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A Dynamic View of the Relationship between Software Development Outsourcing Propensity and Industry Environment

Completed Research Paper

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Abstract

Despite the progress scholars have made on the relationship between IT outsourcing (ITO) and industry environment, our knowledge of this link is still ambiguous and limited. Drawing on recent research on the evolvement of ITO market, we extend our understanding by taking a dynamic view of this issue. Specifically, we focus on software development outsourcing (SDO) and three key elements of industry environment, namely resource munificence, industry concentration and technology change. We argue that the evolvement of ITO market has a moderating effect on the relationship between SDO propensity and industry environment. Using industry-level data for U.S. private industries from 1998 to 2015, we find that industry environment's impact on SDO propensity does change with the evolvement of the ITO market. Our findings provide insights on the relationship between SDO propensity and industry environment and indicate the importance of a dynamic view for understanding ITO-related phenomena.

Keywords: ITO market, market evolvement, software development outsourcing, industry environment, resource munificence, industry concentration, technology change

Introduction

Over the last two decades, IT outsourcing (ITO) has received an increasing popularity among different industries. As a result, the ITO market continues to grow and have evolved into a well-established industry (Pflügler et al. 2015). In the academic field, ITO also attracts massive attention. Scholars have examined multiple factors that could influence firms' ITO intention. Among them, one stream of research took a relative macro-level view of the phenomenon and focused on the impact of industry environment on firms' ITO propensity. However, results are found to be inconsistent or ambiguous and our knowledge of this relationship still remains limited. For example, scholars have drawn inconsistent conclusions about the influence of environment uncertainty (Aubert et al. 2012; Dibbern and Heinzl 2009; Watjatrakul 2005; Willcocks et al. 2006). In other cases, industry differences among the clients were found to be insignificant in influencing firms' ITO intention (Alvarez-Suescun 2010). Thus, the industry environment effects still demand further insights from IS scholars (Lacity et al. 2016).

Recent research on the evolvement and maturity of ITO market could shed light on this relationship (Bapna et al. 2013; Manning 2013; Pflügler et al. 2015; Schermann et al. 2016). Since the early 1990s, the ITO market has been in the process of getting more developed and mature. Associated with the evolvement of ITO market is firms' increasing familiarity with ITO and the changing public opinion about ITO. Those all indicate that certain characteristics of ITO are in flux and a dynamic view is more appropriate for analyzing related ITO questions. However, previous studies on the influence of industry environment all took a static view of the ITO phenomenon. Many studies explicitly or implicitly make the assumption that ITO retains certain innate features such as low cost or flexibility, which to some extent contradicts the research findings of the evolvement of ITO market. We thus think the evolvement of the ITO market could be conducive to explaining some previous puzzles and further our insights about the relationship between industry environment and firms' propensity to utilize ITO. In other words, we think the evolvement of the ITO market could moderate the relationship between industry environment and firms' outsourcing propensity.

In this paper, we focus on the software development outsourcing (SDO) context and explore how firms' reaction towards their industry environment changes over time as the ITO market evolves from ferment to maturity. We focus on three key elements of the industry environment, namely resource munificence, industry concentration and technology change. Our analysis indicates that the evolvement of the ITO market does moderate the relationship between SDO propensity and industry environment. Specifically, as the SDO market evolving towards maturity, 1) the propensity to leverage external resources to develop software will be less sensitive towards resource munificence; 2) industry concentration will be more prominent in promoting the adoption of SDO in recent years; 3) technology change in an industry will change from obstruction to facilitation for SDO. These results suggest that it is more appropriate for scholars to take a dynamic rather than static view of the SDO phenomenon.

In the following section, we introduce the background information of our study and develop the research hypotheses. Then we describe the method, data and present the results of our analysis. Finally, we provide a brief concluding remark.

