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Value relevance of proportionate consolidation versus the equity method: Evidence from Hong Kong

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ABSTRACT

Whether proportionate consolidation (PC) or the equity method (EM) provides more informative financial statements is a controversial issue. This study uses data from listed companies in Hong Kong to investigate the value relevance of the EM compared with PC during 2005–2008 when the local word-for-word equivalent HKAS 31 offered the same options. The results of this study provide evidence that PC does not offer higher value relevance than the EM. PC's horizontal aggregation of a portion of the operations, assets and liabilities of the jointly controlled entities with those of the venturer is less informative to investors than the EM's vertical aggregation.

1. Introduction

This study investigates the value relevance of two alternative accounting methods, proportionate consolidation (PC) and the equity method (EM), which were introduced for reporting interests in jointly

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controlled entities[1] (JCEs) in International Accounting Standard No. 31 "Financial Reporting of Interests in Joint Ventures" (IAS 31 (1990)[2] (IASC, 1990; IASCF, 2010a). Consistent with the recent value relevance studies in the literature (e.g., O'Hanlon and Taylor, 2007; and as summarized in Barth et al., 2001), this study measures value relevance as the association between the key accounting amounts available from the companies' financial statements and their share prices.

In September 2007, as part of its efforts to eliminate choices in the existing standards (IASCF, 2010b), the International Accounting Standards Board (IASB) published Exposure Draft No. 9 "Joint Arrangements" (ED 9 (2007)) (IASCF, 2007a), which proposed to eliminate the PC option for reporting interests in JCEs from IAS 31 (1990), allowing only EM. Ironically, PC is the benchmark method in IAS 31 (1990) (IASC, 1990; IASCF, 2010a). An analysis of the comment letters received on ED 9 (2007) revealed, however, that about two thirds of the respondents disagreed with the proposed elimination of PC (Deloitte, 2008). The IASB was criticized for its haste in achieving convergence by adopting the U.S. standard (which allows only EM) without undertaking a detailed analysis of the accounting alternatives to select the most appropriate method (e.g., Knorr, 2008; Maes, 2008).

Joint venture arrangements provide ready access to new markets, expertise and technology, and the ability to reduce costs and spread risk (Koh and Venkatrman, 1991). A joint venture is an important form of business arrangement, making it essential to establish clear guidance on its reporting.

This study aims to investigate whether EM and PC result in financial statements that provide different value relevance for investors in the capital market. The Conceptual Framework identifies investors as the primary users of financial reports and the reports are primarily intended to facilitate their value estimations (IFRSF, 2010). Empirical studies specifically comparing EM and PC are sparse and their broad focus is on selected accounting ratios and more specifically on their differential accounting return predictability (Graham et al., 2003) and bond riskiness relevance (Kothavala, 2003; Stoltzfus and Epps, 2005; Bauman, 2007). By examining the value relevance of the key accounting figures derived from EM versus PC financial statements, this study provides a stronger and more comprehensive empirical input for the debate on ED 9 (2007), and on the suitability of the IASB's removal of the PC option from IAS 31 (1990).

In this study, we examine the value relevance of EM versus PC in the context of public companies listed on the Hong Kong Stock Exchange (HKSE) since 2005, for two reasons. First, since their full convergence on 1 January 2005, the local Hong Kong Financial Reporting Standards (HKFRS) replicate the International Financial Reporting Standards (IFRS) word-for-word and paragraph-for-paragraph. The Hong Kong Accounting Standards No. 31 "Interests in Joint Ventures," issued in December 2004 (HKICPA, 2004) (HKAS 31 (2004)), carries the same alternative options for interests in JCEs, and the results of this study can therefore serve as a strong reference for IAS 31 (1990) in the IFRS. Second, HKSE listers are likely to

[1] IAS 31 (1990) defines a JCE as a joint venture arrangement that involves the establishment of a corporation, partnership or other entity in which each venturer has an interest. "Joint Arrangements" in ED 9 (2007), however, proposes replacing the term "JCE" with "joint venture" (IASCF, 2007a). ED 9 (2007) defines "joint venture" as a joint arrangement that is jointly controlled by venturers who do not have rights to individual assets or obligations for expenses of the venture but rather, each venturer is entitled to a share of the outcome (e.g., profit or loss) of the activities of the joint venture. "Joint venture" in ED 9 (2007) therefore has essentially the same meaning as "JCE" in IAS 31 (1990), where the venturers' rights to the assets and liabilities of the venture are indirectly attained through their interests in the JCE. Throughout this paper, we use "JCE" to avoid an attempt to anticipate the outcome of ED 9 (2007), which is expected to be finalized in the first quarter of 2011 (IASB, 2011). The term "joint venture" is also used in this paper, but it refers to joint ventures in general. However, we admit that the definitions of "joint venture" under IAS 31 and ED 9 are not exactly the same. Under IAS 31, the definition is more based on the legal form of the joint arrangement. In contrast, under ED 9 the definition is mainly driven by the economic substance of the joint arrangement. This could be a caveat for our research.

[2] The two alternative accounting methods for JCEs (EM and PC) examined in this paper were first introduced in IAS 31 in 1990 by the former International Accounting Standards Committee (IASC). Although IAS 31 (1990) was reformatted in 1994, slightly amended in 1998, 1999 and 2000, re-adopted by the IASB in 2001, re-titled "Interests in Joint Ventures" in 2003, and further amended in 2004 and 2008 as a result of amendments in other accounting standards, no change has been made to the two alternative methods first introduced in 1990. Throughout this paper, reference is made to IAS 31 (1990), although it has been replaced by the subsequent updated versions and conveniently contained in the yearly bound volumes of the International Financial Reporting Standards (IFRSs) as approved at the beginning of each year.

have significant investments in joint ventures, especially those in mainland China,[3] as a result of the latter's entry into the World Trade Organization, the popularity of Chinese–foreign joint ventures (Nippa et al., 2007) and the reported vast investments coming from Hong Kong in particular (Jiang, 2006). With the availability of more observations with more significant[4] investments in joint ventures, the test power of this study will be higher.

