significant negative effects on product innovation, however, it does not show significant effects on product imitation for both types of firms. Different from the full sample estimation, Type II organizational innovation presents a significantly negative effect on product imitation

[2] The MMNL estimators in the first step are not reported due to space limit but are available upon request.

Table 11
Robustness check on product innovation.

	Mixture multinomial logit regression				MTE
	(1) OI2	(2) OI3	(3) OI4	(4) OI5	(5) INO
OI2					−0.499***
					(0.12)
OI3					0.026
					(0.09)
OI4					−0.033
					(0.07)
OI5					0.285**
					(0.13)
PRI	0.623***	0.304***	0.003	0.460***	0.015*
	(0.06)	(0.04)	(0.04)	(0.04)	(0.01)
LAB	−0.258**	0.059	0.352***	0.252**	−0.052***
	(0.13)	(0.09)	(0.09)	(0.10)	(0.02)
SKL	0.004	0.005	0.011**	0.010*	0.001
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
R&D	−0.124	−0.084	0.047	0.210	0.100***
	(0.20)	(0.12)	(0.12)	(0.13)	(0.03)
IMP	0.006	0.007	−0.000	−0.007	0.003**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
EXP	−0.003	−0.004	−0.002	−0.002	0.002**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
AGE	−0.013**	−0.009*	−0.011**	−0.019***	−0.002
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
ISO	0.715**	0.086	0.112	0.297	
	(0.30)	(0.18)	(0.17)	(0.21)	
IND	Yes				Yes
REG	Yes				Yes
Cons	−2.904***	−1.069	−2.002***	−4.246***	3.201***
	(1.07)	(0.65)	(0.65)	(0.74)	(0.15)
lnsigma			−0.948*** (0.12)		
γOI2			0.664*** (0.06)		
γOI3			−0.035 (0.06)		
γOI4			0.124*** (0.05)		
γOI5			−0.219* (0.12)		
lrtest			584.98*** (0.00)		
Obs			1,725		

Notes: Robust standard errors between parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Type I organizational innovation (OI1) is the baseline category. 60 Hator sequence-based quasi-random draws per observation. Outcome density is specified as normally distributed. The likelihood test is based on a $\chi^2(4)$ distribution.

for SOEs, while skilled workers have significant effects on product innovation for both SOEs and PEs. Firm age shows a significantly positive effect on product imitation for SOEs, while it shows a negative effect on their product innovation. Process innovation plays a significant role in increasing product imitation intensity for SOEs.

We further conduct an LCA estimation on the SOE and PE subsamples separately. Classifications into 3–7 patterns are tested, and the results show that the classification into five patterns of organizational innovation yields the minimum AIC and BIC values for both subsamples, confirming the robustness of the LCA estimation results on the full sample. Accordingly, the characteristics of five patterns are shown in the Tables A1 and A2 in the Appendix. Similar to Table 5, the estimators represent the probabilities of firms choosing the corresponding indicator of organizational concepts. Pr(1), Pr(2), and Pr(3) represent the extent of use from a low to a high level. “N” stands for missing values.

As per Tables A1 and A2, the LCA estimation generates robust results for firm ownership, although SOEs and PEs present slightly different patterns of organizational innovations. Compared to SOEs, PEs are more flexible in working hours, payment schemes, and human resources management as Types IV and V of PEs have higher predicted probabilities of flexible work hours and working-at-home, as well as implementing team perform incentive wages and regular interviews. SOEs pay more attention to the standardization and knowledge management as Types III, IV and V of SOEs present higher probabilities to use knowledge base systems and ISO9000 quality management systems.

Table 12
Robustness checks for the SOE and PE subsamples: MTE estimation.

