Information Technology and Management (2019) 20:223–247
https://doi.org/10.1007/s10799-019-00310-3

The value of enterprise information systems under different corporate governance aspects

Xin Chen[1] · Qizhi Dai[2] · Chaohong Na[3]

Published online: 10 October 2019

Abstract
Enterprise information systems (EIS) improve access to information, process optimization and system integration. Such enhanced information processing capabilities have varying effects on firm financial performance under different corporate governance aspects. We examine such interacting effects with data of Chinese listed companies during 2008 and 2013. Our empirical study shows that EIS implementation is associated with higher financial performance when the firm's ownership is more concentrated or the CEO assumes a dual role as the chair of the board of directors. EIS implementation is associated with lower financial performance when the firm is a state-owned enterprise or within a business group. This study contributes to literature in IT business value in general and research in enterprise systems in particular by expanding our understandings about the varying impacts of EIS under different corporate governance aspects.

Keywords IT value · Business value of IT · Enterprise information systems · ERP · Corporate governance

1 Introduction

In IS literature, through decades of research and debates on IT value, researchers have noted that IT creates value under certain conditions [36] and that the prominent research question about IT business value has become "under what conditions does IT pay off" [18]. Enterprise information systems (EIS) are large-scale information systems that comprise integrated modules for various business functions, and the implementation of EIS often requires large amount of investments but the benefits are not guaranteed [57]. Researchers have found similar contingent value and looked into various context factors in studying the impacts of EIS on business performance. Based on organizational information processing theory, Gattiker and Goodhue [24] point out that enterprise resource planning (ERP) systems are more beneficial when there is a higher level of interdependence and commonality among business units. Schubert and Williams [53] take the theoretical lens of social-technical change to identify and understand the benefits of ERP systems. Their ERP expectations-benefits framework implies that the benefits of ERP systems are conditioned by the business design and management resources. Staehr et al. [57] develop a conceptual framework based on the structuration theory to study how firms can achieve benefits from ERP systems. Their framework identifies such organizational context factors as management expectations, financial conditions, business restructuring, ownership change, and acquisitions or divestments. Although there have been studies on the effects of context factors on IT value, there is still a need for further research on explaining how given context factors influence the benefits of IT investments [52].

One important yet rarely-studied context factor is corporate governance [41]. Corporate governance is the institutional structures and rules for controlling management and enterprise performance in order to protect and balance shareholders' interests. The execution of corporate governance relies on information collection and processing. EIS provide improved access to information, process optimization and

✉ Qizhi Dai
qd24@drexel.edu

Xin Chen
xchen3@saif.sjtu.edu.cn

Chaohong Na
nachaohong@gmail.com

[1] Shanghai Advanced Institute of Finance, Shanghai Jiao Tong University, Shanghai, China

[2] LeBow College of Business, Drexel University, Philadelphia, USA

[3] School of Economics, Yunnan University, Kunming, China

integration [54]. Such EIS capabilities have implications for corporate governance management. In practice, it is found that ERP systems can be used for supporting internal controls and meeting compliance requirements. For example, TMobile UK, after implementing the ERP system, was able to tighten the controls on invoice and payment processes as well as the controls on access to these functions in the ERP system, following the company's corporate governance management [37]. Some companies have utilized the documents and functions in ERP systems to meet the Sarbanes–Oxley compliance requirements [38].

In academic research, researchers have studied the influences of ERP systems on accounting activities. Kanellou and Spathis [34] argue that ERP implementation brings about benefits for accounting from "increased flexibility in information generation, increased integration of accounting applications, improved quality of reports, improved decision-making based on timely and reliable accounting information and reduction of time for closure of annual accounts" (p. 211). ERP systems are also found to facilitate auditing and regulatory compliance [47, 49]. IS research on how corporate governance affects the benefits and costs of IT investments has started to gain attention recently and is still at its early stage. Elhardan et al. [20] propose a conceptual framework to describe the intricate interactions between ERP systems and internal auditing function which executes many corporate governance activities. Lu and Huang [41] find that firms achieve higher ERP performance when the shareholders' controlling rights are stronger.

However, these studies do not fully consider the interactions between EIS and corporate governance or address the question of how such EIS capabilities will convert into business value under various corporate governance, even though they have brought to our attention the intertwined effects between corporate governance and IT systems. We recognize that many issues are to be further explored because corporate governance is multi-dimensional and enterprise information systems are complex. In Lu and Huang's [41] study, they use G-index to represent corporate governance in studying its influences on ERP value. However, G-index is a proxy for corporate governance, measuring the strength of shareholders' rights derived from anti-takeover provisions [26]. It reflects the aggregated effect of the implemented corporate governance. With this proxy, a total of twenty-four anti-takeover provisions are aggregated into one corporate governance index and other aspects of corporate governance are not considered. However, different corporate governance aspects resort to different approaches to ensure value for shareholders' investments, bringing about different challenges [55]. For example, while the board of directors can increase the monitoring over management, the board also requires additional communication and coordination to become effective and such coordination costs vary with the size and composition of the board. This prompts us to ask: Would these variances in corporate governance affect the outcomes of enterprise information systems?

Furthermore, the information processing capabilities of enterprise information systems can be utilized in various manners and thus affect businesses differently. Information systems including enterprise information systems can play an important role in affecting the agency costs and decision information costs that make up the costs for firms to monitor and coordinate internal behavior [30]. Such internal monitoring and coordination activities are key to aligning incentives of management with shareholders which is the task of corporate governance. But how would EIS' impacts on these costs interact with corporate governance? Would the capabilities of EIS be utilized in the same manner under different corporate governance to generate the same effects?

To answer the above research questions, we launch the inquiry into the interacting effects between EIS and corporate governance on the business value of EIS. In our study, we argue that, while enterprise information systems enable firms to collect and disseminate information more efficiently, the benefits firms can obtain from EIS vary with different corporate governance aspects. We carry out an empirical investigation of the impacts of EIS on firm financial performance under various corporate governance. Our sample includes firms that are traded on Chinese stock markets. For the past three decades, Chinese companies have been through the transition from command economy to market economy, confronted with the challenge of severe agency problems. Hence, Chinese publicly-traded companies have adopted a range of corporate governance practices. This provides a good opportunity for studying the influences of corporate governance on information systems benefits.

We organize this paper as follows. The second section reviews the relevant literature in enterprise information systems and corporate governance to provide the theoretical background. Section three proposes our research hypotheses. Section four describes the empirical data and data analysis results. Section five discusses the implications of our research, and section six summarizes this research as a conclusion.

2 Theoretical background

In this section, we review the prior relevant studies on enterprise information systems and corporate governance that provide the theoretical basis for our research.

Table 1 Summary of corporate governance aspects

Corporate governance	Main features
Corporate ownership	
Business group	Legally independent firms are linked by multiple ties and coordinate in action to achieve mutual objectives
Ownership distribution	Ownership can be distributed in the form of outside equity and debt while the managers many have no or a small share of the ownership
Separation of controlling shareholders' voting rights from cash flow rights	A controlling shareholder may own a minority of the cash flow rights but control a majority of the votes when cash flow rights and votes are separated due to corporate pyramids, dual-class stock or cross-holdings
State ownership	The government or its agencies control the firm
Board of directors	
Size	The total number of directors on the board
CEO-chair duality	The CEO is also the chairperson of the board of directors
Proportion of independent directors	The proportion of independent directors who do not assume any management position inside the company

2.1 Corporate governance

Shleifer and Vishny [55] define corporate governance as the way in which suppliers of finance assure themselves a return on their investments. The extant corporate governance research examines the ownership structures, shareholders, business groups, state ownership, privatization, board of directors, and executive compensation [7, 22, 33]. Next, we will briefly describe the major aspects and mechanisms of corporate governance.

In the corporate governance literature, business groups are studied as an important organizational form related to ownership structure for managing large businesses, especially outside of North America [62, 63]. Yiu and colleagues [62, p. 1553] define business groups as "a collection of legally independent firms that are linked by multiple ties, including ownership, economic means and/or social relations through which they coordinate to achieve mutual objectives." Another ownership structure is the government ownership of the business. Some businesses are owned or controlled by the government or government agencies, and are often referred to as state-owned enterprises (SOEs). State-owned enterprises are an important instrument for governments to provide public services or invest in strategic industries and technologies [15].

In addition to organizational forms for corporate ownership, the ownership distribution is another aspect of corporate governance. Firm ownership can be distributed in the form of outside equity and debt while the firm manager may have no or a small share of the ownership [33]. This separation of ownership and management gives rise to the agency costs that take place for the owners to bond with managers and monitor their performance. Moreover, when the ownership is dispersed, there may exist controlling shareholders who have the dominant voting rights. The existence of a controlling shareholder is common among publicly traded forms in most countries [23]. In some cases, a controlling shareholder may own a minority of the cash flow rights but control a majority of the votes when cash flow rights and votes are separated due to corporate pyramids, dual-class stock or cross-holdings [12]. Such a separation between the controlling shareholder's voting rights and cash flow rights affects how the wealth is distributed among the controlling shareholder and minority shareholders.

Board of directors provides one mechanism for shareholders to govern the management of a corporation, through advising, disciplining and crisis handling [42]. Researchers have studied the effects of the board of directors' size and composition on firm performance. More directors can provide more advice and recommendations that may benefit firm performance, but the costs for communications and coordination also increase with the size of the board [32].

With regard to board composition, corporate governance literature has studied two aspects. One is the board leadership. CEO, leading the management team, sometimes also assumes the position as the chair of the board of directors (hereafter, chair). The other board composition aspect is the proportion of independent directors who do not assume any management position inside the company [7]. The importance of independent directors has been growing as a means for better monitoring the management [27]. The above aspects of corporate governance are summarized in Table 1.

2.2 Organizational context factors on enterprise information systems outcomes

Enterprise information systems are computer systems that comprise integrated modules for various business functions such as manufacturing, supply chain management, human resource management, accounting and finance. These systems often consist of centralized or integrated real-time

databases that are accessible from different parts of the business, supporting the information flow along business processes across organizational units [16, 56]. Based on the technological features, the main organizational benefits of EIS are improved information accessibility, process optimization, system integration and on-going business improvement projects [54]. Despite these identified benefits and the large amount of investments, the eventual outcomes of EIS implementation regarding firm financial performance vary widely among organizations [57].

Researchers have developed conceptual frameworks and conducted empirical studies to investigate the factors that affect the consequences of enterprise information systems implementation in organizations. These factors include the system features, characteristics of the system implementation projects, implementation and post-implementation initiatives, environmental contexts, and organizational contexts [57]. Among these factors, organizational contexts have been gaining more attention as they are found to explain the differences in IT value in general and benefits of EIS in particular [36, 46, 52]. More specifically, Morton and Hu [46] argue that organizational structures influence the EIS benefits because the integration and standardization brought about by EIS do not fit well with all types of organizational structures. Empirical studies have also tested certain organizational context factors that contribute to the performance of EIS. For example, the interdependence and differentiation among business units are found to affect how much a firm can benefit from improved coordination supported by process integration from EIS [24]. Similarly, the degree of diversification among business divisions also affects the benefits of EIS [59].

Studies on accounting information systems have noted the implications of ERP systems to accounting activities that are relevant to corporate governance, but there is limited research in IS field on the interactions between enterprise information systems and corporate governance. The major benefits of ERP to accounting are increased flexibility in information generation, increased integration of accounting applications, improved quality of reports, improved decisions on better accounting information and reduced account closure time [34]. These benefits may enhance control over reporting processes and thus ensure regulatory compliance as what Mundy and Owen [47] report in a case study on a multi-national organization. EIS implementation is also found to improve the quality and efficiency of auditors' work [49]. In an empirical study, Lu and Huang [41] find that the financial effects of ERP investments vary with the strength of shareholders' rights. In this study, the strength of shareholders' rights is a proxy of corporate governance measured by the G-index composed by anti-takeover provisions [26]. Other studies look into the effects of EIS on business functions supporting corporate governance such as internal auditing and regulatory compliance. For example, Elhardan et al. [20] propose a conceptual framework for explaining the interactions between ERP systems and external governance pressures and their effects on internal auditing and financial reporting based on institutional theory.