Background

Industry Environment and IT outsourcing

Industry environment, such as the competition level or the technology change rate of one industry, refers to factors outside a firm of which the firm has little control (Lacity et al. 2016). It plays a salient role in determining firms' digital business strategy and has important implications for understanding IT-related phenomenon (Chiasson and Davidson 2005; Mithas et al. 2013). In the ITO context, drawing on theories like transaction cost economics (TCE) or industrial organization, IS scholars have made progress on studying the relationship between the industry environment and firms' propensity to outsource (Lacity et al. 2016; Lee et al. 2004; Qu et al. 2011). However, inconsistent and ambiguous results are found and our knowledge of this relationship is still limited. For example, some scholars found environmental uncertainty to be conducive for firms' ITO propensity due to the easy scalability of outsourcing and avoidance of excess assets (Aubert et al. 2012; Willcocks et al. 2006). While the others found that environmental uncertainty would restrain the use of ITO since high transaction cost would deteriorate the flexibility of ITO (Dibbern and Heinzl 2009; Watjatrakul 2005). In other cases, scholars found that industry differences among the clients were insignificant in influencing firms' ITO intention (Alvarez-Suescun 2010; Sobol and Apte 1995). Our knowledge of this link is still ambiguous and limited. Thus, Lacity et al. (2016) argued that industry effects still remain unclear and called for more study on the link between the industry effects and ITO.

It is worth noting that previous studies have treated the ITO as a relatively static phenomenon when studying the relationship between firms' ITO propensity and industry environment. This static view sometimes overlooks the boundaries of the applied theoretical frameworks (Schermann et al. 2016). Many analyses are built on the assumption that ITO retains certain innate features such as low cost or flexibility. However, those claimed features of ITO are not always prominent and depend partly on the actual condition of the market, especially for complicated IT activities like software development. In

fact, the ITO market and the associated clients' attitudes towards ITO are under salient evolvement for the past decades. Thus, a dynamic view and longitudinal study would be conducive to understanding the relationship between industry environment and firms' propensity to outsource.

The Evolvement of ITO market

Though still young compared with the traditional computer industry, ITO market has been in the process of getting more developed and mature since the 1990s (Bhatnagar and Madon 1997; Manning 2013; Pflügler et al. 2015). As ITO service becomes more standardized, modularized and decoupled from specific uses, the ITO industry is characterized by an increasing level of commoditization (Manning 2013). The establishment of market discipline and the increasing consolidation of the market greatly increase the market transparency (Grimshaw and Miozzo 2006; Manning 2013). Meanwhile, the information asymmetry between clients and vendors has decreased due to the increased market transparency (Reimann et al. 2010) and clients' increased familiarity with ITO (Lacity et al. 2010). As a result, clients' dependence on a specific vendor and their concerns for the vendors' opportunistic behavior gradually decline (Pflügler et al. 2015). When considering ITO, firms are less bothered by the transaction cost and related risks such as lock-in or contractual amendments, making the flexibility of outsourcing more prominent. Consequently, ITO has been becoming an increasingly recognized and established practice for many industries.

The development of the market and the clients' evolving attitude towards ITO offer scholars a new lens to reexamine some previous inconsistent findings. For example, in the context of ITO, transaction cost economics (TCE) predicts that task uncertainty would favor the use of time-and-material contracts than the use of fixed-price contracts. However, empirical findings are inconsistent for this relationship (Alagheband et al. 2011; Lacity et al. 2011). Incorporating the temporal effects into their meta-analysis, Schermann et al. (2016) found that the evolvement of the ITO market moderated the relationship between task uncertainty and contract type, indicating that the evolvement of ITO market remained an important explanation for the previous inconsistency. The authors suggested scholars to take the evolving nature ITO market into consideration and to examine the boundaries of their applied theoretical framework. In this study, we will delve into the changes brought by the evolvement of ITO market and take this dynamic view to analyze another ITO issue.

Software Development Outsourcing (SDO)

ITO ranges from simple data entry to complex system development and design (Apte et al. 1997). Different types of ITO investment retain different sensitivity towards the industry environment since they reflect various demands of clients and keep distinctive characteristics. Thus it is necessary to take the specific nature of each type of ITO into consideration and study them separately. In this research, we focus on the SDO context. Software development projects typically require close collaboration between the demand side and the developers. Whether keeping those projects in-house or not, firms usually have to contribute large amounts of resources to those projects (Richmond et al. 1992) and face certain kinds of risks or uncertainty (Chen et al. 2017; Ropponen and Lyytinen 2000).