	(1)	(2)	(3)	(4)
	State-owned enterprise		Private enterprise	
	IMI	INO	IMI	INO
OI2	−1.660***	−0.194	−0.611	−0.137
	(0.27)	(0.23)	(1.32)	(0.15)
OI3	0.625**	0.091	0.364 **	−0.180
	(0.27)	(0.18)	(0.63)	(0.19)
OI4	1.047***	0.225	0.830 **	0.132
	(0.23)	(0.15)	(0.59)	(0.15)
OI5	0.137	0.276 *	0.830	0.264**
	(0.36)	(0.17)	(0.82)	(0.11)
PRI	0.057*	0.015	0.030	0.008
	(0.03)	(0.02)	(0.03)	(0.01)
LAB	0.169	−0.104**	0.040	−0.078**
	(0.11)	(0.05)	(0.08)	(0.03)
SKL	−0.008	0.006**	−0.002	0.003*
	(0.00)	(0.00)	(0.00)	(0.00)
R&D	0.018**	0.024***	0.006***	0.011***
	(0.01)	(0.01)	(0.01)	(0.00)
IMP	0.298	0.027	0.234	0.059
	(0.20)	(0.10)	(0.15)	(0.07)
EXP	−0.069	0.156	0.274	0.088
	(0.15)	(0.12)	(0.20)	(0.09)
AGE	0.011**	−0.006**	−0.001	−0.002
	(0.00)	(0.00)	(0.00)	(0.00)
IND	Yes	Yes	Yes	Yes
REG	Yes	Yes	Yes	Yes
Cons	−1.656***	3.276***	−0.348	3.366***
	(0.62)	(0.36)	(0.66)	(0.25)
lnsigma	−0.731***	0.026 ***	0.780***	0.049***
	(0.13)	(0.06)	(0.12)	(0.06)
γOI2	2.418***	0.242***	−0.222	0.299***
	(0.06)	(0.08)	(1.66)	(0.10)
γOI3	0.228**	−0.166	−0.354	0.244
	(0.11)	(0.14)	(0.75)	(0.20)
γOI4	−0.712***	−0.317***	−0.842	0.207*
	(0.06)	(0.07)	(0.67)	(0.12)
γOI5	−0.478***	−0.094	−0.921	−0.160***
	(0.07)	(0.08)	(1.00)	(0.06)
lrtest	554.75***	211.97***	344.84***	360.22***
	(0.07)	(0.08)	(0.05)	(0.06)
Obs	583	586	1341	1346

Notes: Robust standard errors between parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Type I organizational innovation (OI1) is the baseline category. 60 Hator sequence-based quasi-random draws per observation. Outcome density is specified as normally distributed. The likelihood test is based on a $\chi^2(4)$ distribution. Mixture multinomial logit estimators in the first step of the four MTE estimation are not reported, but are available upon request.

Meanwhile, SOEs show higher predicted shares to maintain lower levels of organizational innovation: Types I and Type II of SOEs constitute more than 62% of all SOEs, while 6% of SOEs engage in the highest level of organizational innovation. PEs have a more evenly distributed pattern of organizational innovation.

5. Conclusions and discussion

The measurement of organizational innovation and the inconclusive evidence for the causal relationship between organizational innovation and product innovation are two questions this article investigated. Combining LCA and MTE estimations, we undertook an initial attempt to improve our understanding on the classification of organizational innovation for Chinese firms and its impacts on new product development. The analysis adopts a more comprehensive measure of organizational innovation and excludes the endogeneity between organizational and product innovation.

5.1. Research findings

The LCA estimation derives five different patterns of organizational innovation for the Chinese firm samples. Based on their performance in the five dimensions of organizational concepts, we identify five patterns of organizational innovation that range from low to high levels.

The results imply a synergetic development between organizational and product innovation. On the one hand, a higher level of organizational innovation improves the intensity of product imitation; in particular, Types III and IV firms demonstrate significantly higher intensity of imitation than Type I firms. On the other hand, only the superior level of organizational innovation (Type V) shows a significant impact on improving the product innovation intensity (compared to Type I).