To our understanding, the research on the interactions between corporate governance and information systems is still at an early stage. Next, we will take one step further to discuss how EIS affect agency costs, decision information costs and principal–principal conflicts that exist in corporate governance.

2.3 Enterprise information systems and corporate governance

The purpose of a firm is to create value for shareholders' investments, and corporate governance is implemented to ensure shareholders get the returns on their investments. To achieve this objective, firms incur internal coordination costs to align incentives and coordinate actions [30]. These internal coordination costs contain two parts: agency costs and decision information costs. And they are part of the costs for running the corporate governance. In addition, principal–principal conflicts exist in firms where there are discrepancies between different groups of shareholders, adding to the costs for corporate governance.

At the same time, enterprise information systems feature centralized databases and integrated modules for business functions, and drive business value through three factors: integrate, optimize and informate [17, 43]. These capabilities can be utilized to affect the internal coordination costs discussed in the above paragraph. Hence, EIS interact with corporate governance through effects on agency costs, decision information costs and principal–principal conflicts. This is depicted in Fig. 1 and discussed as follows.

Agency costs With the separation of operation from ownership of the firm, the shareholders or investors are principals who own the firm and the managers are agents acting on behalf of the principals in running the business. Due to self-interests and bounded rationality, principals and agents do not always share the same goals or information regarding the operations, decisions and performance of the business. Various corporate governance aspects are utilized to manage the principal-agent relationships by aligning the goals and sharing information between shareholders and managers. This is accomplished with efforts in information processing such as collecting data, tracking progress, analyzing outcomes, and coordinating activities. These efforts are referred to as agency costs that include the costs for managers to record and report their actions and the costs for shareholders to monitor managers' performance. Agency costs increase with the lack of information or information asymmetry regarding the agent's capabilities and actions.

With enterprise information systems, organizational data is collected and integrated in a central location [17]. Such

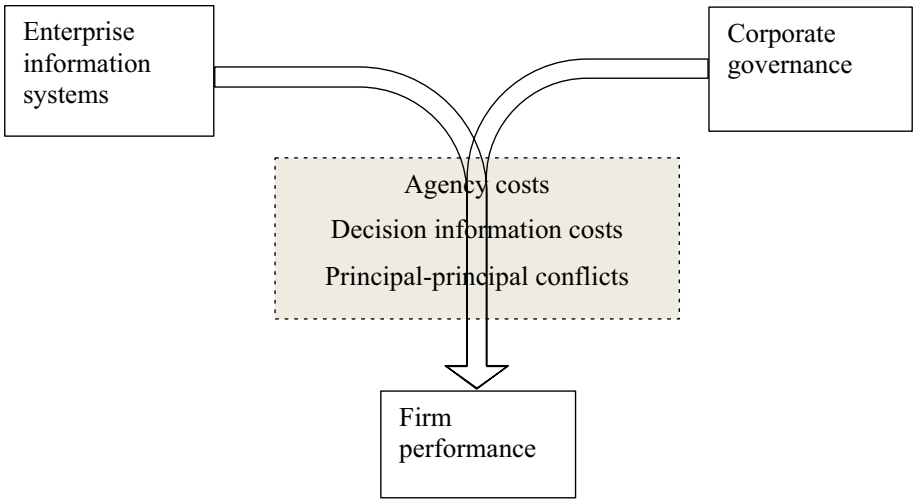

Fig. 1 Interactions between enterprise information systems and corporate governance

data integration is characterized by accessibility, timeliness, transparency and granularity of information [8]. According to Berente et al. [8], information accessibility and timeliness means that information is readily available for conducting activities, is current and is passed to the task without delay. Information transparency means that information passed from one task to another can be understood, and information granularity means that information is provided at the right level of detail.

With the above features of information integration, enterprise information systems enable real-time, enterprise-wide monitoring [60]. The detailed performance data can be collected real-time and made readily available for assessing conformity to enterprise goals. When information is used for this purpose, the implementation of EIS will reduce the efforts required for management to track, report and evaluate operational performance, which is a big part of the agency costs in the principal-agent relationship between shareholders and management [30]. Hence, EIS tend to reduce agency costs in the principal-agency relationships.

Decision information costs The improved information accessibility, timeliness, transparency and granularity with EIS also provide decision makers with readily access to timely and detailed information which lays the basis for reaching a quality decision [34]. Moreover, since the data is centralized and shared with enterprise information systems, participants in a decision-making task have access to the same shared data source. This can reduce the need for resolving discrepancies or disagreements that originate from individual decision makers using different data sources, so that it takes less time to obtain a shared understanding and to reach an agreement on the future course of actions. In this way, the decision information costs are reduced.

Such a capability of EIS in facilitating decision-making plays a role in corporate governance because corporate governance requires decision-making by shareholders and board directors. While such EIS capability can be applied to other decision-making tasks in business operations, we focus on the appropriation of this capability in corporate governance in this study.

In particular, shareholders, and the board of directors, the shareholders' surrogates, participate in decision making processes regarding business strategies and operations. They can provide inputs, make requests and cast votes on a range of issues such as strategic planning, executive appointment and compensation, mergers and acquisitions, and financing [7, 42]. The quality and value of their recommendations and decisions are conditioned on the amount and quality of the information they obtain [30]. To shareholders and board directors, just as any decision maker, the more timely and accurate information they have, the better decisions they can make. In addition, for the board of directors as a group to make decisions, it takes communication, coordination and maybe even negotiation to reach an agreement. Of course, this group decision-making process involves exchange, interpretation and analysis of the information among members. These information processing efforts by shareholders and board of directors comprise decision information costs in the corporate governance.

To sum up, on the one hand, enterprise information systems enhance information availability and quality, and reduce decision information costs. On the other hand, there are decision information costs in corporate governance when shareholders and board directors make decisions on strategies and operations. Hence, we expect to see the interaction effects between EIS and corporate governance on firm performance along this dimension.

Principal-principal conflicts In addition to the above internal coordination costs in managing the principal-agent relationships, there may exist principal–principal conflicts when there are groups of shareholders with different interests. For example, when a controlling shareholder who has a majority of

the votes owns only a minority of the firm's cash flow rights, the controlling shareholder has the incentive to expropriate the wealth of the minority shareholders, especially when the interests of the controlling shareholder differs from those of the minority shareholders [44]. The controlling shareholder can appoint family members or associates as managers in the firm. These affiliated managers are better aligned with the controlling shareholder than with the minority shareholders in terms of sharing goals, benefits and risks [63]. This congruence between the controlling shareholder and the management implies two advantages the controlling shareholder has over the minority shareholders, even though the minority shareholders also have improved access to information due to enhanced information availability provided by EIS. The first advantage is in accessing insider information when the controlling shareholder gets more timely and detailed operation and performance data through the management. The second advantage is in meeting the objectives in operation and resource allocation because management is more obliged and willing to satisfy demands or follow orders from the controlling shareholder.

The above two advantages are further amplified with the implementation of enterprise information systems. First, EIS enhance data availability and quality which adds more benefits to the controlling shareholder's information advantage over the minority shareholders. Second, EIS provide information and functions for streamlining coordination of business activities that support the integration across business processes and organizational functions, that in turn promotes tight coupling among these organizational units to constitute a unified whole [2, 54]. Furthermore, EIS implementation promotes the adoption of best practices or standardized processes across the organization, allowing organizations to pursue centralized behavioral control to achieve enterprise-wide goals [16, 17]. The integration and control reinforce each other through the successful implementation of EIS [9]. This makes it more effective in executing management decisions, and can be used by the controlling shareholder and affiliated managers to implement desired changes in operation and resource allocation.

In summary, the controlling shareholder has advantages over the minority shareholders in accessing operation and performance information, and in implementing desired changes in the firm because some managers are affiliated with the controlling shareholder and are aligned with the controlling shareholder. When enterprise information systems are implemented, the controlling shareholder can further expand these advantages through the actions of affiliated managers. Hence, in the presence of principal–principal conflicts between the controlling shareholder and the minority shareholders, EIS will exacerbate the conflicts in favor of the controlling shareholder.

Overall, the issues at the center of corporate governance include agency costs in aligning management with the shareholders, the principal–principal conflicts when the controlling shareholder's interests differ from those of the minority shareholders, and the decision information costs when shareholders and board of directors make decision on strategies and operations. When enterprise information systems are implemented, the information processing capabilities of the systems affect agency costs, principal–principal conflicts and decision information costs. Since these three factors vary among different corporate governance, the eventual effects of EIS at firm level vary as a result.

3 Research hypotheses

In this section, we examine how the EIS capabilities can be utilized under various corporate governance aspects, producing different outcomes. In a prior study, Lu and Huang [41] measure shareholders' rights as a proxy for corporate governance that are derived from anti-takeover provisions. However, we take a different approach to considering corporate governance and its interactions with EIS. We look into the various aspects of corporate governance structure directly, rather than their effects that are realized as the strength of shareholders' rights. We also study their interactions with EIS one by one, instead of bundling them into one factor. Moreover, our approach goes beyond the anti-takeover provisions, which is necessary when there is little or no variation in these provisions among firms.

On the one hand, corporate governance varies among firms in ownership structures and board compositions, which in turn brings about variances in agency costs, principal–principal conflicts, and associated decision information costs. On the other hand, EIS provide improved information accessibility and quality, system integration and process optimization that can affect agency costs, decision information costs and principal–principal-conflicts. Therefore, when firms implement EIS under different corporate governance aspects, the firm performance is affected differently. Next, we will discuss how this happens in detail.

3.1 Ownership structure

We next look at how four aspects of a firm's ownership structure may interact with EIS capabilities in affecting firm performance. These four aspects are the affiliation with a business group, ownership distribution, separation of the controlling shareholder's voting rights and cash flow rights, and state ownership.

3.1.1 Business group

In a business group, legally independent firms are controlled by a single common share holder or a parent company, and

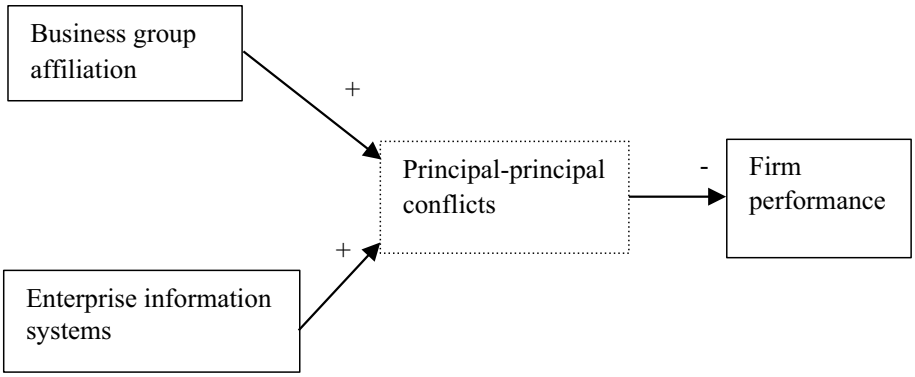

Fig. 2 Enterprise information systems and business group affiliation

they are also affiliated through other informal social and economic ties [62]. Under such an ownership structure, the parent company is the controlling shareholder of the individual firms in the group, with majority voting rights. The parent company coordinates the production and resource allocation among firms within the group for the group's objectives or its own private benefits [35]. However, the parent company's objectives do not necessarily align with those of individual group firms or its minority shareholders, which results in principal–principal conflicts [63]. Even worse, the controlling shareholder can expropriate the wealth of minority shareholders by transferring profits from firms where he has low cash flow rights to firms where he has high cash flow rights, which is referred to as "tunneling" in corporate governance literature, a common form of principal–principal conflicts in business groups [10].

As we discussed in the above section, enterprise information systems can exacerbate the principal–principal conflicts which occurs in a business group. EIS makes it more flexible to collect data and produces reports more quickly so that more accurate and timely information about firm performance becomes available to decision makers. Such an EIS capability can benefit a firm with improved efficiency in related accounting activities [34]. However, when a firm is part of a business group, the improved information availability and report quality can also be exploited by the parent company in tunneling, reducing the benefits this individual firm may gain.