Using models adapted from Easton and Harris (1991), Amir et al. (1993) and Barth (1994), this study provides evidence that PC does not offer higher value relevance than EM. Specifically, PC's horizontal aggregation of a portion of the operations, assets and liabilities of the JCEs is less informative to investors than EM's vertical aggregation.

This paper proceeds as follows. Section 2 describes joint venture accounting. Section 3 describes related studies and Section 4 details the research method. Section 5 discusses the empirical results, and the paper concludes in Section 6 with a summary and discussion of the research limitations.

2. Joint venture accounting

A JCE is an incorporated joint venture arrangement. Unlike investments in subsidiaries, control over a JCE is joint rather than exclusive and is shared with the other venturers through unanimous decisions on the financial and operating policies of the JCE (IASCF, 2010a, 2007a). It is the shared control over the essential activities of such an entity that gives rise to unique joint venture accounting issues.

2.1. Vertical versus horizontal aggregation

Technically, EM and PC are two very different methods and can significantly influence the amounts reported on the face of financial statements. The requirements for disclosure in the footnotes of the accounts are, however, essentially the same under the two methods.

IAS 31 (1990) allows a choice between the two methods but recommends PC as the benchmark method and permits EM as an alternative treatment. In contrast, the U.S. standard mandates EM (APB, 1971).

EM has been referred to as a "one-line consolidation," whereby the venturer's interests in the JCE's individual assets and liabilities and individual income and expense items are "vertically" aggregated into a single line item on the balance sheet (labeled as "interests in JCE," representing the venturer's share of the JCE's net assets) and income statement (labeled as "share of profit of JCE"), respectively. EM is illustrated in Panel A of Exhibit 1. Because the IFRS mandates EM for investments in associates,[5] full details about EM are provided in IAS 28 "Investments in Associates" (IASCF, 2010c).

PC, in contrast, involves a "horizontal" line-by-line "bringing together" of the venturer's share of each of the individual assets and liabilities, income and expense items of the JCE with the venturer's own items (IASCF, 2010a). In taking a line-by-line approach, the method is similar to the full consolidation method as applied to subsidiaries, but dissimilar because only the venturer's share of the JCE is included.

In PC (IASCF, 2010a), two reporting formats may be used for the "bringing together." The venturer may aggregate the venturer's share of each of the individual assets and liabilities, income and expense items of the JCE horizontally with the venturer's own items line-by-line. Alternatively, the venturer may maintain them in separate line items. The two reporting formats are illustrated in Panels B1 and B2 of Exhibit 1 and are labeled as "combined" and "separate" formats, respectively.

[3] Mainland China, Continental China and the Chinese mainland are geopolitical terms that refer to the area under the jurisdiction of the People's Republic of China, excluding Hong Kong and Macau, which run on different economic and political systems. This is the so-called one country, two systems.

[4] As of 31 December 2008, 202 HKSE listers had interests in JCEs (comprising 23% of the total 867 HKSE listers with December year ends). Of the 342 observations (firm-years) in this study, 304 had JCEs in mainland China, of which 18 had 20–43 such JCEs and the mean number of mainland China JCEs per observation was 4.44.

[5] An associate is an entity over which the investor has significant influence and is neither a subsidiary nor an interest in a joint venture (IASCF, 2010c). It is presumed that an investor has significant influence if the investor holds, directly or indirectly (e.g. through subsidiaries), 20% or more of the voting power of the investee, unless it can be clearly demonstrated that this is not the case (IASCF, 2010c).

The separate format of PC is, however, rarely used in practice,[6] presumably because it results in large and cumbersome statements. This separate format is therefore not examined in this study. Throughout this paper, the term "PC" refers to the combined format of PC.

IAS 31 (1990) also has specific requirements for the supplementary disclosure in the notes to the accounts. It requires that a venturer using EM or the combined format of PC also disclose the aggregate amounts of current assets, non-current assets, current liabilities and non-current liabilities and income and expenses related to its interests in JCEs. These additional disclosures closely resemble those that are otherwise presented on the face of the financial statement if the separate format of PC is adopted. No supplementary disclosure in the notes to the accounts is therefore required for the separate PC format in IAS 31 (1990). In this paper, which limits its scope to EM and the combined format of PC, there is therefore no difference in their supplementary footnote disclosure requirements.

Although EM and PC differ only in their means of aggregation, the resulting accounting amounts presented in financial statements are, however, different except for the bottom-line profit and shareholders' equity, which are the same regardless of whether EM or PC is used. This study focuses on the key accounting amounts of total operating income (or revenue), total operating expenses, other income and expenses (net) and total assets and liabilities, which are intrinsically different under EM and PC.

2.2. Arguments for and against

The arguments for and against the two methods are discussed at great length in a special report "Reporting Interests in Joint Ventures and Similar Arrangements," issued by the U.S. FASB in cooperation with the G4 + 1[7] in September 1999 (Milburn and Chant, 1999). There are two main issues in the arguments: (1) the control debate, and (2) the need for informativeness about the assets and liabilities of JCEs. The former revolves around the accounting definitions of assets and liabilities and tends to reject PC, while the latter assumes a user's perspective and tends to disapprove of EM. Testing definition-based arguments is difficult because it depends on the validity of the definitions themselves. This paper aims to clarify the second issue, informativeness, by testing empirically whether accounting amounts reported in PC financial statements provide a higher association with share prices than those in EM financial statements. A higher association indicates that the information is more relevant to the investors (as the major group of users of financial statements) and is therefore more informative.[8]

2.2.1. Control debate

The two methods can be compared in terms of their consistency with the definitions of an asset in terms of "control" and a liability as a present obligation. Such comparison tends to disprove PC. This is also the main concern raised in ED 9 (2007): by adding the venturer's share of assets and liabilities line-by-line horizontally to those of the venturer's, "*PC can lead to the recognition of assets that are not controlled and liabilities that are not obligations*" (IASCF, 2007b Paragraph BC 8). A venturer shares control of the activities of the JCE via "shared decisions" only. ED 9 (2007) stresses that "*when a party has an interest in only a share of the outcome generated by the activities of a group of assets and liabilities that it jointly controls, the only asset it controls is its investment in the joint venture*"[9] (IASCF, 2007c Paragraph IN8). This is the only asset that is recognized using EM.