Type III firms perform relatively well in dimension of standardization and knowledge management compared to other types, especially in quality circles and knowledge base systems, being second to Type V. This result highlights the importance of knowledge innovation in facilitating product imitation. Nevertheless, Type III firms have the lowest tendency of investing in R&D activities among the five patterns (see Table 6) and, therefore, their efforts in knowledge management do not lead them to significant performance in product innovation. Type IV firms have relatively low level of process innovation, yet good performance in other characteristics such as skilled workers and R&D investment as well as all organizational concepts, most of which are second to Type V firms. Such a design in organizational concepts helps firms conduct product imitation but does not show measurable impacts on product innovation. These results suggest that different degrees of organizational innovation correspond to corporate strategies for imitation or innovation. The transition of late-comer firms from imitation to innovation requires a comprehensive improvement of organizational innovation.

5.2. Implications

Our research findings have implications for both theory and management practice. First, this research enriches the organization management theory and product development theories by providing more micro-level evidence on the relationship between organization design and new product development (NPD). It proposes a different approach to measuring organizational innovation by adopting LCA to analyze the multi-dimensional concepts of organizational innovation. Instead of isolating different organizational concepts as most of the existing studies have done, we gather information of the five-dimensional concepts to define the organizational innovation. In this way, it is possible to obtain a comprehensive measurement of the levels of organizational innovation, which helps extend the understanding of organizational innovation and its measurement (Crossan & Apaydin, 2010; Damanpour & Aravind, 2012). Second, the various impacts of organizational innovation on product imitation and innovation in Chinese firms raise the important issue of understanding the transitional process of organizations and the economy as a whole. This suggests that organizational innovation is an important determinant of product imitation or innovation, as well as that of organizational learning (Arvanitis & Seliger, 2014; Jenkins, 2014). To some degree, this study provides a complementary view on the impacts of organizational innovation on NPD (e.g., Sapprasert and Clausen, 2012) by identifying its various effects on imitation or innovation. Hence, it presents an analytical framework that is also useful for future studies on related topics.

This study advances the managerial understanding of organizational innovation and its connection with NPD in two ways. First, our findings suggest that organizational transformation is needed for NPD, especially, as different aspects of organizational concepts should be adopted to promote product imitation or innovation. The essential decision of corporate strategies in NPD is to balance the goals of the exploitation of old certainties and exploration of new possibilities (Michael & Palandjian, 2004). The design of innovative organization requires a full employment of the five aspects of organizational concepts, together with massive efforts toward R&D investment and process innovation. Second, the results particularly advocate the importance of knowledge management and standardization for facilitating NPD because these help firms improve the integration of their existing knowledge into their internal operations and product portfolios (Akgün, Keskin, & Byrne, 2012). Knowledge creation is a process of mobilizing individual tacit knowledge and fostering its interaction with the explicit knowledge base of firms. The organization of work provides an important site, where intense learning and knowledge creation may develop. While knowledge creation is often a product of organizational capabilities recombining the existing knowledge and generating new applications from the existing knowledge base, radically new products tend to the results of a high level of organization and re-organization.

5.3. Limitations and future work

Our results must be viewed in the light of this study's limitation. First, the measures of the organizational concept are relatively subjective because firms respond to the degree of innovation based on their perceptions of their own performance. As such, the different criteria that firms hold for respective performances might generate biased results. Second, this study analyzes the concept of organizational innovation from a holistic and multi-dimensional viewpoint. Owing to the scope of the study, we ignore the relationship between a specific dimension of organizational changes and the performance of product imitation or innovation. Further, we overlook the interrelatedness of organizational variables, although the correlations justify the relative independence of different organizational variables. Technological innovation might mediate the relationship between organizational and product innovation.