We show the effect of business group affiliation and EIS on principal–principal conflicts and firm performance in Fig. 2. In summary, in comparison with an unaffiliated firm, a group-affiliated firm faces a higher level of principal–principal conflicts, which increases when EIS is implemented, resulting in poorer firm performance.

Hypothesis 1 For firms affiliated with business groups, enterprise information systems implementation is associated with lower firm performance.

3.1.2 Ownership distribution

A firm may distribute its ownership among a large group of shareholders in order to collect funds from many investors. The extent to which ownership or equity is distributed influences how much shareholders participate in corporate governance. In the cases where the equity shares are widely distributed among small investors, an individual investor has a small share in the firm equity and his investment in the firm may also account for a small portion of his own investment portfolio. Hence, when the equity shares are widely distributed, the small shareholders are not motivated to learn about the firms they have financed, or even to participate in the governance, yielding to managers the significant control rights over how to allocate the investors' funds [55].

In contrast, when one or a small number of investors with a collectively large cash flow stake in the firm also have concentrated control rights, these large shareholders have the incentive to collect information and monitor the management [55]. With the concentrated ownership, the large shareholders have more power over the management and executives are influenced more by the shareholders' desires in running the business [13]. As a result, the management is better aligned with the shareholders which can transfer to higher shareholders' value than when the control rights are split among widely dispersed small shareholders. However, this potential value can become reality only when the large shareholders know well enough about the firm's operation and strategy.

If the large shareholders are more knowledgeable about the business operation, their desires and directions for the business will be more appropriate and valuable, which can transfer into more effective decisions by executives for generating business value. The efforts in collecting the information and using the information for decision making are a major part of the decision information costs. If the shareholders' information is inaccurate or untimely, their decisions would have more negative effects on firm performance which adds to the decision information costs.

As we discussed in the above section, enterprise information systems provide improved information accessibility

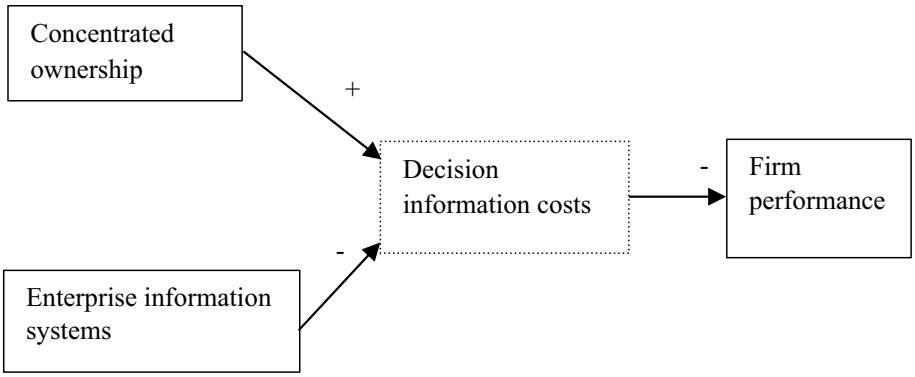

Fig. 3 Enterprise information systems and ownership distribution

and quality, and support decision-making processes. Thus, with EIS, large shareholders can be better informed of business operations so that their directions for the business will become more useful and beneficial. Moreover, when the proportion of the large shareholder's equity shares increases with a more concentrated ownership, the influence of the large shareholder on the management and business operations increases. In such situations, the support that EIS provide to the large shareholder in accessing information and making decisions becomes more important, and has more effects on firm performance. Such effects on decision information costs are depicted in Fig. 3.

In summary, under concentrated ownership, EIS capabilities in reducing decision information costs can be utilized to a greater extent to improve firm performance than under a more distributed ownership.

Hypothesis 2 For firms with more concentrated ownership, enterprise information systems implementation is associated with higher firm performance.

3.1.3 Separation of controlling shareholder's rights

For public companies, when there is a controlling shareholder, there may exist principal–principal conflict, the opportunism by the controlling shareholder at the expense of the minority shareholders [5]. A controlling shareholder may own a minority of the cash flow rights but control a majority of the votes when cash flow rights and votes are separated due to corporate pyramids, dual-class stocks or cross-holdings [12]. When the gap between the controlling shareholder's voting rights and cash flow rights increases, the controlling shareholder's financial stake in the firm decreases and thus his inclination towards expropriating the firm's resources and profits increases. This hurts the firm's market value and minority shareholders' wealth even more.

As is discussed in the above section, the increased information processing capabilities from EIS allow the controlling shareholder to have better knowledge about the firm's performance. With the improved knowledge, the controlling shareholder can find it more convenient to appropriate private benefits at the expense of the minority shareholders, elevating the principal–principal conflicts. This is more likely to happen when the gap between the controlling shareholder's voting rights and cash flow rights is larger because the controlling shareholder has less financial stake in the firm. We depict these scenarios in Fig. 4.

To sum up, when there is a big gap between controlling shareholder's voting rights and its cash flow rights, there exist principal–principal conflicts that may escalate with EIS implementation, weakening firm performance.

Hypothesis 3 When the gap between voting rights and cash flow rights of the company's controlling shareholder is large, enterprise information systems implementation is associated with lower firm financial performance.

3.1.4 State-owned enterprises

In state-owned enterprises, government or government agencies are a controlling shareholder. Such an ownership has two implications. First, the top executives are appointed by the government and hence they are interested in aligning with the governmental objectives that may not be the same as the other investors or minority shareholders. Their career future lies in the hands of the government agencies, not depending solely on the outcomes of their performance in running the business [50]. Second, SOEs often have easier access to resources or better terms to obtain resources such as loans than other enterprises [40]. As a result, SOE management has less pressure or incentives to seek high returns on investments. This can be viewed as one form of principal–principal conflicts. We depict these effects in Fig. 5. Under such conditions, we expect that SOEs management is less motivated to maximize the value of enterprise information systems, which leads to the following hypothesis.

Hypothesis 4 For state-owned enterprises, enterprise information systems implementation is associated with lower firm performance.

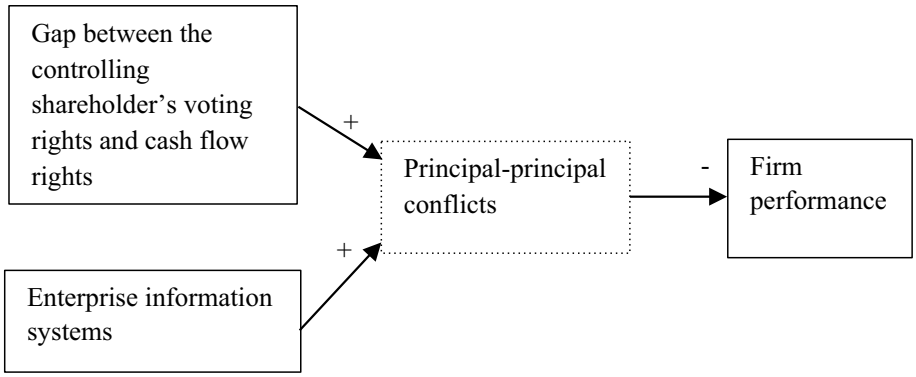

Fig. 4 Enterprise information systems and separation of controlling shareholder's rights

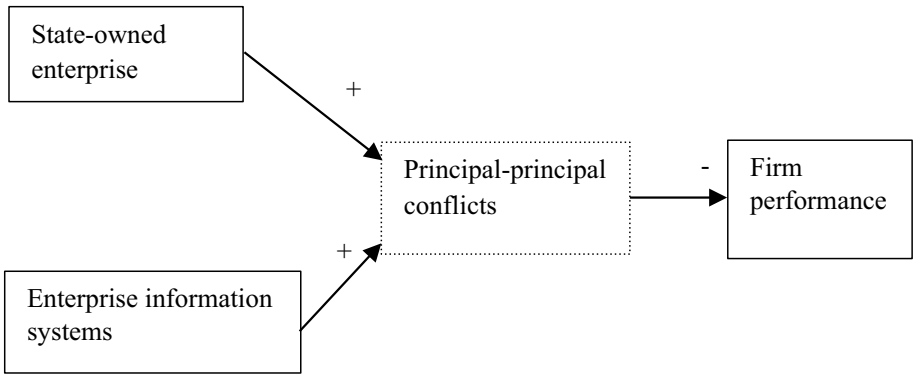

Fig. 5 Enterprise information systems and state-owned enterprise

3.2 Board of directors

In corporate governance, board of directors provides one mechanism for monitoring and aligning management with shareholders' interests [42]. One role of the board of directors is advisorship to management and board directors rely on information about corporate operations to provide effective advices. The time and efforts for collecting and processing such information is a big part of the decision information costs. As is mentioned in the above section, enterprise information systems can reduce the decision information costs for the board of directors by reducing the efforts and time they spend on collecting data, and communicating and coordinating with each other.

A large board provides a large pool of knowledge and experiences from which the management can draw in making decisions. This is the advantage of a large board. However, the disadvantage of a large board is the high decision information costs because there are more members on the board who participate in the decision-making processes. They need more time and efforts to communicate and coordinate with each other in order to reach an agreement for actions [32], which amounts to higher decision information costs. In such scenarios, the enterprise information systems can be used to reduce decision information costs, more than when the board is small. These effects are described in Fig. 6.

In summary, as the size of the board increases, the benefit of EIS from reduced decision information costs for the board increases, which is expected to have a more positive effect on firm performance. This is summarized in the following hypothesis.

Hypothesis 5 When a company has a large board of directors, enterprise information systems implementation is associated with higher firm performance.

An important task of the board of directors is to align the top management's actions with the investors' goals. The top management, represented by CEO, plays an important role in corporate governance, as the prominent agent in the principal-agent relationship. One practice in facilitating the smooth communications between the board and top management is to appoint the CEO as the chair of the board. This CEO-chair duality arrangement allows for better information sharing between the management team and the board, so that the board's advices better meet the business needs and the management is more motivated to pursue innovative initiatives which may have positive effects on firm value [25]. However, these positive effects come at a cost because it also gives the CEO more power and greater discretion in decision making. The CEO has more opportunities to seek private benefits that may harm the firm value and shareholders' wealth [4, 45]. In other

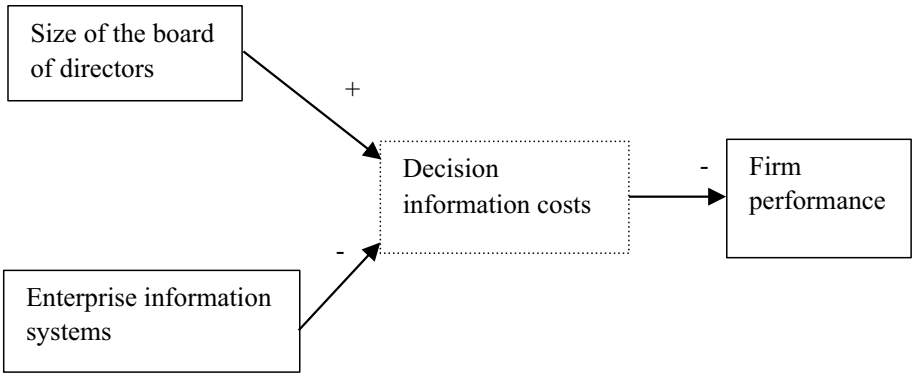

Fig. 6 Enterprise information systems and size of board of directors

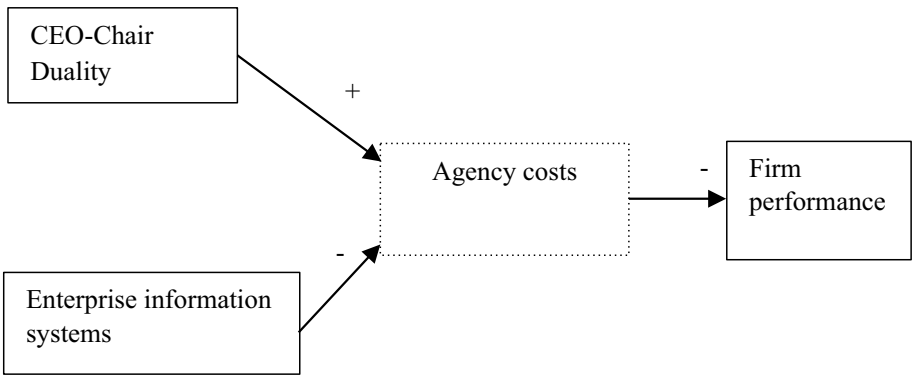

Fig. 7 Enterprise information systems and CEO-chair duality

words, it weakens the monitoring function of the board, and thus requires additional efforts to monitor CEO's performance which translates into increased agency costs. This is captured in Fig. 7.