[6] None of the sample companies in this study follows the "separate" format of PC.

[7] G4 + 1 was an informal group formed in the early 1990 s, initially comprising representatives of the Australian Accounting Standards Board, Canadian Accounting Standards Board, United Kingdom Accounting Standards Board, U.S. FASB and observation by the former International Accounting Standards Committee (IASC, reorganized into the International Accounting Standards Board, IASB, in 2001). It aimed to work cooperatively on new issues in financial reporting and to eliminate some of the accounting differences between countries. Its activities came to a halt in 2001 when the former IASC was restructured into the IASB, which is designed to include an active partnership with national standard setters to achieve global convergence.

[8] "Joint venture" in ED 9 (2007) is essentially the same as "JCE" in IAS 31 (1990), where the venturer's interest in the assets and liabilities of the JCE are indirect. This paper continues to use "JCE" because it is more descriptive and less generic.

[9] The "expanded EM" of accounting presents the venturer's proportionate interest in major classes of assets, liabilities, revenues and expenses (e.g., property, plant and equipment, intangibles, current assets, cost of sales, operating expenses, etc.) of a JCE as separate line items within the venturer's financial statements (Dieter, Wyatt, & Reklau, 1978). The "expanded equity method" is equivalent to the "separate" format of proportionate consolidation in IAS 31 (1990).

2.2.2. Informativeness debate

The vertically aggregated consolidation of EM has been criticized as uninformative in conveying the scope of operation and the assets and liabilities of the venturer because it reports its share of the JCE net asset only in one line. EM is sometimes regarded as enabling a venturer to avoid balance sheet recognition of its share of the JCE's individual assets and liabilities, to hide debts and facilitate off-balance-sheet activities (e.g., Milburn and Chant, 1999). Similarly, Penman (2007) and White, Sondhi and Fried (2003) comment that EM income statements lack detail on the venturer's share of JCE revenues and expenses, and effective financial analyses are potentially hindered as a result.

Mathematically, EM tends to improve financial ratios. For example, by including the venturer's share of JCE earnings in the profit for the period while at the same time excluding the sales revenue and asset base used to generate these earnings, EM reports a higher profitability margin and return on assets although return on equity is unaffected. Similarly, netting joint venture assets and liabilities in the "interests in JCE" account results in a lower leverage ratio, and shielding JCE interest expense in the one-line presentation of "share of JCE profit" results in higher interest coverage (Bauman, 2003). This is illustrated in Panel C of Exhibit 1.

Proponents of PC strongly believe that because PC involves less aggregation (line-by-line horizontal aggregation), it provides more useful information (e.g., Feld et al., 2008). Thus, the issue for the proponents of PC is not whether there are faults in the underlying conceptual validity, but whether the resulting accounting information is more useful for its users.

The informativeness debate is clearly an empirical question. This paper aims to provide an answer to this question by testing empirically the value relevance of EM versus PC statements.

3. Related studies

Practitioners and academics have discussed the issues concerning the concepts and procedures underlying the alternative accounting methods for joint ventures since the 1960s. Kocan (1962), Nielsen (1965) and Reklau (1977) suggest that PC should be used if joint ventures are a way to extend the venturers' activities, and the joint venture debts are in reality venturers' obligations. Dieter et al. (1978) recommend their "expanded EM,"[9] which is essentially PC in the separate format. Neuhausen (1982) points out that EM may not provide useful information about the venturer's resources and obligations arising from its JCE investment. These viewpoints are largely consistent with the preference for PC in IAS 31 (1990) that *"the substance and economic reality are reflected in the consolidated financial statements of the venturer when the venturer recognizes its pro-rata share of interests in the assets, liabilities, income and expenses of the JCE using ... PC*" (IASCF, 2010a Paragraph 32).

Bierman (1992) uses finance theory to argue that PC is superior and should be used for all material intercorporate common stock investments, even majority-owned subsidiaries. King and Lembke (1994) also consider the contentious issue of joint venture accounting, recommending EM when the operations of the venturer and the joint venture are dissimilar and PC when they are similar. Davies and Largay (1999) perform a hypothetical analysis but find "*no substantive justification for continued use of the EM...due to the method's intrinsically limited informational characteristics*" (Davies and Largay, 1999, p. 281). Instead, they recommend PC in two formats, combined or separate (labeled as "expanded EM"), as in IAS 31 (1990), depending on whether the operations of the venturer and the joint venture are similar or dissimilar. In contrast, the earlier mentioned FASB/G4 + 1 report (Milburn and Chant, 1999) reviews and concludes that EM is the more appropriate method, primarily because of the conceptual fault of the PC alternative. Nobes (2002) criticizes EM for its lack of independent theoretical justification, and warns that the pressure for international harmonization ("harmonization haste") can lead to worldwide use of bad methods as well as good ones, an issue also addressed in Miller and Leo (1997).

Addressing the concern that EM promotes off-balance-sheet activities, Bauman (2003) proxies the magnitude of off-balance-sheet activities concealed under EM by the incremental amount of assets/liabilities under *pro forma* PC. The finding that market participants place greater weight on off-balance-sheet liabilities than assets for companies that provide explicit guarantees of investee obligations provides some empirical support for PC in the financial statements.

There is also concern about the conceptual validity of using the same EM to account for both investments in JCEs and associates if the option of PC is removed for JCEs. Joint control typically envisages a higher degree of influence than that of a "significant influence" over an associate, although this is not supported by the results of related empirical studies (O'Hanlon and Taylor, 2007; Soonawalla, 2006).