Finally, as with all cross-sectional analyses, by arguing there exists a causal relationship between the organizational concept and firm performance in product imitation or innovation, our results suffer from endogeneity bias. Although we apply MTE to address this endogeneity problem, a longitudinal structure would reveal the dynamic changes in firm performance in terms of organizational concepts, as well as their impacts over time. Moreover, the data we used were collected in 2009. There might be new forms and foci of organizational innovation with the development of technological changes, globalization of market competition, and emergence of new business models. For example, job or employee sharing occurs in human resources management, and firms are expected to build more external linkages in response to open innovation strategies (Damanpour, 2017). However, organizational innovation can still be analyzed in terms of the five dimensions we defined in this analysis—organizational work, organizational production, standard and knowledge management, working hours and payment schemes, as well as human resources management and leadership. Furthermore, the major challenge that the Chinese economy faces today is similar to the one it faced over the 2009–2010 period, that is, shifting from imitation- to innovation-oriented growth. Therefore, our research findings are valid in terms of understanding the various patterns of organizational innovation for product imitation or innovation in a transitional economy. As the survey is ongoing, it would be possible to undertake a panel data analysis in a future investigation; the use of updated data on Chinese firms would allow new insights into the most recent patterns of organizational innovation *per se* and their impacts. As our data are comparable to the EMS data—which are currently collected in 15 European countries—our identification strategy can be used to explore related research questions for a larger number of economies. Additionally, comparative studies of the various economies would generate more insights into the impacts of organizational innovation on firm-level performance.

Declaration of Competing Interest

None

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Appendix. Appendix

Table A1
Classification of organizational innovation on SOEs: LCA estimation.

OI	Organization of work											
	Teamwork in production				Task integration				Temporary cross-functional project teams			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.43	0.03	0.38	0.15	0.82	0.01	0.14	0.03	0.68	0.04	0.25	0.03
II	0.08	0.51	0.35	0.07	0.38	0.37	0.21	0.04	0.28	0.24	0.38	0.10
III	0.02	0.02	0.38	0.58	0.12	0.07	0.51	0.29	0.10	0.13	0.55	0.22
IV	0.18	0.01	0.11	0.70	0.53	0.01	0.12	0.33	0.48	0.03	0.25	0.25
V	0.01	0.00	0.02	0.97	0.04	0.01	0.10	0.86	0.04	0.02	0.19	0.75
	Organization of production											
	Customer-/product-focused line				Internal 0-buffer principle				Total cost of ownership			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.58	0.04	0.27	0.11	0.92	0.01	0.05	0.01	0.87	0.02	0.09	0.02
II	0.12	0.55	0.30	0.03	0.53	0.24	0.19	0.04	0.4	0.36	0.21	0.02
III	0.08	0.04	0.39	0.48	0.23	0.08	0.47	0.22	0.21	0.11	0.48	0.20
IV	0.27	0.01	0.11	0.61	0.79	0.00	0.08	0.13	0.7	0.01	0.11	0.18
V	0.02	0.00	0.06	0.92	0.09	0.01	0.10	0.81	0.05	0.01	0.10	0.84
	Standardization, knowledge management											
	Quality circles				Knowledge base systems				ISO9000 quality management			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.82	0.01	0.11	0.06	0.95	0.01	0.03	0.01	0.2	0.03	0.24	0.54
II	0.41	0.35	0.20	0.03	0.56	0.18	0.22	0.04	0.07	0.58	0.19	0.15
III	0.14	0.05	0.39	0.41	0.32	0.16	0.43	0.09	0.05	0.02	0.14	0.80
IV	0.67	0.01	0.04	0.28	0.82	0.01	0.08	0.09	0.06	0.00	0.03	0.91
V	0.02	0.00	0.05	0.93	0.07	0.03	0.17	0.74	0.02	0.00	0.01	0.97
	Working hours, payment schemes											
	Flexible working hours				Team perform incentives wage				Financial participation			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.74	0.03	0.19	0.04	0.45	0.07	0.39	0.09	0.86	0.03	0.07	0.05
II	0.50	0.26	0.20	0.05	0.13	0.39	0.43	0.06	0.71	0.11	0.11	0.07
III	0.28	0.12	0.41	0.19	0.05	0.05	0.53	0.37	0.57	0.14	0.22	0.07
IV	0.60	0.01	0.11	0.28	0.14	0.02	0.18	0.66	0.77	0.01	0.08	0.14
V	0.12	0.04	0.13	0.72	0.01	0.00	0.06	0.93	0.33	0.06	0.12	0.48
	Human resource management, leadership											
	Regular appraisal interviews				Personnel training program				Work-at-home			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.56	0.09	0.26	0.09	0.25	0.09	0.53	0.13	0.95	0.03	0.02	0.00
II	0.17	0.47	0.29	0.06	0.09	0.47	0.39	0.05	0.81	0.08	0.02	0.10
III	0.06	0.08	0.53	0.34	0.02	0.04	0.43	0.51	0.65	0.22	0.11	0.02
IV	0.28	0.01	0.20	0.52	0.08	0.01	0.13	0.79	0.90	0.04	0.03	0.04
V	0.02	0.01	0.06	0.91	0.02	0.01	0.03	0.95	0.39	0.12	0.11	0.37
N	1095											
AIC	28,362.63											
BIC	29,882.18											
Estimated class population shares					0.38	0.24	0.14	0.18	0.06			