Initially, SDO emerged as an alternative to the internal software development. However, there are salient distinctions between the control of SDO and the control of internal IT projects. When it comes to outsourcing, risks common to software development could be more prominent in SDO (Gefen et al. 2008). And different from other ITO that is dominantly driven by cost consideration and is akin to a utility (Teng et al. 1995), SDO reflects more strategic consideration and is beyond the pure concern of cost. The performance of software development is also hard to evaluate compared with other computing facilities (Dibbern et al. 2004). Thus SDO is found to be more complicated than the outsourcing of fundamental functions like data storage or hardware management. As a result, firms typically bore more preference towards outsourcing fundamental and stable IT activities than outsourcing relative critical activities like software development (Lacity and Willcocks 1998). Empirical evidence also proved that the output of the SDO industry witnessed lower stability than that of the hardware management industry (Dos Santos et al. 2012).

In the next part, we will focus on SDO and analyze the moderating role of the evolvement of ITO market in detail.

Hypotheses Development

In this study, we focus on three key elements of the industry environment: resource munificence, industry concentration, technology change. These elements depict three important dimensions of the industry environment and have been extensively studied by previous scholars (Derfus et al. 2008; Mithas et al. 2013; Qu et al. 2011). As we will discuss below, they reflect three dimensions of firms' consideration concerning software development. And the evolvement of ITO market is directly related with those dimensions of consideration.

SDO propensity is defined as the propensity to utilize outsourcing rather than in-house method to fulfill the software development demands. We don't make hypotheses about the main effects of industry environment since their direct impact is changing with the evolvement of ITO market and we are more interested in testing the moderating effects.

Resource Munificence

Resource munificence measures the availability of resources and indicates the chance of growth or the economic condition in one industry (Randolph and Dess 1984). It is an important reference when firms are making their IT investment decisions. However, the demands for different IT products or services are affected diversely by it. Specifically, investments whose usability and value have been established are less sensitive towards the economic condition than investments exploring new potential opportunities (Dos Santos et al. 2012). In the ITO context, Dos Santos et al. (2012) discovered that among various categories of ITO, services for managing computing facilities (MCF) have become current business necessities which were less sensitive towards changes in economic conditions. Those services consist of relative fundamental ITO such as the computer facilities management and data hosting. By contrast, demand for the software development service demonstrated relatively higher sensitivity towards changes in economic conditions, implying that SDO still retained the feature of discretionary investment opportunities for the client firms.

The initial immaturity of the ITO market incurred relative high transaction cost and risks for SDO practice (DiMaggio and Powell 1983), making SDO more akin to an explorative investment. In the first place, firms had to make efforts to search for the appropriate vendor from a chaotic market (Levina and Ross 2003). Also, it is necessary for the clients to devote much to developing complicated contracts to restrain vendors' opportunistic behavior and to guarantee the quality and efficiency of the project (Osei-Bryson and Ngwenyama 2006; Schermann et al. 2016; Susarla 2012). Even though, cases are not rare that budget overrun and renegotiation occurred or SDO projects failed in the end (Benaroch et al. 2006; Veltri et al. 2008; Verner and Abdullah 2012), which are deteriorated by firms' the inexperience with SDO. In other words, this immaturity of ITO market exerted a barrier for firms to overcome before SDO become a rewarding and applicable practice for them. Thus, firms pursuing outsourcing needed the ability to overcome this barrier and bear the relatively high failure rate of SDO projects. SDO was more akin to an explorative behavior. In this scenario, relative good economic conditions bestow firms the ability to leverage the superior outside experts and to bear the related risks and cost (Dibbern et al. 2004). Consequently, industries with relative munificent resources and growing opportunities would witness higher propensity of utilizing this administrative innovation.