In Fig. 7, we also show that enterprise information systems can lower agency costs, as we discussed in the above section. EIS can improve availability of data, reducing the efforts that board members and investors need to find out how top management including CEO performs. In other words, thanks to the EIS implementation, a firm with CEO-chair duality can expect to enjoy the benefits of better alignment between the board and management while incurring little or no additional agency costs. In contrast, in a firm where its CEO does not assume the chair position on the board, such benefits of EIS from supporting the CEO-chair duality at low costs won't be obtained. Hence, we propose the following hypothesis.

Hypothesis 6 When a company's CEO is also the chairman of the board of directors, enterprise information systems implementation is associated with higher firm performance.

On the board of directors, the independent directors who are from outside of the firm are supposed to provide external monitoring on management. Director independence is found to be associated with better decision making on CEO turnover, executive compensation, handling frauds and granting stock options [3, 6, 14, 61]. However, since independent directors do not participate in the organizational operations directly, one necessary condition for them to be effective is the amount and quality of information that they have regarding the operations [31]. The efforts that they need to spend on collecting and processing relevant data to make sound decisions and recommendations are part of the decision information costs in corporate governance that we discussed in Sect. 2. Also, as is discussed in the above section, EIS can help reduce such decision information costs by enabling efficient collection, aggregation and communication of information on operations. Figure 8 depicts this interaction effect of EIS and independent directors.

In short, EIS provide independent directors with improved information access, supporting their effective functioning that may enhance firm financial performance eventually. Such an effect due to the reduction in decision information costs by EIS implementation increases when there is a large proportion of independent directors on the board. When there are more independent directors, there are higher decision information costs and thus more improvements in information access can be obtained with EIS.

Hypothesis 7 When a company has a large proportion of independent directors on its board, enterprise information systems implementation is associated with higher firm performance.

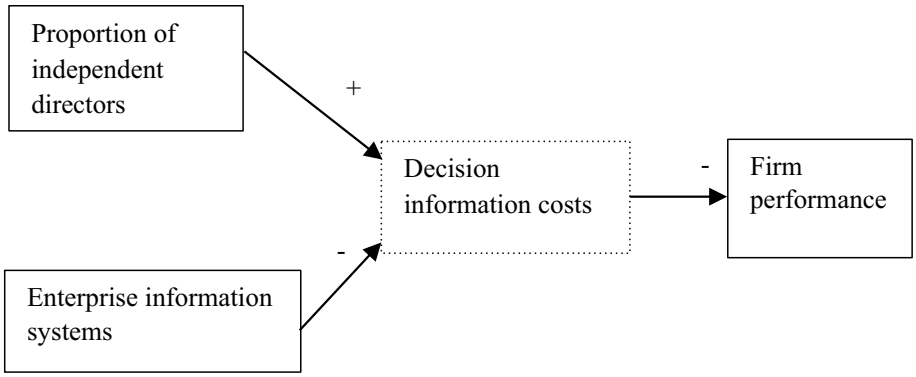

Fig. 8 Enterprise information systems and independent directors

4 Research method

We tested our hypotheses empirically with a sample of publicly listed Chinese companies whose stocks are traded in Shanghai Stock Exchange and Shenzhen Stock Exchange.

Over the past three decades, China has been transforming from a planned or command economy to a market economy [29]. In early 1980s, the Chinese government started to reform enterprise ownership structure and capital market. The government converted wholly state-owned firms into corporations with share capital, which were owned by the central and local State-owned Asset Supervision and Administration Commission (SASAC) linked to the government. The government separated ownership and control rights by gradually granting managerial freedom to managers of state-owned enterprises (SOEs). Also, since 1980s, many firms have been founded by individual investors or entrepreneurs backed by investments from the capital market.

Through a series of legislative, financial and economic reforms, Chinese companies have been developing the corporate governance system for effective monitoring and regulation. They have adopted the various corporate governance aspects and mechanisms from the Western market economies, such as the structure of board of directors [28]. At the same time, they have retained some practices that are common in emerging economies such as the pyramid ownership structure [22, 63].

There are some distinct institutional features in China's capital market that impact corporate governance [11]. First, the legal and institutional environment is under development and weak in terms of investor protection, accounting standards and quality of government regulation [1]. Second, state ownership dominates in Chinese capital market. The State remains as the controlling equity holder in SOEs directly or indirectly after listings [58]. Third, Chinese listed firms normally have one ultimate controlling owner holding a significant percentage of shares. The existence of such controlling shareholders makes the principal–principal conflicts a prominent issue in corporate governance as La Porta et al. [39] noted. Fourth, due to regulatory and legal requirements, Chinese listed firms do not vary much in their anti-takeover provisions. In this case, G-Index [26, 41] is not an appropriate measure to capture the differences in corporate governance practice among firms. Instead, the approach we take in identifying and measuring corporate governance aspects directly allows us to capture the variances among these firms more effectively.

Chinese listed firms went through a 'non-tradable share reform' in 2005 and 2006, which transformed non-tradable controlling blocks into tradable shares. China has also adopted new accounting rules starting from January 2007. Since 2008, China Securities Regulatory Commission (CSRC) has required Chinese listed firms to disclose strictly their internal control and governance practices, and the accumulated amount of related-party transactions. In 2008, CSRC also promoted the use of information systems for enhancing corporate governance. To prevent these events from biasing our analysis, we excluded pre-2007 observations; as a result our sample includes Chinese listed firms from 2008 to 2013.

We started with an initial sample of 12,725 firm-year observations. We eliminated 212 observations in financial industry, 3338 observations that do not disclose intangible assets, 434 observations that do not disclose control chains, and 1550 observations that have missing data on other control variables. Thus we end up with a final sample of 7191 firm-year observations. The sampling process and the distribution of the observations are summarized in Tables 2 and 3.

4.1 Data description

We retrieved financial data on Chinese listed firms from the Wind database, and corporate governance data from the CSMAR database.[1] The data on the use of ERP systems

[1] The Wind database is developed by Wind Information Co., Ltd (Wind Info), headquartered in Shanghai and a leading provider of financial data, information, and software. The China Stock Market and Accounting Research (CSMAR) research database system is jointly produced by GTA Information Technology Co. Ltd, the University of Hong Kong and the China Accounting and Finance Research Center of the Hong Kong Polytechnic University.

Table 2 Sampling process

Initial sample	12,725
Firms in financial industry	−212
Firms without disclosure of footnotes about intangible assets (no ERP information)	−3338
Firms without disclosure about control chains (no data of affiliation to business group)	−434
Firms missing data of other control variables	−1550
Final sample	7191

Table 3 Distribution of observations

Year	Number of observations without ERP	Number of observations with ERP	Total
2008	737	90	827
2009	834	85	919
2010	960	85	1045
2011	1233	89	1322
2012	1397	97	1494
2013	1477	107	1584
Total	6638	553	7191

and the data of affiliation to a business group were collected manually from footnotes of annual reports.

The description of variables is summarized in Table 4. The variable *ROA* is return on assets. We scale up the raw number of ROA by multiplying it with 100. The variable *Leverage* is financial leverage ratio. The variable *FCF* is free cash flow divided by total assets. The variable *Size* is firm size measured by the natural log of total assets. The variable *First* is the proportion of the largest shareholder's share holdings. The variable *Separation* is the disparity between the controlling rights distribution and ownership distribution. *Boardsize* is the natural log of (1 + the total number of directors of the board). *Growth* is the annual revenue growth computed with the revenues in the current year and the previous year. *Independent* is the proportion of independent directors over the total number of directors on the board. *Indexmarket* is the National Economic Research Institute's (NERI) marketization index, a measure for the degree to which the local economy is open to the market. To avoid the influence of extreme observations, we winsorize continuous variables at 1% and 99%.

We encoded the relevant information in the annual reports to identify the following variables. The dummy variable

Table 4 Variables definitions

Variable	Definition	Type
Dependent variable		
ROA	Return on assets, 100 × net income/total assets	Financial
Cash	Cash holding/total assets	Financial
RRPTCash	Net cash flow out of the listed firm in related-party transactions/net equity	Financial
Independent variables		
ERP	A dummy variable, which has the value of 1 if the company uses an ERP system or 0 if otherwise	Encoded
Boardsize	The size of the board of directors, ln (1 + number of board directors)	Derived
Dual	A dummy variable, which has the value of 1 if the CEO is also the chair of board of directors or 0 if otherwise	Encoded
Group	A dummy variable, which has a value of 1 if the company is a subsidiary of a business group or 0 if otherwise	Encoded
First	The proportion of the largest shareholder's shares	Derived
Independent	The proportion of independent directors on the board	Derived
Separation	Degree of separation of control and ownership, which is measured by the difference between the proportion of voting rights and the proportion of owned cash flow	Derived
Control variables		
CEOchange	A dummy variable, which has the value of 1 if CEO has changed in the current year or 0 if otherwise	Encoded
FCF	Free cash flow/total assets	Financial
Firmage	Firm age, measured by the number of years since the firm went public	Derived
Growth	The growth rate of annual revenue	Derived
Indexmarket	An index that measures the degree to which the local economy is open to market [21]	Derived
Leverage	Financial leverage ratio measured by total liability/total assets	Financial
LnEmployee	ln (number of employees)	Derived
Size	Firm size, measured by ln (total assets)	Financial
SOE	A dummy variable, which has the value of 1 if the company is ultimately controlled by government agency or 0 if otherwise	Encoded
ROE	Return on equity, net income/net equity	Financial

ERP is coded as 1 when the firm states in the footnotes of its annual report that an ERP system is in use or is implemented. To avoid the bias caused by missing reports, we define *ERP* equal to 1 in the fifth year if *ERP* is equal to 1 in the previous 4 years continuously, and we define *ERP* equal to 1 in the middle year if *ERP* is equal to 1 in both the previous year and the next year.[2] The dummy variable *Group* is encoded to indicate if the firm is a subsidiary of a business group. To make sure that the affiliated listed firms are governed by complex business groups rather than shell firms, we require firms affiliated with business groups featured with 'business group' in the names of controlling shareholders along its control chains. The dummy variable *Dual* indicates if the firm's CEO (general manager) is also the chairman of the board of directors. The variable *CEOchange* is encoded as 1 if the firm has changed its CEO in a given year. The variable *SOE* is a dummy variable encoded to indicate if the firm is ultimately controlled by a Chinese government agency.

In addition, we also include two other control variables: *Firmage* and *LnEmployee*. *Firmage* is the number of years since the firm went public, and *LnEmployee* is the natural logarithm of the total number of employees. We recognize that firms vary in their usage of ERP systems and intend to control this variance. In an empirical study on technology usage in hospitals, Devaraj and Kohli [19] measure the usage by number of times reports are executed, number of data records accessed, and computer processing capacity utilized. They also include the number of employees and hospital age as control variables. But in our study, we do not have access to the actual usage data. Considering that both firm age and number of employees indicate the organizational complexity which in turn is closely related to the ERP usage pattern, we thus use *Firmage* and *LnEmployee* as proxies to control for the inter-firm variances in ERP usage. In addition, the control variable *Growth* may also capture some variances in ERP usage.

In addition to the above variables for testing our hypotheses, we collected data on three other variables that are used for additional analysis of the financial impacts of ERP systems in Sect. 4.4. The variable *ROE* is return on equity. The variable *Cash* is cash holding divided by total assets. The variable RRPTCash is the net cash flow out of the listed firm in related-party transactions divided by net equity.

[2] We have also estimated our models with two alternative methods for encoding the variable ERP. In one alternative encoding method, we encoded ERP as 1 only if the annual report explicitly discloses the use of ERP. With this encoding method, we estimated our models and obtained similar results. In the other alternative encoding method, if a firm discloses the use of ERP in one year's annual report, then we encoded the variable ERP as 1 for this firm in this year and all the following years. With this encoding method, our data analysis generates similar results although the magnitude of significance tends to be smaller.