To date, there are few empirical studies directly comparing EM and PC, and those that do focus on the implications for the venturer's bond rating arising from the differential off-balance-sheet nature of the reported interests in the joint venture under the two methods. Using a sample of Canadian firms, Kothavala (2003) finds that accounting ratios such as leverage, return on assets and profit margin produced from EM statements are more relevant for bond ratings than are those from PC statements. As the findings are surprising, Bauman (2007) re-examines the issue using a sample of U.S. manufacturing firms and finds, in contrast, that PC ratios have greater bond rating relevance. He attributes the differing results to the greater sample homogeneity in his study. An earlier study by Stoltzfus and Epps (2005), using a sample of U.S. firms, also finds that selected PC-computed accounting ratios are more strongly associated with bond risk premiums, but the strong association is only for firms that guarantee the debt of their joint venture investments. Graham et al. (2003) examine the predictability of profits and find that PC provides more informative DuPont ratios than EM for predicting future returns on shareholders' equity (book/accounting based) for a set of Canadian firms. Lourenco and Dias Curto (2010) examine the determinants of the management choice between EM and PC and their results support their prediction that venturers are more likely to change to PC when the majority of their JCEs are "linked" cases; i.e., when each venturer contributes its own critical resources to enter a new business and each controls its own share of the JCE assets and liabilities.

To the best of our knowledge, no study has directly compared the relevance of the two accounting practices for share pricing in the capital market (i.e., value relevance). Following Ball and Brown (1968), the examination of share price behavior is deemed to be an effective way to study investors' behavior as a group, and an accounting number is value relevant to an investor if it is capable of influencing that investor's decision, and has a predicted significant relation with the share price (Amir et al., 1993; Barth et al., 2001; Hu et al., 2014). Brown and Howieson (1998) identify a number of areas for future capital research in an accounting standard setting, one of them being joint venture accounting. This study aims to address this apparent gap in the literature and seeks to understand the value relevance of the two alternative accounting practices for joint ventures.

A review of the studies by Kothavala (2003), Graham et al. (2003), Stoltzfus and Epps (2005) and Bauman (2007) raises a common question about their research design—the use of artificial "pro forma" financial statements and the accounting ratios computed from them. These studies are conducted in either the U.S. or Canada, where only one method is allowed (Canada generally requiring PC and the U.S. requiring EM). To make comparisons between the two alternative methods, accounting numbers and ratios are computed from pro forma statements constructed for the other method "as if" the users have full knowledge about the differences in the two methods and have correctly made all of the necessary adjustments accordingly. Unlike these earlier studies, this study utilizes the uniqueness of the regulatory financial reporting setting in Hong Kong for accounting years beginning on or after 1 January 2005, when a choice between EM and PC was available. The use of differential reporting practices in Hong Kong enables us to examine the two alternative methods in a "real" setting where the "true" share price implications are known and measurable.

4. Research method

Value relevance research typically examines the association between accounting amounts and share price levels or firm value in aggregate (Landsman, 1986; Barth, 1994). Examining changes in share price levels, or returns, is an alternative approach to assessing value relevance (Easton and Harris, 1991; Amir et al., 1993). This study examines the association with both firm value and returns. Consistent results for both associations allow us to be more confident about the robustness of the subsequent inferences, despite the econometric limitations[10] arising from the use of price-based models (Christie, 1987; Kothari and Zimmerman, 1995).

[10] The econometric limitations of the price-based valuation and returns model are largely due to dependencies between the error term of the regression and the independent variables (Christie, 1987). These dependencies may be due to errors in variables, correlated omitted variables or variation in coefficients across observations (Christie, 1987).

Another frequently used model for value relevance research is that based on Ohlson (1995), which conveniently incorporates both the balance sheet and income statement effects in a single equation (Barth et al., 2001). Nevertheless, we do not use Ohlson's (1995) model in this study because its "clean surplus" assumption[11] is more restrictive than the accounting standard requirement (Barth 1994) and may not reflect the real situation.

The difference between EM and PC is not confined to just a few specific financial statement items. The difference is wide-ranging and simultaneously affects almost all of the reported items, except the bottom-line profit and shareholders' equity (or net assets). Because it is practically impossible to include all of the affected items, we focus on the key summary statement items that are affected by whether EM or PC is used. For the return model, we include total operating income (or revenue), total operating expenses and other income/expenses (net) reported on the income statements. For the firm value model, we include total assets and total liabilities reported on the balance sheets. By including a dummy variable in both models to indicate whether EM or PC is used during the accounting year, the value relevance of the two methods can be compared.

Control variables are also included in our regressions. To ensure that our results fully capture the effects from the key summary statement items, which are intrinsically different between EM and PC, we ensure that the control variables are measured in such a way that they are the same whether EM or PC is used.

Following Fan and Wong (2002) and Haw et al. (1999), we include typical control variables of firm size, growth opportunity, industry and accounting year. Because the use of EM or PC in the financial statements changes the amounts reported for total assets and total revenue, this study uses market capitalization to measure firm size. For the same reason, growth opportunity is measured by the market-to-book value of equity, which is not affected by the JCE method used.

Because previous studies suggest the possible impact of the operational similarity between a JCE and a venturer (King and Lembke, 1994; Davies and Largay, 1999), we also include control variables indicating whether the venturer provides a guarantee related to the JCE debt (Stoltzfus and Epps, 2005), whether a significant portion of business is conducted through JCEs (Feld et al., 2008), operational similarity, guarantee provision and the size of JCE interest. The size of JCE interest is measured as the venturer's share of JCE net assets as a proportion of the venturer's net assets, both of which are unaffected by the JCE method used.

While previous studies include leverage and return on assets (Fan and Wong, 2002; Kothavala, 2003; Graham et al., 2003; Stoltzfus and Epps, 2005; Bauman, 2007), this study uses the ratio of the venturer's share of the JCE's total liabilities to the venturer's own total liabilities (i.e., without including the venturer's share of the JCE's total liabilities) and return on equity to avoid the difference introduced by the use of either EM or PC in the financial statements.

Mainland China-based companies (red chips[12] and H-shares[13]) are significant in the Hong Kong stock market. The total market capitalization of these companies in December 2008 was HK$5608 billion, representing 55% of the total market capitalization of all HKSE equities (51% in 2007, 48% in 2006 and 37% in 2005) (HKSE, 2005, 2006, 2007, 2008). These mainland China-based companies have to comply with HKFRS or IFRS in the same way as all other companies listed on the HKSE. However, because investors may have different criteria for these companies (Cheung et al., 2007), a dummy variable is included to distinguish them from the other Hong Kong-based companies.