However, as the ITO market evolves towards maturity and SDO gets more popular, the explorative nature of SDO will decrease and SDO will retain more characteristics of a recognized practice rather than an administrative innovation (Dos Santos et al. 2012). The ITO market is evolving in favor of the customer (Lacity and Willcocks 1998). On the one hand, market transparency has increased which significantly reduces the information asymmetry between the clients and vendors (Reimann et al. 2010). And with the increased penetration of quality certifications like the capability maturity model (CMM) certification, it is easier for clients to acquire information of a vendor's ability and to find an appropriate partner (Gao et al. 2010). On the other, the standardization and modularization of the SDO

service get increased, which reduces the clients' dependence on a specific vendor and their efforts to monitor vendors' behavior (Pflügler et al. 2015; Schermann et al. 2016). What's more, the increasing experience with SDO in one industry helps reduce uncertainty (Gefen et al. 2008). Thus, the initial barrier to SDO has significantly reduced. Firms are less bothered by the initial transaction cost and related risks, making SDO a more applicable practice for them. Accordingly, SDO decisions are made more from perspectives other than exploring it as an administrative innovation. It has become more stable for firms who adopt it and is viewed by more firms as a standard practice (Deloitte 2012). Consequently, SDO propensity will be less sensitive towards the industry's resource munificence or economic conditions.

Thus, we make the following hypothesis:

Hypothesis 1. The evolvement of SDO market negatively moderates the relationship between resource munificence and SDO propensity.

Industry Concentration

Industry concentration, typically proxied by the Herfindahl-Hirschman index, measures the extent to which the industry is concentrated and is negatively related with the industry competitiveness. Scholars have found that confronted with normative signals in one industry, firms under high industry concentration tend converge to the established norm while firms under low industry concentration tend to diverge from it (Mithas et al. 2013). Since dominant companies typically share greater interdependence and tacit coordination (Scherer and Ross 1990), concentrated industries are characterized by a higher level of mutual awareness. This higher level of mutual awareness escalates the likelihood of firm actions being noticed and copied by their competitors (Bain 1951). Any behavior that breaks the tacit collusion and diverge from the established norm will get punished severely (Derfus et al. 2008). Thus, the power and visibility of the established norms would be more prominent for industry with higher concentration (Mithas et al. 2013). By contrast, lower industry concentration corroborates the feasibility of escaping from the pressure of the established norm and diverging from it.

Scholars has treated the outsourcing practice in one industry as an institutional force or established norm and studied the outsourcing phenomenon through the sociologic lens (Balakrishnan et al. 2010; Blaskovich and Mintchik 2011). For example, Balakrishnan et al. (2011) found that weak CIO skills may increase accountants' likelihood to suggest mimicing industry peers' outsourcing actions. However, the legitimacy of SDO as an established norm was faint when the market was still immature and managers were still skeptical about this administrative innovation. On the contrary, SDO would initially be viewed more as divergence from the traditional in-house method of development. SDO was introduced as an administrative innovation (Loh and Venkatraman 1992) with its usability not being fully recognized. The fact that firms' financial motives may not be satisfied and associated risks greatly reduced the power of SDO as an established norm. What's more, it was hard for firms to benchmark their SDO practice since the SDO practices were quite diverse among the practitioners and there were debates about the best practice (Grimshaw and Miozzo 2006; Lacity and Willcocks 1998). As a result, in the early phase, those who would pursue this administrative innovation and diverge from the in-house norm would be firms in industries of less concentration.

As time goes on, the evolvement of ITO market corroborates the legitimacy of SDO as an established norm, leading to higher SDO propensity in concentrated industries. On the one hand, the decreasing transaction cost and risks make SDO practice more applicable to the clients. The increasing SDO experience in one industry also contributes to the success SDO projects (Lacity and Willcocks 1998). SDO is less viewed as a backup option to the internal development. On the other, this development leads to the consolidation of the market (Manning 2013) and the establishment of market discipline like the external benchmarking price or the practice of multi-sourcing (Bapna et al. 2013; Grimshaw and Miozzo 2006). SDO service and industry peers' SDO practice thus get more standardized and transparent, which significantly reduces the variations among different firms' SDO practices and makes it easier for firms to benchmark their SDO (Grimshaw and Miozzo 2006). As a result, signals from industry peers' SDO decision are getting clearer and more influential and SOD is in the process

of becoming an established and recognized practice. Thus, as the ITO market evolves towards maturity, the adoption of SDO would be more viewed as a convergence towards the industry norm, leading to higher SDO propensity in concentrated industries.