Table 5 Descriptive statistics

Variable	No. of obs	Mean	SD	Min	Max
ROA	7191	6.467	6.905	−16.741	43.050
ERP	7191	0.077	0.266	0	1
Group	7191	0.655	0.475	0	1
First	7191	0.369	0.157	0.022	0.894
Boardsize	7191	2.287	0.181	1.609	2.944
Dual	7191	0.197	0.398	0	1
Seperation	7191	0.058	0.082	0	0.300
Independent	7191	0.369	0.055	0.091	0.714
Size	7191	21.903	1.274	14.108	27.387
FCF	7191	0.031	0.198	−1.231	0.398
CEOchange	7191	0.179	0.383	0	1
Growth	7191	0.220	0.637	−0.732	5.292
Leverage	7191	0.493	0.238	0.044	1.791
Indexmarket	7191	8.954	2.083	0.380	11.800
SOE	7191	0.497	0.500	0	1
Cash	7083	0.187	0.134	0.002	0.729
RRPTCash	7083	0.020	0.106	−0.055	1.019
ROE	7083	0.077	0.132	−0.698	0.452
Firmage	7191	9.986	5.627	0.811	23.049
LnEmployee	7191	7.631	1.348	1.609	12.594

The descriptive statistics and correlation matrix are displayed in Tables 5 and 6.

4.2 Data analysis results

We estimated the regression model in Eq. (1) with our data set in order to test our hypotheses.

$$ROA_{t+1} = \alpha + \beta_1 ERP_t + \beta_2 ERP_t \times Gov_t + \gamma Control_t + \mu \quad (1)$$

In this model, ROA_{t+1} is the dependent variable that measures the financial performance (ROA) in year $t+1$. The values of independent variables and control variables are in year t. Since ERP implementation decisions may be affected by business financial performance, there may be concerns about endogeneity if we use values from the same year. Hence, we use the dependent variable's value one year after the independent variables in order to control for endogeneity. Gov_t represents the vector of independent variables except ERP_t, that captures the company's corporate governance and includes *Group*, *First*, *Separation*, *SOE*, *Boardsize*, *Dual*, and *Independent*. And the coefficients of the interaction terms estimate the effects proposed in our hypotheses. Specifically, we estimate the interaction term of each governance variable and *ERP* separately. The coefficient of the interaction term $ERP \times Group$ tests

Table 6 Correlation matrix

		1	2	3	4	5	6	7	8	9
1	ROA	1								
2	ERP	−0.030**	1							
3	Cash	0.205***	−0.047***	1						
4	RRPTCash	−0.022*	0.033***	−0.039***	1					
5	Group	−0.038***	−0.019	−0.145***	0.073***	1				
6	First	0.118***	−0.051***	0.035***	0.015	0.126***	1			
7	Boardsize	0.032***	0.009	−0.047***	0.037***	0.115***	−0.007	1		
8	Dual	0.007	−0.006	0.112***	−0.055***	−0.178***	−0.062***	−0.151***	1	
9	FCF	0.117***	−0.011	−0.139***	−0.027**	−0.014	0.057***	0.027**	−0.025**	1
10	CEOchange	−0.032***	0.012	−0.042***	0.024**	0.035***	0.021*	−0.014	−0.077***	−0.035***
11	Independent	−0.015	−0.013	0.004	−0.036***	−0.047***	0.040***	−0.390***	0.087***	−0.020*
12	Size	0.094***	−0.093***	−0.179***	−0.005	0.178***	0.296***	0.275***	−0.156***	0.009
13	Growth	0.257***	0.005	0.009	0.032***	0.016	0.072***	−0.014	0.009	−0.090***
14	Leverage	−0.252***	−0.017	−0.380***	0.089***	0.207***	−0.027**	0.095***	−0.112***	−0.095***
15	Seperation	0.074***	0.000	−0.014	0.029**	0.145***	0.118***	0.023*	−0.046***	0.012
16	Indexmarket	0.055***	−0.028**	0.135***	−0.035***	−0.103***	0.057***	−0.055***	0.118***	0.034***
17	SOE	−0.087***	−0.033***	−0.166***	0.080***	0.320***	0.179***	0.265***	−0.267***	0.012
18	ROE	0.815***	−0.040***	0.174***	−0.022*	−0.006	0.139***	0.023*	0.009	0.058***
19	Firmage	−0.075***	−0.033***	−0.264***	0.062***	0.327***	−0.111***	0.037***	−0.195***	−0.045***
20	LnEmployee	0.087***	−0.050***	−0.112***	0.008	0.098***	0.176***	0.261***	−0.102***	0.105***

		10	11	12	13	14	15	16	17	18	19
1	ROA										
2	ERP										
3	Cash										
4	RRPTCash										
5	Group										
6	First										
7	Boardsize										
8	Dual										
9	FCF										
10	CEOchange	1									
11	Independent	0.007	1								
12	Size	−0.008	0.052***	1							
13	Growth	0.092***	0.003	0.059***	1						
14	Leverage	0.079***	0.005	0.239***	0.051***	1					

Table 6 (continued)

		10	11	12	13	14	15	16	17	18	19
15	Seperation	−0.007	−0.096***	0.004	0.002	0.040***	1				
16	Indexmarket	−0.057***	−0.009	0.011	−0.045***	−0.118***	0.011	1			
17	SOE	0.041***	−0.054***	0.320***	−0.022*	0.226***	−0.198***	−0.208***	1		
18	ROE	−0.060***	−0.001	0.183***	0.217***	−0.165***	0.081***	0.072***	−0.061***	1	
19	Firmage	0.067***	−0.005	0.166***	0.031***	0.343***	0.064***	−0.179***	0.361***	−0.049***	1
20	LnEmployee	−0.020*	0.019	0.642***	−0.015	0.082***	0.046***	−0.036***	0.216***	0.110***	−0.009

t statistics in parentheses, $^{*}p<0.10$; $^{**}p<0.05$; $^{***}p<0.01$

Hypothesis 1, the coefficient of *ERP* × *First* for Hypothesis 2, the coefficient of *ERP* × *Separation* for Hypothesis 3, the coefficient of *ERP* × *SOE* for Hypothesis 4, the coefficient of *ERP* × *Boardsize* for Hypothesis 5, the coefficient of *ERP* × *Dual* for Hypothesis 6, and the coefficient of *ERP* × *Independent* for Hypothesis 7. $Control_t$ represents the vector of control variables as listed in Table 4. We also control for industry and year.

The regression model estimation results are summarized in Table 7.

In Table 7, Model 1.0 is the baseline model that does not include any interaction terms. Model 1.1–Model 1.7 each contains one interaction term by one governance variable. Model 1.1 has the interaction term *ERP* × *Group* and its coefficient is significantly negative, which supports Hypothesis 1. Model 1.2 has the interaction term *ERP* × *First*, which tests the interaction effect between ERP and the largest shareholder's share proportion. Its coefficient is positive and significant, supporting Hypothesis 2. Model 1.3 has the interaction term *ERP* × *Separation* and its coefficient is insignificant. Model 1.4 has the interaction term *ERP* × *SOE* and its coefficient is significantly negative, which supports Hypothesis 4. Model 1.5 has the interaction term *ERP* × *Boardsize* and its coefficient is negative but insignificant for Hypothesis 5. Model 1.6 has the interaction term *ERP* × *Dual* and its coefficient is significantly positive, which supports Hypothesis 6. Model 1.7 has the interaction term *ERP* × *Independent* and its coefficient is positive but insignificant, which does not support Hypothesis 7.

Model 1.8 and Model 1.9 take into account all the interaction terms between the governance variables and ERP. Model 1.8 considers only the interaction terms, and model estimate results show three significant interaction effects: *ERP* × *First*, *ERP* × *SOE*, and *ERP* × *Dual*, thereby supporting Hypotheses 2, 4 and 6. Model 1.9 considers both main effects and the interaction effects, and the estimate results show two significant interaction effects: *ERP* × *First* and *ERP* × *Dual*. The changes in coefficients from individual effect models to the interaction effect model and the full model indicate that the individual governance variables interfere with each other in interacting with the ERP implementation on affecting firm performance.

In summary, the results across the models show consistently the positive effects of *ERP* × *First* and *ERP* × *Dual*, in the individual effect models, interaction effect model and full models. This indicates strong support for Hypotheses 2 and 6. We also find consistent support for Hypothesis 4 with significant negative coefficient for *ERP* × *SOE* in both the individual effect model (Model 1.4) and interaction effect model (Model 1.8). This coefficient remains negative in the full model although insignificant. The coefficient for *ERP* × *Group* is significant in the individual effect model only, but remains negative in both the interaction effect

Table 7 Regression results

	Model 1.0	Model 1.1	Model 1.2	Model 1.3	Model 1.4	Model 1.5	Model 1.6	Model 1.7	Model 1.8	Model 1.9
ERP	−0.010***	−0.004	−0.026***	−0.011***	−0.002	0.017	−0.015***	−0.028	−0.086*	−0.066
	(−3.92)	(−0.96)	(−4.19)	(−3.53)	(−0.70)	(0.54)	(−4.98)	(−1.54)	(−1.76)	(−1.31)
Group	−0.004***	−0.004**	−0.005***	−0.005***	−0.004***	−0.005***	−0.005***	−0.005***	−0.004**	−0.004**
	(−2.59)	(−2.31)	(−3.00)	(−2.92)	(−2.73)	(−2.88)	(−2.85)	(−2.91)	(−2.54)	(−2.24)
First	0.021***									0.017***
	(4.08)									(3.30)
Separation	0.020**									0.021**
	(2.14)									(2.20)
SOE	−0.013***									−0.013***
	(−7.07)									(−6.55)
Boardsize	0.011**									0.011**
	(2.34)									(2.30)
Dual	−0.000									−0.002
	(−0.15)									(−0.95)
Independent	−0.012									−0.014
	(−0.83)									(−0.95)
FCF	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***
	(9.04)	(9.12)	(9.09)	(9.15)	(9.15)	(9.15)	(9.18)	(9.15)	(9.08)	(9.00)
CEOchange	−0.007***	−0.007***	−0.007***	−0.007***	−0.007***	−0.007***	−0.007***	−0.007***	−0.006***	−0.007***
	(−3.64)	(−3.63)	(−3.67)	(−3.66)	(−3.59)	(−3.66)	(−3.57)	(−3.66)	(−3.52)	(−3.56)
Size	0.004***	0.003***	0.003***	0.003***	0.004***	0.003***	0.003***	0.003***	0.003***	0.004***
	(3.83)	(3.89)	(3.72)	(3.86)	(3.94)	(3.87)	(3.89)	(3.85)	(3.77)	(3.81)
Growth	0.012***	0.013***	0.013***	0.013***	0.013***	0.013***	0.013***	0.013***	0.012***	0.012***
	(10.55)	(11.19)	(11.15)	(11.19)	(11.14)	(11.20)	(11.18)	(11.21)	(11.06)	(10.54)
Leverage	−0.036***	−0.038***	−0.037***	−0.037***	−0.037***	−0.037***	−0.037***	−0.037***	−0.037***	−0.036***
	(−10.70)	(−11.08)	(−11.07)	(−11.05)	(−11.01)	(−11.04)	(−11.04)	(−11.02)	(−11.03)	(−10.75)
Indexmarket	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(5.08)	(6.49)	(6.38)	(6.42)	(6.33)	(6.43)	(6.43)	(6.42)	(6.23)	(5.08)
Firmage	−0.000	−0.000***	−0.000**	−0.000***	−0.000**	−0.000***	−0.000***	−0.000***	−0.000**	0.000
	(−0.06)	(−2.79)	(−2.55)	(−2.77)	(−2.52)	(−2.77)	(−2.63)	(−2.78)	(−2.14)	(0.04)
LnEmployee	0.002**	0.002*	0.002**	0.002*	0.002**	0.002**	0.002**	0.002**	0.002*	0.002**
	(2.05)	(1.95)	(1.98)	(1.96)	(2.00)	(2.03)	(2.03)	(2.01)	(1.95)	(2.04)
ERP × Group		−0.010*							−0.005	−0.007
		(−1.81)							(−0.92)	(−1.14)
ERP × First			0.046***						0.057***	0.045**
			(2.80)						(3.38)	(2.57)
ERP × Separation				0.019					0.016	−0.003