Notes: The numbers shown in this table represent the probabilities with which firms choose the corresponding category. "N" stands for missing values; "1", "2", and "3" correspond to the extent of respectively using organizational concepts from a lower to a high level.

Table A2
Classification of organizational innovation on PEs: LCA estimation.

OI	Organization of work											
	Teamwork in production				Task integration				Temporary cross-functional project teams			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.43	0.03	0.38	0.14	0.79	0.01	0.14	0.03	0.68	0.04	0.25	0.03
II	0.11	0.51	0.35	0.07	0.38	0.37	0.21	0.04	0.28	0.24	0.38	0.12
III	0.02	0.02	0.38	0.58	0.12	0.07	0.51	0.29	0.1	0.13	0.55	0.22
IV	0.18	0.01	0.11	0.72	0.53	0.01	0.12	0.33	0.48	0.03	0.25	0.25
V	0.01	0.01	0.02	0.97	0.04	0.01	0.11	0.86	0.04	0.02	0.19	0.75
							Organization of production					
	Customer-/product-focused line				Internal 0-buffer principle				Total cost of ownership			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.58	0.04	0.27	0.11	0.92	0.01	0.05	0.01	0.87	0.02	0.09	0.02
II	0.12	0.55	0.30	0.03	0.53	0.24	0.19	0.04	0.40	0.36	0.21	0.02
III	0.08	0.04	0.39	0.48	0.23	0.08	0.47	0.22	0.21	0.11	0.48	0.20
IV	0.22	0.01	0.13	0.62	0.79	0.00	0.08	0.13	0.70	0.01	0.11	0.18
V	0.02	0.00	0.06	0.92	0.09	0.01	0.11	0.81	0.05	0.01	0.12	0.85
							Standardization, knowledge management					
	Quality circles				Knowledge base systems				ISO9000 quality management			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.82	0.01	0.11	0.06	0.95	0.01	0.03	0.01	0.22	0.03	0.24	0.54
II	0.41	0.35	0.20	0.03	0.56	0.18	0.22	0.04	0.07	0.58	0.19	0.15
III	0.14	0.05	0.39	0.39	0.32	0.16	0.43	0.12	0.05	0.02	0.14	0.85
IV	0.69	0.01	0.05	0.25	0.87	0.07	0.06	0.07	0.06	0.04	0.03	0.86
V	0.09	0.01	0.04	0.87	0.15	0.03	0.17	0.69	0.02	0.01	0.01	0.91
							Working hours, payment schemes					
	Flexible working hours				Team perform incentives wage				Financial participation			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.72	0.03	0.19	0.04	0.45	0.07	0.39	0.09	0.86	0.03	0.07	0.05
II	0.48	0.26	0.21	0.05	0.13	0.39	0.43	0.06	0.71	0.11	0.11	0.07
III	0.28	0.12	0.41	0.21	0.05	0.05	0.53	0.37	0.57	0.14	0.22	0.07
IV	0.57	0.02	0.11	0.29	0.14	0.02	0.18	0.66	0.77	0.01	0.08	0.14
V	0.12	0.04	0.13	0.77	0.01	0.00	0.06	0.93	0.33	0.06	0.12	0.48
							Human resource management, leadership					
	Regular appraisal interviews				Personnel training program				Work at home			
	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)	Pr(N)	Pr(1)	Pr(2)	Pr(3)
I	0.56	0.09	0.26	0.09	0.25	0.09	0.53	0.13	0.95	0.03	0.02	0.02
II	0.17	0.47	0.29	0.06	0.09	0.47	0.39	0.05	0.81	0.08	0.03	0.11
III	0.04	0.08	0.53	0.34	0.02	0.04	0.43	0.51	0.62	0.22	0.11	0.02
IV	0.22	0.01	0.23	0.61	0.08	0.01	0.13	0.79	0.88	0.04	0.03	0.08
V	0.02	0.01	0.12	0.92	0.02	0.01	0.03	0.95	0.39	0.12	0.11	0.41
N	2546											
AIC	65,322.75											
BIC	67,098.80											
Estimated class population shares					0.28	0.18	0.23	0.19	0.12			