[11] Ohlson's (1995) model expresses firm value in terms of accounting earnings and equity book value. Ohlson's "clean surplus" assumes that all changes in assets/liabilities (except those arising from dividends and capital contributions) must pass through the income statement, i.e., the change in book value is equal to earnings minus dividends (net of capital contributions).

[12] An H-share company is a company incorporated in mainland China but traded on the HKSE. H-share companies' activities are based in mainland China (HKSE 2004). Their financial statements are in Renminbi, the currency of mainland China, and are prepared following the mainland China accounting standards for reporting in mainland China and the IFRS or HKFRS for reporting in Hong Kong. Their shares are quoted in Hong Kong dollars on the HKSE. According to the statistics published by the HKSE, 1261 companies were listed on the HKSE by the end of 2008, of which 150 were H-share companies (HKSE, 2008).

[13] A red chip company is a company incorporated outside mainland China and listed on the HKSE. Although red chips are not mainland-China-incorporated, they are controlled by mainland China entities (individuals or companies), by way of direct or indirect shareholdings and/or representation on the board of directors (HKSE 2004). If they are part of a mainland China group, their financial statements are to be consolidated and must be in Renminbi and prepared following the mainland China accounting standards. According to HKSE statistics, among its 1261 listed companies, 95 were red-chip companies (HKSE, 2008).

Although Hong Kong companies are free to choose their accounting year-end dates, 31 December is the most popular date, chosen by around 72% of HKSE companies from 2005 to 2008 (as estimated from Datastream). To ensure a simpler research design, this study includes only companies with 31 December year-ends. The sample years in this study are 2005–2008, covering the four-year period when the two alternative options for JCE accounting are available.

Because the choice between EM and PC is an endogenous decision for each company and the factors that determine the EM-PC choice can also influence the dependent variables in the study, we calculate the inverse Mills ratio[14] (Heckman, 1976) and include it in both the return and firm value regressions to control for the possible selection bias in the estimations.

Following Haw et al. (1999), to mitigate the scale effect, we deflate all of the variables (except the dummy and ratio variables) in the returns association with the market value of common equity on the first day of the fifth month after the beginning of the accounting year, and those in the firm value association with the number of common shares outstanding on the last day of the fourth month after the end of the accounting year. As HKSE listed companies are required to announce their results and publish their annual reports within four months of the accounting year end, an important part of the analyses in this study is based on the 12-month period extending from the first day of the fifth month after the beginning of the accounting year until the last day of the fourth month after the end of the accounting year, which captures the period between the results announcements. As the sample companies in this study all have 31 December year-ends, the between-results announcement period is the 12-month period from May 1 to April 30 of the next year.

4.1. Return association

The return association approach is based on Beaver's (1981) information perspective on financial reporting, which posits that in response to the release of a company's financial statements, investors will analyze the statements for new and unexpected information and revise their beliefs about the company's future performance, causing movements in the company's share prices and resulting in abnormal returns to investors (as first hypothesized by Ball and Brown, 1968). Thus, financial statement information is informative and decision-useful or value-relevant if it results in abnormal returns to investors. Easton and Harris (1991) confine the financial information to reported income or earnings from the income statement and develop a model relating unexpected earnings to abnormal returns. Easton and Harris (1991) measure unexpected earnings by earnings change and earnings level. Earnings change is identified as the dominant measure, while earnings level is included to reduce the measurement error bias in the regression estimates[15] (Brown et al., 1987; Easton et al., 1991). Amir et al. (1993) devise a simple method to measure an abnormal return as the difference between the company's return during the period and the return on the market portfolio, also known as the market-adjusted rate of return.[16] The market-wide return is removed and the abnormal return thus obtained represents a company-specific return, a major indication of abnormal returns. Barth (1994) extends earnings to earnings components and examines the informativeness of a particular component—securities gains and losses. This study focuses on the key summary components of the venturer's earnings that are intrinsically

[14] The inverse Mills ratio, named after John Mills, is a ratio commonly applied in regression analyses to take account of possible selection biases. Heckman (1976) proposed a 2-stage estimation procedure using the inverse Mills' ratio to overcome possible selection biases. In the first stage, a regression to observe a positive outcome of a particular selection is modeled with a probit model. The estimated parameters are then used to calculate the inverse Mills ratio, which is then included as an additional explanatory variable in the second stage OLS estimation.

[15] Easton and Harris (1991) include earnings change (current earnings – previous earnings) as the dominant measure of unexpected earnings, assuming that earnings follow a random walk and previous earnings represent expected earnings. However, the evidence in Beaver and Morse (1978) suggests that earnings/price ratios are mean-reverting and thus the current earnings level may be a useful alternative measure of unexpected earnings. Brown et al. (1987) also demonstrate that multiple proxies for unexpected earnings may reduce the measurement bias in the regression estimates. Easton and Harris (1991) therefore include both earnings change and earnings level as measures of unexpected earnings, although earnings change is the dominant measure.

[16] Brown and Warner (1980) find the market-adjusted rate of return, despite its simplicity, to perform reasonably well under a wide variety of conditions when compared with the more conventional market model used in Ball and Brown (1968) and other studies (e.g., Ball and Kothari, 1991).

different under EM and PC—total operating income (or revenue), total operating expenses and other income and expenses (net) from the income statements.

Following Easton et al. (1991), Amir et al. (1993) and Barth (1994), the regression equations below are used to evaluate the differential value relevance of EM versus PC key income statement components. The main variables of interest are the interaction variables $\Delta INC \times METHOD$, $\Delta EXP \times METHOD$ and $\Delta OINC/EXP \times METHOD$, which are constructed by interacting the EM versus PC variable of METHOD with the dominant measure of unexpected earnings – the earnings change component variables ΔINC, ΔEXP and ΔOINC/EXP.

$$\begin{aligned} AR = {} & a_0 + a_1 METHOD + a_2 INC + a_3 EXP + a_4 OINC/EXP + a_5 \Delta INC + a_6 \Delta EXP \\ & + a_7 \Delta OINC/EXP + a_8 \Delta INC \times METHOD + a_9 \Delta EXP \times METHOD + a_{10} \Delta OINC/EXP \\ & \times METHOD + a_{11} SJCELIAB + a_{12} SJCENA + a_{13} SIMILAR + a_{14} GUAR + a_{15} SIZE \\ & + a_{16} GROW + a_{17} ROE + a_{18} MCHINA + a_{19} IND + a_{20} YR + a_{21} INVMR \end{aligned} \quad (1)$$

The variables are defined as follows.