Thus, we make the following hypothesis:

Hypothesis 2. The evolution of SDO market positively moderates the relationship between industry concentration and SDO propensity.

Technology Change

Technology change in an industry could quickly transform the product markets and break the previous equilibrium of one industry (Sahaym et al. 2007; Schilling and Steensma 2001). It is a primary source of environment uncertainty regarding the future clients' demand or technology trajectories (Anderson and Tushman 1990; Sahaym et al. 2007). When it comes to the deployment of resources under high rate of technology change, scholars have emphasized the importance flexibility (Schilling and Steensma 2001). In the IT context, IS scholars also attached great importance to the flexibility of IT since firms need to align IT with their strategic agility and to cope with the fluctuations of IT resources demands (Qu et al. 2011; Willcocks et al. 2006).

However, no consensus has been reached about whether SDO is a more flexible practice compared with internal software development. Some scholars found that the flexibility demand may drive firms to utilize outsourcing since outsourcing enable the easy scalability of IT resources and firms' avoidance of excess assets (Aubert et al. 2012; Qu et al. 2011; Willcocks et al. 2006). However, the others held the viewpoint that the associated transaction cost of outsourcing could significantly deteriorate the flexibility of outsourcing, especially when the environment was of high uncertainty (Dibbern and Heinzl 2009; Lacity et al. 2009; Watjatrakul 2005).

We think that this divergence happens due to two competing features of SDO. On the one hand, SDO inherently possesses the feature of scalability so that firms can agilely access related resources according to their own demands and avoid excess assets. On the other, transaction cost with regards to drafting and monitoring contracts does salient damage to the flexibility of SDO, especially when the environment is of high uncertainty (Leiblein and Miller 2003).

Thus the transaction cost of SDO would be important in understanding the flexibility of SDO. As we have mentioned before, one feature of the evolution of the ITO market is the establishment of market discipline and increased market transparency. It would be easier for the clients to find an appropriate outsourcing partner when needed. Also, the standardization and modularization of the SDO service greatly reduce the vendors' opportunistic behaviors. Clients' dependence on a specific vendor and their concerns for the vendors' opportunistic behavior gradually decline (Pflügler et al. 2015). Along with the increased industry SDO experience, these changes significantly save the efforts on drafting complicated contracts and monitoring vendors' behaviors. As a result, the previous obstruction gets reduced, making the flexibility of SDO more prominent. Thus, SDO becomes a more appropriate option when firms are facing great technology changes in their industry.

Thus, we make the following hypothesis:

Hypothesis 3. The evolution of SDO market positively moderates the relationship between industry uncertainty and SDO propensity.

Method

Data and variables

Since we are interested in a macro-level outsourcing phenomenon over a long time period, we collected information of three-digit NAICS private industries which covers the period from 1998 to 2015 (information about SDO from BEA is only available from 1998). Industry level data eliminates firm-specific variations and enables us to extract the impacts of industry environment on the general SDO propensity in this industry (Nachum and Zaheer2005). The data sources include the the U.S.

Bureau of Economic Analysis (BEA), the U.S. Bureau of Labor Statistics (BLS) and Compustat. BEA's Fixed Assets Tables contain detailed capital data, from which we acquired the IT information. We also utilized BEA's information about the gross output and value added of one industry. We referred to BLS to acquire information on technology change and labor data. From Compustat, we acquired the sales data to calculate the industry concentration and information about the SDO market. Our final sample thus includes information of 55 industries ranging from 1998 to 2015 (seven industries are removed due to the limitation of HHI information). All data is transformed into real values in 2009 U.S. dollars by using the chain-type quantity indices from BEA as deflators.