Notes: The numbers shown in this table represent the probabilities with which firms choose the corresponding category. “N” stands for missing values; “1”, “2”, and “3” correspond to the extent of respectively using organizational concepts from a lower to a high level.

References

Akgün, A. E., Keskin, H., & Byrne, J. (2012). Antecedents and contingent effects of organizational adaptive capability on firm product innovativeness. *Journal of Product Innovation Management, 29*, 171–189.

Alegre, J., & Chiva, R. (2008). Assessing the impact of organizational learning capability on product innovation performance: An empirical test. *Technovation, 28*(6), 315–326.

Alves, M. F. R., Galina, S. V. R., & Dobelin, S. (2018). Literature on organizational innovation: Past and future. *Innovation & Management Review, 15*(1), 2–19.

Armbruster, H., Bikfalvi, A., Kinkel, S., & Lay, G. (2008). Organizational innovation: the challenge of measuring non-technical innovation in large-scale surveys. *Technovation, 28*(10), 644–657.

Arvanitis, S., & Seliger, F. (2014). Imitation versus innovation: What makes the difference? *Kof working papers no. 14-367.*. ETH Zurich: KOF Swiss Economic Institute.

Ballot, G., Fakhfakh, F., Galia, F., & Salter, A. (2015). The fateful triangle: Complementarities in performance between product, process and organizational innovation in France and the UK. *Research Policy, 44*(1), 217–232.

Bas, C. L., Mothe, C., & Nguyen-Thi, T. U. (2015). The differentiated impacts of organizational innovation practices on technological innovation persistence. *European Journal of Innovation Management, 18*(1), 110–127.

Birkinshaw, J., Hamel, G., & Mol, M. J. (2008). Management innovation. *Academy of Management Review, 33*(4), 825–845.

Calantone, R. J., Harmancioglu, N., & Droge, C. (2010). Inconclusive innovation “returns”: A meta-analysis of research on innovation in new product development. *Journal of Product Innovation Management, 27*(7), 1065–1081.

Camisón, C., & Villar-López, A. (2014). Organizational innovation as an enabler of technological innovation capabilities and firm performance. *Journal of Business Research, 67*(1), 2891–2902.

Cappelli, R., Czarnitzki, D., & Kraft, K. (2014). Sources of spillovers for imitation and