AR is the buy-and-hold[17] abnormal return (adjusted for dividends and stock splits) for the 12 months beginning on the first day of the fifth month after the beginning of the accounting year, calculated using the market-adjusted return.

METHOD is a dummy variable that indicates whether EM or PC is used for JCE reporting during the accounting year; METHOD is set to one if PC is used during the accounting year, and zero otherwise.

INC is the company's total operating income (or revenue) in the accounting year, as available from the income statements, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.

EXP is the company's total operating expenses in the accounting year, as available from the income statements, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.

OINC/EXP is the company's other income and expenses (net) in the accounting year, as available from the income statements, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year,

ΔINC is the difference between INC in the current and previous accounting year, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.

ΔEXP is the difference between EXP in the current and previous accounting year, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year,

ΔOINC/EXP is the difference between OINC/EXP in the current and previous accounting year, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.

SJCELIAB is the venturer's share of the JCE's total liabilities relative to the venturer's own total liabilities at the end of the accounting year.

SJCENA is the venturer's share of the JCE's net assets relative to the venturer's net assets at the end of the accounting year.

[17] While there is disagreement in the literature regarding the method for calculating long-run abnormal returns because of the inherent right-skewed non-normal distribution problem (Lyon et al., 1999), the choice of method is not as important for the measurement of short-run abnormal returns (Fama, 1998; Jakobsen and Voetmann, 2003). Because a horizon of 3–5 years is referred to in the literature as long-run, the12-month abnormal returns in this study constitute short-run returns. Commonly used abnormal returns in event studies are buy-and-hold abnormal returns (BHAR) (monthly abnormal returns compounded) and cumulative abnormal returns (CAR) (monthly abnormal returns summed and averaged). Lyon et al. (1999) suggest BHAR as suitable for answering the question of whether sample firms earn abnormal returns over a particular period of time, while CAR is preferred where sample firms persistently earn abnormal monthly returns. Fewer data are collected for BHAR because the compounded monthly returns are simply the annual return; BHAR is therefore used in this study.

SIMILAR is a dummy variable to indicate whether the operations of the majority of the JCEs are similar to those of the venturer/venturer-group during the accounting year. SIMILAR is set to one if the operations are similar and zero otherwise.

GUAR is a dummy variable to indicate whether the venturer/venturer group provides a financial guarantee on the JCE debt. GUAR is set to one if a financial guarantee is provided and zero otherwise.

SIZE is the natural logarithm of the company's market capitalization at the end of the accounting year.

GROW is the ratio of the company's market-to-book value of equity at the end of the accounting year.

ROE is the ratio of the company's profit for the accounting year after preferred dividends divided by the equity at the beginning of the accounting year.

MCHINA is a dummy variable to indicate whether the company is mainland China-based during the accounting year. MCHINA is set to one if the company is a red chip or H-share company, and zero otherwise.

IND is a set of eight dummy variables IND1, IND2, IND3, IND4, IND5, IND6, IND7 and IND8 to indicate the company's industry in the accounting year, out of the nine industry sectors classified by the HKSE: conglomerates, consumer goods, energy, industrial goods, information technology, materials, properties and construction, services and telecommunications.

YR is a set of three dummy variables, YR1, YR2 and YR3, to indicate the four accounting years ending 31 December 2005, 2006, 2007 and 2008.

INVMR is the inverse Mills ratio computed from a probit regression of the EM-PC choice model, which includes company characteristic variables that may influence the likelihood of a company adopting EM or PC for their JCE interests:

$$\begin{aligned}\text{METHOD} = {} & x_0 + x_1\text{SJCELIAX} + x_2\text{SJCENA} + x_3\text{SIMILAR} + x_4\text{GUAR} + x_5\text{SIZE} + x_6\text{GROW} \\ & + x_7\text{ROE} + x_8\text{MCHINA} + x_9\text{IND}\end{aligned}$$

The focus of this study is on the sign and significance of the differential slope coefficients a_8, a_9 and a_{10} of the interaction variables $\Delta\text{INC} \times \text{METHOD}$, $\Delta\text{EXP} \times \text{METHOD}$ and $\Delta\text{OINC/EXP} \times \text{METHOD}$. As the dummy variable METHOD is coded 1 when PC is used, support for the higher value relevance of PC over EM is provided if the resulting coefficients a_8 and a_{10} (assuming net other income) are both individually significant and positive and a_9 is significantly negative. Conversely, if a_8 and a_{10} (a_9) turn out to be significantly negative (positive), it will provide support for the higher relevance of EM over PC.

Prediction is more straightforward for the separate value relevance of EM and PC. The value relevance of EM (i.e., when $\text{METHOD} = 0$) is assessed by the individual coefficients a_5, a_6 and a_7 of ΔINC, ΔEXP and $\Delta\text{OINC/EXP}$, respectively. The value relevance of PC is assessed by the individual sums of the coefficients a_5 and a_8, a_6 and a_9, and a_7 and a_{10}. The signs of a_5, a_7, the sum of a_5 and a_8, and the sum of a_7 and a_{10} are each expected to be positive, as they are the coefficients of ΔINC and $\Delta\text{OINC/EXP}$ (assuming net other income). The signs of a_6 and the sum of a_6 and a_9 are expected to be negative as they are the coefficients of ΔEXP.

4.2. Firm value association

An alternative value relevance model expresses firm value as a function of the book values of the firm's asset and liability components (Barth, 1994). Following Barth (1994), and with the control variables and inverse Mills ratio added as in the return association, the following regressions evaluate the differential value relevance of the key summary accounting amounts of total assets and total liabilities available from the EM versus PC statements of financial position.

$$\begin{aligned}\text{MV} = {} & b_0 + b_1\text{METHOD} + b_2\text{ASSET} + b_3\text{LIAB} + b_4\text{ASSET} \times \text{METHOD} + b_5\text{LIAB} \\ & \times \text{METHOD} + b_6\text{SJCELIAB} + b_7\text{SJCENA} + b_8\text{SIMILAR} + b_9\text{GUAR} + b_{10}\text{SIZE} \\ & + b_{11}\text{GROW} + b_{12}\text{ROE} + b_{13}\text{MCHINA} + b_{14}\text{IND} + b_{15}\text{YR} + b_{16}\text{INVMR} \qquad (2)\end{aligned}$$

where MV is the market value of common equity on the last day of the fourth month after the end of the accounting year, scaled by the number of common shares outstanding (adjusted for dividends and stock splits) on the last day of the fourth month after the end of the accounting year.