SDO propensity. When thinking of initiating a software development project, firms face an alternative between utilizing in-house resources and outsourcing. BEA distinguishes between these two types of software development practices and provides measures for two ultimate products: own-account software and custom software (Parker et al. 1999). Own-account software is composed of in-house spending for designing, programming and modifying software for the firm's own use. Custom software refers to software designed and tailored for the specific need of a business unit by external developers which are classified in the outsourcing industry NAICS 541511 (Han et al. 2011). We measure an industry's SDO propensity as the ratio of the industry's custom software stock to the sum of the custom software and own-account software stock. This measure could properly reflect the fluctuation of SDO propensity in one industry. In the extreme condition where all the software development projects are conducted by the internal IT department, this measure will equal zero. As firms gradually replace the in-house method with SDO, this measure will increase and approach one. It also controls the fluctuations in the total software development demands in one industry.

The evolvement of ITO market. Previous studies have used various measures for the evolvement of ITO market. Thus, in this study we use two different measures of the evolvement of ITO market to ensure the robustness of our analysis. In the first method, following Schermann et al. (2016) and Bapna et al. (2013), we treat the evolvement of ITO market as a continuous process and use the temporal variable to proxy the evolvement of the ITO market (Bapna et al. 2013). We use *Year* from 1998 to proxy the evolvement of the ITO market by setting the year 1998 the baseline year 0 (we also use a dummy to indicate the early and late phase of our sample, the result is similar to our continuous measure). Though no consensus has been reached about the market for SDO, scholars typically found the year 2001 or 2006 as the time when ITO market has entered into a relative mature stage (Pflügler et al. 2015; Stadtmann and Kreutter 2009). The fact the SDO industry demonstrated higher volatility also indicates that the maturity of the market for SDO lags other fundamental ITO industries. Thus our time period covers the time during which the market for SDO has underwent significant evolvement. For the second measure, we utilize the measure of one industry's maturity from (Suarez et al. 2013). Since 1998, the number of active firms in the computer systems design and related services industry (NAICS 5415) has been declining (except for a slight increase in 2005), indicating the increasing maturity of the market. By using the reciprocal of the publicly traded firm numbers in the software system design and related service industry, we acquire an approximately monotonic proxy which increases after 1998 and name it *Inverse Firm Number*.

Resource munificence. We used the the industry gross output to calculate resource munificence. Following previous studies (Keats and Hitt 1988; Qu et al. 2011), we log-transform the industry gross output and then regress it against an index of year, over a period of five years. The antilog of the regression coefficient is used as the proxy for resource munificence. The intuition is that this proxy measures the growth rate of an industry's gross output and measure the plentifulness of an industry's resources (Anderson and Tushman 2001).

Industry concentration. As was done in previous research (Hou and Robinson 2006; Scherer and Ross 1990), Herfindahl-Hirschman Index (HHI) is used to measure industry concentration as follow: $HHI = \sum_{i=1}^N S_{ij}^2$, where S_{ij} refers to the market share of firm i in industry j . For some industries, the Compustat database only included a small number of firms. As the four-firm or eight-firm concentration ratios are the most commonly used in research, this study takes a conservative approach and only includes industries with at least four firms in the Compustat database (the analysis results are similar when we change this criterion to one or eight firms). Thus seven industries are removed in this process.

Technology change. Following Sahaym et al. (2007) and Schilling and Steensma (2001), we use the growth rate of total factor productivity (TFP) to measure technology change. TFP is also known as multifactor productivity (MFP) or Solow residual and measures the technology change rate at the industry level (Crafts 1996; Sahaym et al. 2007). We acquire the industry-level TFP data in BEA-BLS Integrated Industry-Level Production Account table. In this study, the average TFP growth rate of the previous five years is used to measure technology change.

Scholars have found IT intensity to be a salient factor in influencing the outsourcing propensity (Slaughter and Ang 1996). Thus we include the IT intensity as a control variable in the analysis. IT intensity is measured as the ratio of IT capital to labor (Han et al. 2011). Using data from BEA, we calculate IT capital as the stock of information processing equipment and software, and labor as the number of full-time equivalent employees. Another factor that should be taken into consideration is the capital intensity of one industry. Capital intensity of one industry also may influence the use of ITO (Qu et al. 2011). We measure it as an industry's fixed assets capital divided by gross output and add it as a control variable.