Table 7 (continued)

	Model 1.0	Model 1.1	Model 1.2	Model 1.3	Model 1.4	Model 1.5	Model 1.6	Model 1.7	Model 1.8	Model 1.9
				(0.59)					(0.46)	(−0.08)
ERP×SOE					−0.018***				−0.016***	−0.006
					(−3.47)				(−2.73)	(−0.94)
ERP×Boardsize						−0.012			0.020	0.009
						(−0.87)			(1.22)	(0.53)
ERP×Dual							0.022***		0.019***	0.022***
							(3.44)		(2.86)	(3.11)
ERP×Independent								0.048	0.048	0.063
								(0.98)	(0.87)	(1.11)
_cons	−0.058***	−0.035**	−0.031*	−0.034**	−0.036**	−0.034**	−0.035**	−0.034**	−0.032**	−0.056***
	(−3.05)	(−2.18)	(−1.95)	(−2.13)	(−2.26)	(−2.17)	(−2.21)	(−2.12)	(−2.04)	(−2.90)
N	7170	7170	7170	7170	7170	7170	7170	7170	7170	7170
R^2	0.141	0.131	0.131	0.130	0.132	0.130	0.132	0.130	0.134	0.143
adj. R^2	0.135	0.126	0.127	0.126	0.127	0.126	0.127	0.126	0.129	0.137
F	27.747	28.944	29.086	28.854	29.218	28.866	29.211	28.873	25.677	24.300

t statistics in parentheses, $^{*}p<0.10$; $^{**}p<0.05$; $^{***}p<0.01$

model and the full model. In comparing the models in Table 7, we notice that the F-value is higher with individual effect models than with the interaction effect model Model 1.8 or with the full model Model 1.9. Therefore, we lean towards the results in the individual effect models, and thus the coefficient for *ERP* × *Group* in Model 1.1 shows a weak support for Hypothesis 1 in our sample.

4.3 Robustness tests

In addition to the above model, we use two other methods for model specification with different treatments for endogeneity. One is the method of propensity score matching, and the other is the two-stage least square (2SLS) with an instrument variable.

First, we estimate propensity score matching (PSM) models. The method of propensity score matching is used to identify similar observations using a propensity score and then matching observations can be used to estimate the impact of the focal variable [51]. With our sample data, we compute propensity scores based on *Size*, *Leverage*, the year of the observations and the industry of the firms, and then use the nearest neighbor matching method to match firms with ERP with those without ERP. This provides us with 551 pairs of matched observations. That is, there is one group of 551 observations with ERP implementation and there is another group of 551 observations without ERP implementation that are similar to the first group. The total number of observations are 1102. We then estimate the regression models with these observations.

The estimate results are summarized in Table 8. In Table 8, Model 2.0 is the baseline model, Model 2.1–Model 2.7 are individual effect models where one interaction term is included in each model. Model 2.8 includes all interaction terms, but does not have main effects of the governance variables. Model 2.9 is the full model that includes all main effects and interaction effects. The results are consistent with what we have seen in Table 7. Specifically, there are significant positive coefficients on *ERP* × *First* and *ERP* × *Dual*, and negative coefficients on *ERP* × *Group* and *ERP* × *SOE*, across the individual effect models, the interaction effect model (Model 2.8) and the full model (Model 2.9). These results provide strong support for Hypotheses 1, 2, 4 and 6. In addition, the coefficient on*ERP* × *Boardsize* becomes significant and positive in the full model, which is consistent with our Hypothesis 5.

Next, we identify an instrument variable for *ERP* and estimate a 2SLS model. Our instrument variable is *ITInvestment*, the total amount of investments in information technologies in the province in which the firm is located. The reason for choosing this variable as the instrument variable is that the implementation of ERP at corporate level is

Table 8 Results of PSM models

	Model 2.0	Model 2.1	Model 2.2	Model 2.3	Model 2.4	Model 2.5	Model 2.6	Model 2.7	Model 2.8	Model 2.9
ERP	0.015*	0.028***	−0.004	0.013	0.026***	0.028	0.012	0.006	−0.039	−0.085
	(1.69)	(2.62)	(−0.36)	(1.40)	(2.70)	(0.85)	(1.37)	(0.31)	(−0.77)	(−1.32)
Group	−0.004	0.005	−0.005	−0.005	−0.002	−0.004	−0.004	−0.004	0.004	0.003
	(−1.02)	(0.95)	(−1.35)	(−1.19)	(−0.56)	(−1.04)	(−0.92)	(−1.07)	(0.62)	(0.61)
First	0.019*									−0.003
	(1.67)									(−0.23)
Separation	0.019									0.025
	(0.84)									(0.80)
SOE	−0.012***									−0.005
	(−2.84)									(−0.79)
Boardsize	−0.003									−0.014
	(−0.28)									(−1.01)
Dual	0.014***									0.005
	(2.91)									(0.75)
Independent	−0.034									−0.038
	(−0.95)									(−0.83)
FCF	0.027***	0.024***	0.024***	0.025***	0.025***	0.025***	0.026***	0.025***	0.024***	0.025***
	(3.18)	(2.87)	(2.87)	(2.95)	(2.96)	(2.96)	(3.12)	(2.96)	(2.89)	(2.97)
CEOchange	−0.010**	−0.012***	−0.012***	−0.012***	−0.012***	−0.012***	−0.011***	−0.012***	−0.011***	−0.010**
	(−2.50)	(−2.91)	(−2.88)	(−2.85)	(−2.78)	(−2.87)	(−2.64)	(−2.87)	(−2.60)	(−2.48)
Size	0.006***	0.005**	0.004*	0.005**	0.006***	0.005**	0.006**	0.005**	0.005**	0.006**
	(2.66)	(2.39)	(1.90)	(2.28)	(2.66)	(2.31)	(2.57)	(2.28)	(2.34)	(2.57)
Growth	0.013***	0.014***	0.014***	0.014***	0.014***	0.014***	0.014***	0.014***	0.013***	0.013***
	(5.61)	(6.04)	(6.01)	(6.06)	(5.94)	(6.10)	(6.05)	(6.10)	(5.68)	(5.57)
Leverage	−0.034***	−0.036***	−0.037***	−0.036***	−0.032***	−0.036***	−0.035***	−0.036***	−0.033***	−0.033***
	(−4.05)	(−4.27)	(−4.39)	(−4.32)	(−3.84)	(−4.25)	(−4.15)	(−4.24)	(−3.98)	(−3.99)
Indexmarket	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000
	(0.70)	(1.22)	(0.97)	(1.03)	(0.63)	(1.09)	(1.00)	(1.10)	(0.38)	(0.37)
FirmAge	0.000	−0.001	−0.000	−0.001	−0.000	−0.001	−0.000	−0.001	0.000	0.000
	(0.29)	(−1.51)	(−1.02)	(−1.54)	(−0.88)	(−1.59)	(−1.11)	(−1.60)	(0.42)	(0.67)
LnEmployee	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
	(−0.07)	(−0.11)	(−0.15)	(−0.22)	(−0.03)	(−0.08)	(−0.04)	(−0.09)	(−0.23)	(−0.21)
ERP × Group		−0.018**							−0.014*	−0.015*
		(−2.40)							(−1.85)	(−1.87)
ERP × First			0.043**						0.060***	0.063***
			(2.54)						(3.47)	(2.86)
ERP × Separation				0.032					0.029	0.004

Table 8 (continued)

	Model 2.0	Model 2.1	Model 2.2	Model 2.3	Model 2.4	Model 2.5	Model 2.6	Model 2.7	Model 2.8	Model 2.9
				(1.02)					(0.92)	(0.10)
ERP×SOE					−0.020***				−0.019***	−0.015*
					(−3.70)				(−3.26)	(−1.83)
ERP×Boardsize						−0.006			0.021	0.034*
						(−0.44)			(1.32)	(1.65)
ERP×Dual							0.024***		0.024***	0.019**
							(3.89)		(3.67)	(1.99)
ERP×Independent								0.022	−0.004	0.034
								(0.44)	(−0.07)	(0.47)
_cons	−0.056	−0.058	−0.020	−0.045	−0.071	−0.048	−0.063	−0.045	−0.054	−0.017
	(−1.08)	(−1.27)	(−0.43)	(−0.99)	(−1.55)	(−1.04)	(−1.39)	(−0.98)	(−1.15)	(−0.27)
N	1102	1102	1102	1102	1102	1102	1102	1102	1102	1102
R^2	0.169	0.156	0.156	0.152	0.162	0.151	0.163	0.151	0.184	0.187
adj. R^2	0.137	0.127	0.128	0.123	0.133	0.123	0.135	0.122	0.152	0.150
F	5.274	5.452	5.474	5.297	5.712	5.270	5.759	5.269	5.687	5.047

t statistics in parentheses, $^{*}p<0.10$; $^{**}p<0.05$; $^{***}p<0.01$

often affected by provincial factors such as local government policies to promote IT investment. Therefore, the IT investment at provincial level is related to the decisions on ERP implementation by firms in the given province, but is not directly associated with the firm performance.

The 2SLS estimate results are summarized in Table 9. In Table 9, Model 3.0 is the baseline model, Model 3.1–Model 3.7 are individual effect models where one interaction term is included in each model. Model 3.8 is the interaction effect model that includes all interaction terms, but does not have main effects of the governance variables. Model 3.9 is the full model that includes all main effects and interaction terms of the governance variables. The results show significant positive effect of *ERP* × *First*, negative *ERP* × *SOE*, supporting Hypotheses 2 and 4, which is consistent with the results in the above Table 7. However, Hypothesis 1 on *ERP* × *Group* and Hypothesis 6 on *ERP* × *Dual* are not supported. Instead, coefficients for *ERP* × *Separation* and *ERP* × *Boardsize* both are significant and positive.

One issue we notice in estimating the 2SLS models is that the original independent variable ERP is a dummy variable while the fitted value with the instrument variable becomes a continuous variable. Then the fitted value interacts with the governance variables in the 2SLS models. Such transformation may cause the deviation from the effects of the original independent variables, which makes us feel more cautious in interpreting the results in Table 9.

4.4 Additional financial performance tested

To further explore how ERP systems could affect firms' financial performance, we examine how ERP use impacts the firms' cash holdings (variable *Cash*) and net cash flow out of the listed firm in related-party transactions (variable *RRPTCash*). See Table 10 for the regression results.

In Table 10, Column 1 (Model 4.1) reports the OLS regression estimating the effect of ERP use on cash holdings. Column 2 (Model 4.2) shows the results of OLS regression estimating the effect of ERP use on net cash flow out of the listed firm in related-party transactions. Since 5547 among 7083 observations of *RRPTCash* have the value of 0, we also estimate a *Tobit* regression model and report the results in column 3 (Model 4.3). The cash holding is negatively and significantly associated with ERP use, while the net cash flow out of the listed firms in related-party transactions is positively and significantly associated with ERP use. In another model that is not reported in the table, we estimated OLS regression Model 1.9 using only the observations with positive *RRPTCash* (*RRPTCash* > 0) and our findings still hold. Overall, the results suggest that controlling shareholders of listed firms could utilize the ERP system to reduce the cash from listed firms and one potential channel is through related-party transactions.