ASSET is the company's total assets at the end of the accounting year, as available from the statements of financial position, scaled by the number of common shares outstanding (adjusted for dividends and stock splits) on the last day of the fourth month after the end of the accounting year.

LIAB is the company's total liabilities at the end of the accounting year, as available from the statements of financial position, scaled by the number of common shares outstanding (adjusted for dividends and stock splits) on the last day of the fourth month after the end of the accounting year.

As in regression Eq. (1), the differential value relevance of PC over EM for the statements of financial position is assessed in Eq. (2) by the differential slope coefficients b_4 and b_5 of the interaction variables ASSET × METHOD and LIAB × METHOD. If PC is of higher relevance, b_4 will be significantly positive and b_5 significantly negative. Conversely, if EM is of higher relevance, b_4 will be significantly negative and b_5 significantly positive.

Similar to the coefficients of ΔINC, ΔEXP and ΔOINC/EXP in regression Eq. (1), the coefficients of ASSET are expected to be positive and those of LIAB are expected to be negative, irrespective of whether EM or PC is used. The coefficients of EM are indicated by b_2 and b_3 while those of PC are indicated by the sum of b_2 and b_4 and the sum of b_3 and b_5.

5. Empirical results

Data for this study are collected from two sources. The financial statement data are hand-collected from the financial statements published on the website of the HKSE http://www.hkex.com.hk. The Morgan Stanley Capital International (MSCI) Equity Hong Kong Index is used as the proxy for equity market return in Hong Kong. The equity market data, including the MSCI Equity Hong Kong Index, are obtained from Datastream.

5.1. Sample characteristics and descriptive statistics

Companies are eligible for selection if, during the 2005 to 2008 sample period, they had interests in JCEs at the year end(s) and (1) they are listed on the HKSE, (2) their accounting year ended on 31 December 2005, 2006, 2007 and 2008, (3) they are not in the finance and utilities industries, (4) their share of JCE total assets is higher than their share of JCE total liabilities, i.e., their share of JCE net assets is a positive amount, (5) they report positive values for their shareholders' equity, and (6) they did not change their accounting year ends, company names or HKSE listing codes during 2004–2008.[18]

After also excluding the cases with missing data, 398 firm-year observations remain. Extreme observations with less than 3% interest in a JCE (i.e., JCESIZE < 3%) are also excluded to mitigate undue influence from these observations, yielding a final sample of 342 firm-year observations.

Table 1 provides the sample make-up according to the categorical characteristics of companies, as a whole and separated into EM and PC venturers. The number of sample companies available increases from 2005 to 2008 (43 to 136), showing that joint ventures were becoming more popular as a form of business arrangement. Throughout the sample years, more companies applied EM than PC (66% of the firm-years applied EM, and 34% PC), largely because the local Hong Kong Statement of Standard Accounting Practice No. 21 "Accounting for Interests in Joint Ventures" (HKSA, 2001), which was in force before 2005, mandated EM. In 2005, even though the convergence with the IFRS opened up PC as an alternative method, the popularity of EM was maintained among the HKSE listers.

Although not reported in Table 1, our sample includes six companies that changed from EM to PC in 2005 and five companies that changed from PC to EM in 2008. Checking against their annual report disclosures revealed that they made the change for convenience only. They were red chip or H-share companies (so-

[18] We exclude 2004 because the earnings change variables ΔINC, ΔEXP and ΔOINC/EXP in the return regression model require data not only from the current year, but also from the previous year.

Table 1
Sample characteristics 342 firm-years.

	Equity method (number of companies)		Proportionate consolidation (number of companies)		Total (number of companies)	
Year						
2005	27	(63%)	16	(37%)	43	(12%)
2006	40	(61%)	25	(39%)	65	(19%)
2007	66	(67%)	32	(33%)	98	(29%)
2008	92	(68%)	44	(32%)	136	(40%)
	225	(66%)	117	(34%)	342	
Industry sectors						
Conglomerates	14	(70%)	6	(30%)	20	(6%)
Consumer goods	38	(64%)	21	(36%)	59	(17%)
Energy	19	(70%)	8	(30%)	27	(8%)
Industrial goods	11	(50%)	11	(50%)	22	(6%)
Information technology	1	(33%)	2	(67%)	3	(1%)
Materials	9	(60%)	6	(40%)	15	(4%)
Properties and construction	47	(75%)	16	(25%)	63	(19%)
Services	86	(66%)	45	(34%)	131	(38%)
Telecommunications	0	(0%)	2	(100%)	2	(1%)
	225	(66%)	117	(34%)	342	
Whether mainland-China-based						
Mainland-China-based	128	(67%)	63	(33%)	191	(56%)
Non-mainland-China-based	97	(64%)	54	(36%)	151	(44%)
	225	(66%)	117	(34%)	342	
Whether financial guarantee provided to JCE debt						
Financial guarantee provided	23	(55%)	19	(45%)	42	(12%)
Financial guarantee not provided	202	(67%)	98	(33%)	300	(88%)
	225	(66%)	117	(34%)	342	
Operation similarity between venturer and its JCE(s)						
Similar operations	166	(65%)	91	(35%)	257	(75%)
Dissimilar operations	59	(69%)	26	(31%)	85	(25%)
	225	(66%)	117	(34%)	342	

called mainland China-based companies in this study) that had chosen to change so that they could use the same JCE method for reporting in both Hong Kong and mainland China.[19] As reported earlier, our results suggest that the HKSE listers continued to use EM in 2005 despite the availability of PC. However, this might not have been the case for the mainland China-based HKSE listers. As PC was mandated by the mainland China accounting standards in 2005 (MOFPRC, 2001), mainland China-based companies might have chosen to change to PC in 2005 to avoid keeping two sets of JCE accounts. For the same reason, when the mainland China accounting standards first mandated EM in 2008 (MOFPRC, 2006), mainland China-based HKSE listers might have decided to switch to EM. As a result, the 11 mainland China-based companies that changed methods in 2005 and 2008 clearly did so only for convenience. Unreported results confirm that their inclusion or exclusion has no effect on the results of this study.