Analytical Procedure and Results

It is worth noting that we don't make hypotheses on the main effects of industry environment since their direct impact is changing with the evolvement of ITO market and we are more interested in testing the moderating effects. But we will discuss the direct effect on our split sample analysis to make our argument more comprehensible. To test the moderating effects of the evolvement of SDO market, we use the following model to test the hypotheses:

$$SDO = \beta_0 + \beta_1 Munificence + \beta_2 Concentration + \beta_3 TechChange + \beta_4 Evolve + \beta_5 Evolve \times Munificence + \beta_6 Evolve \times Concentration + \beta_7 Evolve \times TechChange + \beta_c X_c + \varepsilon$$

where *SDO* represents the SDO propensity, *Munificence* represents resources munificence, *Concentration* represents industry concentration, *TechChange* represents technology change. *Evolve* is the evolvement of ITO market, which is measured separately by year and inverse firm number. The vector β_c represents the coefficients for control variables and ε represents the error term. The moderating effects of the evolvement of ITO industry are captured by the coefficients of the interaction between the industry environment characteristics and the evolvement of ITO market. We mean-center the variables involved in the interaction terms. For the panel data, we adopt the fixed effect model to get rid of the unobserved fixed effects. Industry and year dummies are included for each regression. None of variance inflation factors (VIFs) of the independent variables exceed 5, indicating that severe multicollinearity problem doesn't exist (Cohen et al. 2013).

Table 1 illustrates the results of the analysis and coefficients for control variables and dummies are omitted to save space. Model 1 and 2 respectively present the moderating effects when the proxy for the evolvement of ITO market is year and inverse firm number. In both model, the coefficients of the interaction are significant and match the predicted direction. The coefficient of the *Evolve* × *Munificence* interaction is negative and significant (Model 1: $\beta = -0.0403$, $p < 0.01$; Model 2: $\beta = -234$, $p < 0.01$), suggesting that the impact of resources munificence on SDO propensity gets weaker as the market evolves towards maturity. Hypothesis 1 gets supported. The positive and significant coefficient of the *Evolve* × *Concentration* interaction (Model 1: $\beta = 0.0117$, $p < 0.01$; Model 2: $\beta = 55.3$, $p < 0.01$) suggests that the evolvement of ITO market positively moderates the relationship between industry concentration and SDO propensity. Hypothesis 2 gets supported. Finally, Hypothesis 3 also gets supported. The coefficient of the *Evolve* × *TechChange* interaction is positive and significant (Model 1: $\beta = 3.83e-04$, $p < 0.05$; Model 2: $\beta = 2.11$, $p < 0.01$). It suggests that the evolvement of the ITO market positively moderates the relationship between technology change and SDO propensity.

Table 1. Results of Hypothesis Testing

	Model 1	Model 2
Proxy for <i>Evolve</i>	<i>Year</i>	<i>Inverse Firm Number</i>
<i>Munificence</i>	0.211** (0.0536)	0.194** (0.0544)
<i>Concentration</i>	0.031 (0.0511)	6.66e-03 (0.0512)
<i>TechChange</i>	8.29e-05 (9.39e-04)	1.00e-03 (9.39e-04)
<i>Evolve</i>	5.03e-03** (4.12e-04)	2.94 (6.10)
<i>Evolve</i> × <i>Munificence</i> (β_5)	-0.0403** (9.53e-03)	-234** (53.2)
<i>Evolve</i> × <i>Concentration</i> (β_6)	0.0117** (4.26e-03)	55.3** (18.5)
<i>Evolve</i> × <i>TechChange</i> (β_7)	3.83e-04* (1.63e-04)	2.11** (0.800)

** $p < 0.01$; * $p < 0.05$; standard errors in parentheses

Table 2. Results of Split Sample Analysis

	Model 1	Model 2
	<i>Early Period</i>	<i>Late Period</i>
<i>Munificence</i>	0.314** (0.0677)	-0.0123 (0.0399)
<i>Concentration</i>	-0.255** (0.0696)	0.365** (0.050)
<i>TechChange</i>	-2.46e-04 (1.20e-03)	1.33e-03 (8.32e-04)