Table 9 Results of 2SLS models

	Model 3.0	Model 3.1	Model 3.2	Model 3.3	Model 3.4	Model 3.5	Model 3.6	Model 3.7	Model 3.8	Model 3.9
ERP	−0.005	0.001	−0.036	−0.016	0.031	−0.346**	−0.004	0.073	−0.555***	−0.926***
	(−0.12)	(0.01)	(−0.99)	(−0.46)	(0.84)	(−2.49)	(−0.11)	(1.14)	(−3.03)	(−3.16)
Group	−0.004**	−0.004	−0.005***	−0.005***	−0.003*	−0.005***	−0.005***	−0.005***	−0.008**	−0.006*
	(−2.54)	(−1.48)	(−3.33)	(−3.26)	(−1.77)	(−2.99)	(−2.75)	(−2.87)	(−2.54)	(−1.94)
First	0.021***									−0.002
	(4.11)									(−0.27)
Separation	0.018**									0.031*
	(1.99)									(1.75)
SOE	−0.013***									−0.012***
	(−6.90)									(−3.44)
Boardsize	0.010**									−0.014
	(2.06)									(−1.62)
Dual	−0.000									−0.002
	(−0.14)									(−0.66)
Independent	−0.011									−0.028
	(−0.74)									(−1.05)
FCF	0.033***	0.033***	0.033***	0.033***	0.033***	0.032***	0.033***	0.033***	0.032***	0.032***
	(8.80)	(8.94)	(9.01)	(8.98)	(8.90)	(8.63)	(8.96)	(8.88)	(8.54)	(8.71)
CEOchange	−0.007***	−0.007***	−0.007***	−0.007***	−0.007***	−0.007***	−0.007***	−0.007***	−0.007***	−0.007***
	(−3.77)	(−3.78)	(−3.86)	(−3.78)	(−3.73)	(−3.75)	(−3.74)	(−3.77)	(−3.75)	(−3.72)
Size	0.003***	0.003***	0.004***	0.003***	0.003***	0.002**	0.003***	0.003***	0.003**	0.004***
	(2.98)	(3.16)	(3.56)	(3.32)	(3.35)	(2.22)	(3.18)	(3.12)	(2.52)	(3.39)
Growth	0.012***	0.013***	0.012***	0.012***	0.012***	0.013***	0.012***	0.013***	0.012***	0.011***
	(10.22)	(10.92)	(10.21)	(10.87)	(10.70)	(11.13)	(10.91)	(10.95)	(10.21)	(9.85)
Leverage	−0.036***	−0.037***	−0.036***	−0.038***	−0.037***	−0.037***	−0.037***	−0.037***	−0.035***	−0.035***
	(−10.61)	(−10.95)	(−10.64)	(−11.14)	(−10.79)	(−10.87)	(−10.96)	(−10.91)	(−10.34)	(−10.24)
Indexmarket	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(4.87)	(6.20)	(6.41)	(6.09)	(5.25)	(6.01)	(6.10)	(6.17)	(4.92)	(4.94)
FirmAge	−0.000	−0.000***	−0.000**	−0.000***	−0.000*	−0.000***	−0.000***	−0.000***	−0.000	−0.000
	(−0.17)	(−2.87)	(−2.01)	(−2.96)	(−1.72)	(−2.88)	(−2.80)	(−2.88)	(−0.53)	(−0.05)
LnEmployee	0.002**	0.002**	0.002**	0.002**	0.002***	0.002**	0.002**	0.002**	0.002**	0.002**
	(2.43)	(2.37)	(2.17)	(2.27)	(2.71)	(2.26)	(2.39)	(2.34)	(2.34)	(2.34)
ERP × Group		−0.002							0.044	0.025
		(−0.06)							(1.36)	(0.76)
ERP × First			0.285***						0.318***	0.369***
			(4.59)						(4.98)	(3.44)
ERP × Separation				0.376***					0.121	−0.198

Table 9 (continued)

	Model 3.0	Model 3.1	Model 3.2	Model 3.3	Model 3.4	Model 3.5	Model 3.6	Model 3.7	Model 3.8	Model 3.9
				(3.81)					(1.16)	(−1.01)
ERP×SOE					−0.099***				−0.126***	−0.022
					(−5.53)				(−6.30)	(−0.61)
ERP×Boardsize						0.134***			0.206***	0.322***
						(2.58)			(3.58)	(3.31)
ERP×Dual							0.014		0.004	0.030
							(0.71)		(0.19)	(0.74)
ERP×Independent								−0.215	−0.028	0.235
								(−1.38)	(−0.17)	(0.74)
_cons	−0.056**	−0.034	−0.050**	−0.036	−0.037*	−0.011	−0.034	−0.032	−0.019	−0.002
	(−2.42)	(−1.54)	(−2.22)	(−1.63)	(−1.69)	(−0.45)	(−1.55)	(−1.46)	(−0.80)	(−0.07)
N	7161	7161	7161	7161	7161	7161	7161	7161	7161	7161
R^2	0.136	0.127	0.129	0.128	0.130	0.127	0.127	0.127	0.136	0.139
adj. R^2	0.131	0.122	0.125	0.124	0.126	0.123	0.122	0.122	0.131	0.133
F	27.441	28.664	29.333	29.127	29.637	28.875	28.680	28.724	26.673	23.948

t statistics in parentheses, *$p<0.10$; **$p<0.05$; ***$p<0.01$

Table 10 ERP impacts on cash holdings and net cash flow out of the listed firm in related-party transactions

	Model 4.1 Cash	Model 4.2 RRPTCash	Model 4.3 RRPTCash
ERP	−0.021***	0.012***	0.048**
	(−4.14)	(2.63)	(2.44)
Group	−0.008***	0.005*	0.031**
	(−2.63)	(1.73)	(2.36)
First	0.056***	0.011	0.026
	(5.88)	(1.21)	(0.70)
Boardsize	0.044***	0.011	−0.015
	(4.97)	(1.34)	(−0.45)
Dual	0.011***	−0.007**	−0.036**
	(2.98)	(−2.00)	(−2.33)
CEOchange	0.000	0.002	0.018
	(0.01)	(0.58)	(1.32)
Independent	0.023	−0.018	−0.251**
	(0.83)	(−0.72)	(−2.24)
ROE	0.063***	0.004	−0.020
	(5.44)	(0.35)	(−0.46)
Size	−0.003*	−0.008***	−0.007
	(−1.86)	(−6.09)	(−1.16)
Growth	0.002	0.005**	0.013
	(1.05)	(2.33)	(1.60)
Leverage	−0.246***	0.059***	0.167***
	(−29.75)	(7.69)	(5.10)
Separation	−0.019	0.030*	0.154**
	(−1.07)	(1.82)	(2.23)
Indexmarket	0.003***	0.000	−0.002
	(4.38)	(0.19)	(−0.76)
SOE	−0.010***	0.013***	0.072***
	(−2.86)	(3.99)	(5.35)
_cons	0.183***	0.136***	−0.280**
	(5.24)	(4.22)	(−2.02)
N	7083	7083	7083
R^2	0.285	0.038	
adj. R^2/Pseudo. R^2	0.281	0.032	0.085
F/chi^2	70.292	6.884	377.238

t statistics in parentheses, *$p<0.10$; **$p<0.05$; ***$p<0.01$

5 Discussion

In our sample, the main effect of ERP systems on firm ROA is often negative or insignificant, depending on the interaction effect included in the regression model. Since the data in our sample include firm performance one year after the ERP systems were implemented, the negative or insignificant main effects are likely due to productivity drop during the post-implementation stabilization period. Nevertheless, the objective of our analyses is to examine the interaction effects that are captured by the coefficients of the interaction

Table 11 Hypotheses testing results summary

Corporate governance	Hypotheses	Results
Corporate ownership		
Business group	H1: For firms affiliated with business groups, EIS implementation is associated with lower firm performance	Supported
Ownership distribution	H2: For firms with more concentrated ownership, EIS implementation is associated with higher firm performance	Supported
Separation of controlling shareholders' voting rights from cash flow rights	H3: When the gap between the controlling shareholders' voting rights and cash flow rights is large, EIS implementation is associated with lower firm performance	Not supported
State ownership	H4: For state-owned enterprises, EIS implementation is associated with lower firm performance	Supported
Board of directors		
Size	H5: When a company has a large board of directors, EIS implementation is associated with higher firm performance	Not supported
CEO-chair duality	H6: When the CEO is also the chair of the board, EIS implementation is associated with higher firm performance	Supported
Proportion of independent directors	H7: When there is a large proportion of independent directors on the board, EIS implementation is associated with higher firm performance	Not supported

terms in the regression models. Our results show that there exist interaction effects between ERP implementation and corporate governance on firm financial performance. The ERP implementation has different effects under different ownership structures and board compositions. We summarize our hypotheses testing results in Table 11.

With regard to ownership structure, we find that, a firm that belongs to a business group has lower ROA when ERP is implemented, as shown by the negative coefficient of the interaction term $ERP \times Group$. This result indicates that for such firms, the "tunneling" effect escalates when enterprise information systems are deployed. In addition, SOEs have lower ROA with ERP implementation, which is consistent with SOEs' under-performance that has been reported in literature [15]. In contrast, a firm's ROA goes up with ERP implementation when the proportion of its largest shareholder's shares is large. As the proportion of the largest shareholder is an indicator of ownership concentration, this result supports the argument that, under more concentrated ownership, the enterprise information systems improve firm performance furthermore. However, we do not find interaction effect between ERP implementation and the separation of the controlling shareholder's voting rights from its cash flow rights on firm performance.

With regard to board composition, we find that a firm gains a higher ROA with the ERP implementation when its CEO also assumes the role as the chairman of the board. This effect is consistent with our argument that enterprise information systems contribute more to business performance when CEOs take dual-roles on the board. However, the ERP implementation does not affect firm performance much when the board size or proportion of independent board directors changes. One possible explanation for this result is that the board of directors only utilize the information on business operations to a limited extent or already have access to such information through reports by middle-level managers so that the information benefits from the ERP implementation are not fully exploited by all the board members.

To further explore the mechanism of ERP systems' impacts on firm value, we also examined two specific items potentially related to tunneling: cash holdings and net cash flow out of the listed firms in related-party transactions. Our results show that ERP implementation is associated with a smaller amount of cash holdings and a greater amount of net cash flow out of the listed firms in related-party transactions, implying that ERP systems can be used as a tool of tunneling by controlling shareholders.

Contributions to research According to a number of literature review articles [18, 36, 52] on IT business value, researchers have studied the variances in IT value under different organizational contexts but have also pointed out the need for more efforts in investigating the conditions under which IT systems create business value. In this literature, such organizational contextual factors as IS-business alignment, IS-business relationships, CIO knowledge, and centralization of organizational structure are shown to have significant effects on IT value [52]. Expanding this list of organization-level conditions for obtaining IT value, we have provided a large-scale cross-sectional study that looks into the interaction effects between corporate governance and enterprise information systems on firm financial performance. We argue that enterprise information systems enable improved information availability and integration that influences agency costs, decision information costs and principal–principal conflicts in corporate governance

management. Furthermore, we look into interactions between EIS capabilities and the seven corporate governance aspects respectively. We find out that EIS implementation is associated with better firm performance under some corporate governance aspects. Our findings add to the IT business value literature not only by revealing the effects of corporate governance, but also by showing the varying effects of different aspects of corporate governance.

As we examine the value of ERP systems empirically, our study also contributes to research on enterprise information systems. Although researchers have noted that the benefits of ERP systems are conditioned by organizational business environment [53, 57], there is a scarcity of large-scale empirical studies in this area. The major capabilities of ERP systems lie in the information and process integration enabled by these enterprise information systems [8]. Moreover, the business value that a firm can gain from ERP implementation depends on the interdependence, differentiation and diversification among business units [24, 59]. Going farther along this line of research, we show that the benefits of the ERP's information processing capabilities also vary by corporate governance practice. While researchers have examined the intra-firm variances in ERP benefits that are caused by the differentiation among business units within the same company, our study focuses on the inter-firm variances that are related to the different corporate governance aspects at firm-level.

Contributions to practice The quest for IT value has been a core task for IT management. It is challenging to prove the benefits of enterprise information systems such as ERP in terms of firm financial performance because of the complex interactions between the information systems and organization design, according to prior research on IT business value and ERP. This suggests to management that assessing the value of enterprise information systems at the firm level needs to take into account relevant aspects in organizational structure and business environment. Our study expands this suggestion for practice by pointing out the need for considering corporate governance. Furthermore, our findings suggest that the different aspects and mechanisms of corporate governance shall be considered separately as they interact differently with the capabilities of enterprise information systems in influencing firm performance. For example, when a company has a dual CEO-chair arrangement, management can be more optimistic in expecting the financial returns from ERP implementation. But when a company has a large controlling shareholder, management may be more conservative in estimating the ERP benefits in financial terms.