innovation. *Research Policy, 43*(1), 115–120.
Černe, M., Kaše, R., & Škerlavaj, M. (2016). Non-technological innovation research: Evaluating the intellectual structure and prospects of an emerging field. *Scandinavian Journal of Management, 32*(2), 69–85.
Cohen, M. D., & Bacdayan, P. (1994). Organizational routines are stored as procedural memory: Evidence from a laboratory study. *Organization Science, 5*(4), 554–568.
Cosh, A., Fu, X., & Hughes, A. (2012). Organisation structure and innovation performance in different environments. *Small Business Economics, 39*(2), 301–317.
Cozzarin, B. P. (2017). Impact of organizational innovation on product and process innovation. *Economics of Innovation and New Technology, 26*(5), 405–417.
Crossan, M. M., & Apaydin, M. (2010). A multi dimensional framework of organizational innovation: A systematic review of the literature. *Journal of Management Studies,* 11541191.
Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *The Academy of Management Journal, 34*(3), 555–590.
Damanpour, F. (2017). Oxford Research Encyclopedia of Business and Management. *chap. Organizational innovation.*. Oxford University Press.
Damanpour, F., & Aravind, D. (2012). Managerial innovation: Conceptions, processes, and antecedents. *Management and Organization Review, 8*(2), 423–454.
Deb, P., & Trivedi, P. K. (2006a). Maximum simulated likelihood estimation of a negative binomial regression model with multinomial endogenous treatment. *Stata Journal, 6*(2), 246–255.
Deb, P., & Trivedi, P. K. (2006b). Specification and simulated likelihood estimation of a non-normal treatment-outcome model with selection: Application to health care utilization. *Econometrics Journal, 9*(2), 307–331.
Ettlie, J. E., & Rubenstein, A. H. (1987). Firm size and product innovation. *Journal of Product Innovation Management, 4*(2), 89–108.
Fagerberg, J., & Godinho, M. (2006). The Oxford Handbook of Innovation. In J. Fagerberg, & D. C. Mowery (Eds.). *chap. Innovation and catching-up.*. Oxford University Press.
Forés, B., & Camisón, C. (2016). Does incremental and radical innovation performance depend on different types of knowledge accumulation capabilities and organizational size? *Journal of Business Research, 69*(2), 831–848.
Fritsch, M., & Meschede, M. (2001). Product innovation, process innovation, and size. *Review of Industrial Organization, 19*(3), 335–350.
Gallego, J., Rubalcaba, L., & Hipp, C. (2013). Organizational innovation in small European firms: A multidimensional approach. *International Small Business Journal, 31*(5), 563–579.
Glynn, M. A. (1996). Innovative genius: A framework for relating individual and organizational intelligences to innovation. *The Academy of Management Review, 21*(4), 1081–1111.
Glynn, M. A., Kazanjian, R., & Drazin, R. (2010). Fostering innovation in complex product development settings: The role of team member identity and interteam interdependence. *Journal of Product Innovation Management, 27*(7), 1082–1095.
Herrmann, A. M., & Peine, A. (2011). When 'national innovation system' meet 'varieties of capitalism' arguments on labour qualifications: On the skill types and scientific knowledge needed for radical and incremental product innovations. *Research Policy, 40*(5), 687–701.
Hervas-Oliver, J.-L., & Sempere-Ripoll, F. (2015). Disentangling the influence of technological process and product innovations. *Journal of Business Research, 68*(1), 109–118.
Hervas-Oliver, J.-L., Sempere-Ripoll, F., & Boronat-Moll, C. (2014). Process innovation strategy in SMEs, organizational innovation and performance: A misleading debate? *Small Business Economics, 43*(4), 873–886.
Jenkins, M. (2014). Innovate or imitate? The role of collective beliefs in competences in competing firms. *Long Range Planning, 47*(4), 173–185.
Kimberly, J. R., & Evanisko, M. J. (1981). Organizational innovation: the influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations. *The Academy of Management Journal, 24*(4), 689–713.
Kogut, B., & Zander, U. (1993). Knowledge of the firm and the evolutionary theory of the multinational corporation. *Journal of International Business Studies, 24*(4), 625–645.
Lam, A. (2006). The oxford handbook of innovation. In J. Fagerberg, & D. C. Mowery (Eds.). *chap. Organizational innovation.*. Oxford University Press.
Linda M.~Collins, S. T. L.. (2010). *Latent class and latent transition analysis: With applications in the social, behavioral, and health sciences*. John Wiley and Sons Publication.