** $p < 0.01$; * $p < 0.05$; standard errors in parentheses

We also conduct a split sample analysis to increase the comprehensibility and robustness of our results. Year 2006 is used as the divide and regressions are run for the two periods before and after 2006. We choose year 2006 because on the one hand, some scholars referred to the year around 2006 as the time when ITO market entered into a relative mature stage (Pflügler et al. 2015; Stadtmann and Kreutter 2009). On the other, it evenly divides our data into two subsamples (we also use years round 2006 as the divide, the results are similar). We eliminate the interaction terms and study the main effects of industry environment. The intuition is that the analysis of the two periods reveals the impacts of industry environment under different level of market maturity. Table 2 illustrates the results. As the ITO market evolves towards maturity, the impact of resource munificence on SDO propensity has transformed from significantly positive to insignificant. It corroborates our argument that the propensity to leverage external resources to develop software will be less sensitive towards resource munificence. For industry concentration, its impact changes from significantly negative to significantly positive. It demonstrates the increasing legitimacy of SDO as an established practice and that SDO is less viewed as a divergence from original in-house norm. Though the coefficients for technology change are not significant at the 95% confidence level, the direct of the coefficients has changed and statistic test indicates that there is significant difference between these two coefficients.

It partly indicates the increasing of flexibility of SDO. Those results corroborate our argument about the main effects of industry environment and demonstrate the changes brought by the evolvement of ITO market.

Discussion and conclusion

Research has shown that industry environment has significant implications for understanding IT-related phenomenon. In the ITO context, scholars have also taken industry environment into their consideration and achieved certain progress. However, previous studies have all taken a static view of the phenomenon and their results are found to be inconsistent and ambiguous. Inspired by the recent study on the evolvement and maturity of ITO market (Pflügler et al. 2015; Schermann et al. 2016), we try to contribute to the previous puzzle of the effects of industry environment by taking a dynamic view of this phenomenon. We focus on the SDO context and involve the evolving nature of outsourcing into our analysis. More specifically, we analyze how firms' reaction towards their industry environment changes over time as the ITO market evolves from ferment to maturity and make hypotheses about this moderating role of the evolvement of ITO market.

We find that, first, the evolvement of ITO market negatively moderates the relationship between resource munificence and SDO propensity. As the ITO market evolves towards maturity, the initial barriers to SDO significantly reduce and SDO is becoming an increasingly accepted and recognized practice. Thus, the propensity to leverage external resources to develop software will be less sensitive towards resource munificence. Second, the evolvement of ITO market positively moderates the relationship between industry concentration and the propensity to outsource. The evolvement of ITO market makes SDO an increasingly established and recognized practice and the signals from industry peers' SDO decision clearer and more influential. As a result, industry concentration will be more prominent in promoting the adoption of SDO in recent years. Third, the evolvement of ITO market positively moderates the relationship between technology change and SDO propensity. As the ITO market evolves towards maturity, the inflexibility brought by the transaction cost will decrease, making SDO more applicable under rapid industry technology change. As a result, technology change in an industry will change from obstruction to facilitation for SDO.

This study focuses on three aspects of the industry environment that have been extensively studied in previous research. This model doesn't necessarily take all industry environment facets into consideration, such as regulations from governments. Future research could refer to our research to take a dynamic view to study other industry environment factors' impacts on firms' outsourcing propensity. What's more, ITO consists of a variety of activities issues besides SDO. Future study could utilize a dynamic view to study the industry differences of other ITO phenomenon such as the design of contract or multi- versus single-sourcing.

Our research furthers the knowledge about the relationship between industry environment and firms' propensity to utilize ITO. It offers scholars a new perspective to study questions concerning IS adoption. By reexamining the assumptions and boundaries of previous studies, we employ a dynamic view of this phenomenon to offer insights to some previous inconsistency and ambiguity. The ITO market is characterized by increasing level of commoditization and is in the process of becoming more mature. ITO has become a recognized and established management practice in many industries. As a result, certain characteristics of ITO are in flux, like the decreasing influence of transaction cost. This study echoes scholars' suggestion to reflect on ITO phenomenon beyond transaction cost economics (Lacity et al. 2011; Schermann et al. 2016) and indicates that it is necessary for scholars to adopt a dynamic rather than static view to analyze certain ITO questions.

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