Our findings can also partly explain the loose and sometimes elusive connection between the use of enterprise information systems and firm-level financial performance. For example, when a company is a member firm of a business group, the implementation of an enterprise information system makes the operational and performance data more accessible due to its information integration capability. This may bring about more "tunneling", by which the company's resources are furthermore expropriated by the parent company to other sibling companies in the same group. As a result, the company may not obtain financial gains, even if its operational performance may improve because business activities and tasks are better coordinated with the EIS. In such cases, the EIS generates operational benefits at business process level but these benefits do not transcend to financial benefits at firm level, triggering the question about the business value of the enterprise information system. Hence, according to our study, the disconnection between EIS implementation and firm financial performance is partly explained by the firm's corporate governance. With such understandings, management and shareholders may expand the scope in assessing the impacts of EIS to include the spillover benefits to sibling companies in the business group. Or managers may adjust corporate governance or related business procedures to reduce tunneling so that more benefits of EIS will turn into financial gains at firm-level.

Limitations and future research While we have investigated how the value of enterprise information systems varies under different corporate governance aspects, our study has limitations and can be extended in future research. First, in practice, corporate governance includes structure and processes. Corporate governance structure includes ownership structure and board composition, and corporate governance process includes procedures and policies for directing and controlling a company and its management to act in the shareholders' interests. We have focused on corporate governance structure in this study. But we recognize the importance of corporate governance processes and suggest that a topic for future research would be about the influences of the corporate governance processes. Second, as prior research has noted, other organization design factors such as business diversification may also impact the value of enterprise information systems. In the future, it will be interesting to explore how these organization design factors including corporate governance interact with each other and how these interactions may shift the value of enterprise information systems. Third, our study is a cross-sectional empirical one, and leaves out the dynamic changes that may take place as a result of the implementation of enterprise information systems. According to structuration theory [48], it is possible that individual users and organizations change work routines and beliefs after the use of enterprise information systems, leading to changes in institutional structures including corporate governance. Hence, another possible future research direction would be to look into whether and how corporate governance may change after the implementation of enterprise information systems. A case study may provide us insights into these dynamic processes.

6 Conclusion

In this research, we have studied how enterprise information systems affect firm performance under different corporate governance aspects, including ownership structure and board composition. Using the data on firms that are publicly traded on Chinese stock markets, we empirically tested our hypotheses. Our data analysis results show that ERP systems are associated with better financial performance when a firm has a more concentrated ownership structure and a dual CEO-chair arrangement. Moreover, non-SOEs and non-group-affiliated firms outperformed SOEs and group-affiliated firms in obtaining financial benefits from ERP implementation. We also further show that the use of ERP systems tends to lead to smaller cash holdings and greater net cash flow out of the listed firms in related-party transactions, suggesting that enterprise information system could be utilized for tunneling by controlling shareholders. As we have developed our work on the extant knowledge base in IS research, we strive to add value to current research and also to identify possible future research topics. Our work contributes to the academic research on IT business value and ERP impacts, and also provides practical implications for management in assessing the benefits of enterprise information systems. Moving forward, we suggest that future research explore the effects of corporate governance processes and the possible post-ERP-implementation changes in corporate governance.

References

1. Allen F, Qian J, Qian M (2005) Law, finance and economic growth in China. J Financ Econ 77:57–116
2. Barki H, Pinsonneault A (2005) A model of organizational integration, implementation effort, and performance. Organ Sci 16(2):165–179
3. Beasley M, Carcello JV, Hermanson DR, Lapids PD (2000) Fraudulent financial reporting: consideration of industry traits and corporate governance mechanisms. Account Horiz 14:441–452
4. Bebchuk LA, Fried JM, Walker DI (2002) Managerial power and rent extraction in the design of executive compensation. Univ Chic Law Rev 69(3):751–846
5. Bebchuk LA, Kraakman R, Triantis G (1999) Stock pyramids, cross-ownership, and the dual class equity: the cration and agency costs of separating control from cash flow rights. NBER working paper series
6. Bebchuk LA, Cohen A, Ferrell A (2009) What matters in corporate governance. Rev Financ Stud 22:783–827
7. Bebchuk LA, Weisbach MA (2010) The state of corporate governance research. Rev Financ Stud 23(3):939–961
8. Berente N, Vandenbosch B, Aubert B (2009) Information flows and business process integration. Bus Process Manag J 15(1):119–141
9. Berente N, Lyytinen K, Yoo Y, King JL (2016) Routines as shock absorbers during organizational transformation: integration, control, and NASA's enterprise information system. Organ Sci 27(3):551–572
10. Bertrand M, Mehta P, Mullainathan S (2002) Ferreting out tunneling: an application to Indian business groups. Q J Econ 117(1):121–148
11. Chang C, Chen X, Liao G (2014) What are the reliably important determinants of capital structure in China? Pac Basin Financ J 30:87–113
12. Claessens S, Djankov S, Fan JPH, Lang LHP (2002) Disentangling the incentive and entrenchment effects of large shareholdings. J Financ 57(6):2741–2771
13. Connelly BL, Hoskisson RE, Tihanyi L, Certo ST (2010) Ownership as a form of corporate governance. J Manag Stud 47(8):1561–1589
14. Core J, Holthausen RW, Larcker DF (1999) Corporate governance, CEO compensation, and firm performance. J Financ Econ 51:371–406
15. Daiser P, Ysa T, Schmitt D (2017) Corporate governance of state-owned enterprises: a systematic analysis of empirical literature. Int J Public Serv Manag 30(5):447–466
16. Davenport TH (1998) Putting the enterprise into the enterprise system. Harv Bus Rev 76(4):121–132
17. Davenport TH, Harris JG, Cantrell S (2004) Enterprise systems and ongoing process change. Bus Process Manag J 10(1):16–26
18. Dehning B, Richardson VJ, Zmud RW (2003) The value relevance of transformational information technology investment announcements. MIS Q 27(4):637–656
19. Devaraj S, Kohli R (2003) Performance impacts of information technology: is actual usage the missing link? Manag Sci 49(3):273–289
20. Elhardan H, Ali M, Ghoneim A (2015) The dilemma of internal audit function adaptation: the impact of ERP and corporate governance pressures. J Enterp Inf Manag 28(1):93–106
21. Fan G, Wang X (2008) NERI index of marketization of China's provinces. Economics Science Press, Beijing **(Chinese)**
22. Fan JPH, Wei KCJ, Xu X (2011) Corporate finance and governance in emerging markets: a selective review and an agenda for future research. J Corp Financ 17:207–214
23. Franks J, Mayer C (2001) Ownership and control of German corporations. Rev Financ Stud 14(4):943–977
24. Gattiker TF, Goodhue DL (2005) What happens after ERP implementation: understanding the impact of interdependence and differentiation on plant-level outcomes. MIS Q 29(3):559–585
25. Ghosh A, Karuna C, Tian F (2015) Causes and consequences of the CEO also being the chair of the board. J Manag Account Res 27(2):197–223
26. Gompers P, Ishii J, Metrick A (2003) Corporate governance and equity prices. Quart J Econ 118:107–155
27. Gordon JN (2007) The rise of independent directors in the United States, 1950-2005: of shareholder value and stock market prices. Stanf Law Rev 59:1465–1568
28. Greenberg MD, Kang Y, Brown ED (2009) Corporate governance in China: a tale of rapid change. Corp Financ Rev 13(5):5–11
29. Guo L, Smallman C, Radford J (2013) A critique of corporate governance in China. Int J Law Manag 55(4):257–272
30. Gurbaxani V, Whang S (1991) The impact of information systems on organizations and markets. Commun ACM 34(1):59–73
31. Hermalin BE, Weisbach MS (1991) The effects of board composition and direct incentives on firm performance. Financ Manag 20:101–112
32. Jensen MC (1993) The modern industrial revolution, exit, and the failure of internal control systems. J Financ 48(3):831–880
33. Jensen MC, Meckling WH (1976) Theory of the firm: managerial behavior, agency costs and ownership structure. J Financ Econ 3:305–360

34. Kanellou A, Spathis C (2013) Accounting benefits and satisfaction in an ERP environment. Int J Account Inf Syst 14:209–234
35. Khanna T, Yafeh Y (2007) Business groups in emerging markets: paragons or parasites? J Econ Lit 45(2):331–372
36. Kohli R, Grover V (2008) Business value of IT: an essay on expanding research directions to keep up with times. J Assoc Inf Syst 9(1):23–39
37. Krell E (2007) ERP system controls. Bus Financ 13(4):18–22
38. Krell E (2007) ERP crashes the SOX party. Bus Financ 13(11):33–36
39. La Porta R, Lopez-de-Silanes F, Shleifer A (1999) Corporate ownership around the world. J Financ 54:471–517
40. Liang Y, Shi K, Wang L, Xu J (2017) Local government debt and firm leverage: evidence from China. Asian Econ Policy Rev 12:210–232
41. Lu Z, Huang J (2012) The moderating factors in the relationship between ERP investments and firm performance. J Comput Inf Syst 53(2):75–84
42. Mace ML (1972) The president and the board of directors. Harvard Bus Rev 50(2):37–49
43. Markus ML, Axline S, Petrie D, Tanis C (2000) Learning from adopters' experiences with ERP: problems encountered and success achieved. J Inf Technol 15:245–265
44. Morck R, Wolfenzon D, Yeung B (2005) Corporate governance, economic entrenchment, and growth. J Econ Lit 43:655–720
45. Morse Adair, Nanda Vikram, Seru Amit (2011) Are incentive contracts rigged by powerful CEOs? J Financ 66(5):1779–1821
46. Morton NA, Hu Q (2008) Implications of the fit between organizational structure and ERP: a structural contingency theory perspective. Int J Inf Manag 28:391–402
47. Mundy J, Owen CA (2013) The use of ERP systems to facilitate regulatory compliance. Inf Syst Manag 30:182–197
48. Orlikowski WJ (1992) The duality of technology: rethinking the concept of technology in organizations. Organ Sci 3(3):398–427
49. Pincus M, Tian F, Wellmeyer P, Xu SX (2017) Do clients' enterprise systems affect audit quality and efficiency? Contemp Account Res 34(4):1975–2021
50. Rong Z, Wu X, Boeing P (2017) The effect of institutional ownership on firm innovation: evidence from Chinese listed firms. Res Policy 46:1533–1551
51. Rosenbaum P, Rubin D (1983) The central role of the propensity score in observational studies for causal effects. Biometrika 70(1):41–55
52. Schryen G (2013) Revisiting IS business value research: what we already know, what we still need to know, and how we can get there. Eur J Inf Syst 22(2):139–169
53. Schubert P, Williams SP (2011) A framework for identifying and understanding enterprise systems benefits. Bus Process Manag J 17(5):808–828
54. Seddon PB, Calvert C, Yang S (2010) A multi-project model of key factors affecting organizational benefits from enterprise systems. MIS Q 34(2):305–328
55. Shleifer A, Vishny R (1997) A survey of corporate governance. J Financ 52:737–783
56. Shao Z, Feng Y, Hu Q (2016) Effectiveness of top management support in enterprise systems success: a contingency perspective of fit between leadership style and system life-cycle. Eur J Inf Syst 25:131–153
57. Staehr L, Shanks G, Seddon PB (2012) An explanatory framework for achieving business benefits from ERP systems. J Assoc Inf Syst 13(6):424–465
58. Sun Q, Tong WHS (2003) China share issue privatization: the extent of its success. J Financ Econ 70:183–222
59. Tanriverdi H (2006) Performance effects of information technology synergies in multibusiness firms. MIS Q 30(1):57–77
60. Volkoff O, Strong DB, Elmes MB (2005) Understanding enterprise systems-enabled organizations. Eur J Inf Syst 14(2):110–120
61. Weisbach MS (1988) Outside directors and CEO turnover. J Financ Econ 20:431–460
62. Yiu DW, Lu Y, Bruton GD, Hoskisson RE (2007) Business groups: an integrated model to focus future research. J Manag Stud 44(8):1551–1579
63. Young MN, Peng MW, Ahlstrom D, Bruton GD, Jiang Y (2008) Corporate governance in emerging economies: a review of the principal-principal perspective. J Manag Stud 45(1):196–220