Lukas, B. A., & Ferrell, O. C. (2000). The effect of market orientation on product innovation. *Journal of the Academy of Marketing Science, 28*(2), 239.
Luo, Y., Sun, J., & Wang, S. L. (2011). Emerging economy copycats: Capability, environment, and strategy. *The Academy of Management Perspectives, 25*(2), 37–56.
Mariano, S., & Casey, A. (2015). Is organizational innovation always a good thing? *Management Learning, 46*(5), 530–545.
McFadden, D., & Train, K. (2000). Mixed MNL models for discrete response. *Journal of Applied Econometrics, 15*(5), 447–470.
Michael, S. C., & Palandjian, T. P. (2004). Organizational learning and new product introductions. *Journal of Product Innovation Management, 21*(4), 268–276.
Michael L.~Tushman, R. R. N.. (1990). Introduction: Technology, organizations, and innovation. *Administrative Science Quarterly, 35*(1), 1–8.
Min, W. Z., Ling, K. C., & Piew, T. H. (2016). The effects of technological innovation, organizational innovation and absorptive capacity on product innovation: A structural equation modeling approach. *Asian Social Science, 12*(1), 199–222.
Naranjo-Valencia, J. C., JiménezJiménez, D., & SanzValle, R. (2011). Innovation or imitation? The role of organizational culture. *Management Decision, 49*(1), 55–72.
Nelson, R. R., & Winter, S. G. (1982). *An Evolutionary Approach to Economic Change*. Belknap Press.
OECD. (2005). The measurement of scientific and technological activities–Oslo Manu Guidelines for collecting and interpreting innovation data (3rd ed.) [Computer software manual].
Olsson, A., Blomé, M., Kaulio, M., Guve, B. Norell~Bergendahl, M.& Odenrick, P. . (2009). Organizational factors affecting product innovation capability: Findings from the med-tech industry. *Conference Proceedings ICED 2009.*.
Pekovic, S., & Galia, F. (2009). From quality to innovation: Evidence from two French employer surveys. *Technovation, 29*(12), 829–842.
Pentland, B. T., & Hærem, T. (2015). Organizational routines as patterns of action: Implications for organizational behavior. *Annual Review of Organizational Psychology and Organizational Behavior, 2*(1), 465–487.
Prajogo, D. I., & Hong, S. W. (2008). The effect of TQM on performance in R&D environments: A perspective from South Korean firms. *Technovation, 28*(12), 855–863.
Prajogo, D. I., & Sohal, A. S. (2006). The relationship between organization strategy, total quality management (TQM), and organization performance–the mediating role of TQM. *European Journal of Operational Research, 168*(1), 35–50.
Robinson, W. T., Fornell, C., & Sullivan, M. (1992). Are market pioneers intrinsically stronger than later entrants? *Strategic Management Journal, 13*(8), 609–624.
Sapprasert, K., & Clausen, T. H. (2012). Organizational innovation and its effects. *Industrial and Corporate Change, 21*(5), 1283–1305.
Schumpeter, J. A. (1934). *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*. Harvard University Press.
Song, M., & Chen, Y. (2014). Organizational attributes, market growth, and product innovation. *Journal of Product Innovation Management, 31*(6), 1312–1329.
Teece, D. J. (2008). Firm organization, industrial structure, and technological innovation. *The Transfer And Licensing Of Know-How And Intellectual Property Understanding the Multinational Enterprise in the Modern World* (pp. 265–296). World Scientific Publishing.
Uzkurt, C., Kumar, R., & Ensari, N. (2013). Assessing organizational readiness for innovation: An exploratory study on organizational characteristics of innovativeness. *International Journal of Innovation and Technology Management, 10*(04), 1–26.
Walker, R. M., Chen, J., & Aravind, D. (2015). Management innovation and firm performance: An integration of research findings. *European Management Journal, 33*(5), 407–422.
Wang, F. (2014). Complementarities between R&D investment and exporting–Evidence from China. *China Economic Review, 31*, 217–227.
Westney, E. (1987). *Imitation and Innovation: The Transfer of Western Organizational Patterns to Meiji Japan*. Cambridge, Massachusetts: Harvard University Press.
Wolfe, R. A. (1994). Organizational innovation: Review, critique, and suggested research directions. *Journal of Management Studies, 31*(3), 405–431.
Zander, U., & Kogut, B. (1995). Knowledge and the speed of the transfer and imitation of organizational capabilities: An empirical test. *Organization Science, 6*(1), 76–92.
Zhou, K. Z., & Wu, F. (2010). Technological capability, strategic flexibility, and product innovation. *Strategic Management Journal, 31*(5), 547–561.

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