The switch to EM of the five mainland China-based companies in 2008 contributed to the slightly increased popularity of EM over the sample years (63% in 2005 to 68% in 2008). The slight increase could also result from some companies believing (or being advised by their auditors) that it would be inevitable that the new standard would allow EM only. PC was therefore avoided by new joint ventures.

About 74% of the sample companies were from the services (38%), properties and construction (19%), and consumer goods (17%) industries. Other than the information technology and telecommunications industries, which had very few companies in the sample, and the properties and construction industry, which showed a

[19] Refer to Notes 13 and 14 for the reporting requirements for red chip or H-share companies in mainland China.

higher application of EM (75% EM versus 25% PC), the popularity of EM versus PC was more or less the same across all of the other industries.

The proportion of mainland China-based companies in our sample was higher than among the HKSE listers (191 out of 343 (56%) versus 245 out of 1261 (19%) among the HKSE listers at 31 December 2008, as detailed in Notes 13 and 14). The relative predominance of mainland China-based companies in our sample is consistent with the likely predominance of mainland China JCEs held (as detailed in Note 5) by our sample companies. Most of the sample companies did not provide a financial guarantee for the JCE debt and had similar operations to their JCEs (88% and 75%). Their overall preference for EM over PC was similar to that

Table 2
Descriptive statistics 342 firm-years.

	N	Mean	SD	Max	Min
Control variables in OLS regressions					
When equity method is used					
Share of JCE liabilities over venturer's own total liabilities (%)	225	35.64	55.53	323.64	0.02
Share of JCE net assets over venturer's net assets (%)	225	13.92	13.45	75.76	3.12
Size (market capitalization at year end Dec 31) (HK$m)	225	14,805	28,808	200,580	42
Growth (market-to-book value of equity)	225	1.44	1.24	6.60	0.17
Return on equity (%)	225	4.74	23.53	47.91	−89.62
When proportionate consolidation is used					
Share of JCE liabilities over venturer's own total liabilities (%)	117	46.58	117.04	719.66	0.00
Share of JCE net assets over venturer's net assets (%)	117	12.55	9.60	44.23	3.12
Size (market capitalization at year end Dec 31) (HK$m)	117	9878	27,202	121,971	36
Growth (market-to-book value of equity)	117	1.32	0.96	4.25	0.17
Return on equity (%)	117	6.13	16.77	48.82	−44.06
Dependent variables in OLS regressions					
When equity method is used					
Abnormal return (%)	225	7.02	67.70	344.18	−89.15
Market value of common equity at Apr 30 (HK$m)	225	15,033	25,567	139,968	84
When proportionate consolidation is used					
Abnormal return (%)	117	2.42	34.53	101.18	−96.33
Market value of common equity at Apr 30 (HK$m)	117	9551	25,531	116,809	130
Key financial statement variables in ols regressions					
When equity method is used					
Total income (HK$m)	225	34,139	187,749	1,582,449	30
Total expenses (HK$m)	225	34,018	191,100	1,645,172	813
Other income and expenses (net) (HK$m)	225	3836	24,068	229,760	−28,624
Total assets (HK$m)	225	31,603	109,631	863,815	219
Total liabilities (HK$m)	225	15,692	59,349	464,156	6
When proportionate consolidation is used					
Total income (HK$m)	117	61,273	227,351	1,032,874	26
Total expenses (HK$m)	117	60,115	222,463	1,010,491	23
Other income and expenses (net) (HK$m)	117	4050	18,527	80,929	−14,862
Total assets (HK$m)	117	44,907	134,006	608,199	381
Total liabilities (HK$m)	117	24,845	72,067	321,730	33
Other financial statement data					
When the equity method is used					
Profit for the year (HK$m)	225	3957	20,194	167,038	−28,730
Net assets (HK$m)	225	15,910	50,755	399,659	113
Share of JCE profit (HK$m)	225	138	366	2933	−1091
Share of JCE net assets (HK$m)	225	1195	2035	13,785	15
When proportionate consolidation is used					
Profit for the year (HK$m)	117	5208	23,387	103,311	−18,309
Net assets (HK$m)	117	20,062	62,568	286,469	206
Share of JCE profit (JK$m)	117	248	670	2749	−263
Share of JCE net assets (HK$m)	117	1209	2669	12,294	14

Table 3
Pearson correlations (except industry and year dummy variables and interaction variables) 342 firm-years.

Return association regression (1)

	AR	METHOD	INC	EXP	OINC/EXP	ΔINC	ΔEXP	ΔOINC/EXP	SJCELIAB	SJCENA	SIMILAR	GUAR	SIZE	GROW	ROE	MCHINA
METHOD	−0.08															
INC	−0.14***	0.14**														
EXP	−0.14**	0.13**	0.99***													
OINC/EXP	0.08	0.12**	0.06	0.12**												
ΔINC	0.03	0.10*	0.06	0.05	0.12**											
ΔEXP	0.01	0.08	0.16***	0.15***	0.13**	0.98***										
ΔOINC/EXP	0.16***	0.07	−0.10*	−0.10*	0.54***	0.09*	0.09*									
SJCELIAB	0.09	0.06	−0.16***	−0.16***	−0.01	−0.11**	−0.12**	0.00								
SJCENA	0.05	−0.05	−0.15***	−0.14***	0.07	−0.07	−0.08	0.03	0.35***							
SIMILAR	−0.04	0.04	0.11**	0.09*	−0.09*	−0.08	−0.08	−0.06	0.09	0.08	.	.	.	.	.	.
GUAR	0.04	0.09	0.05	0.05	0.10*	0.13**	0.12**	0.13**	−0.11**	−0.11*	−0.11**					
SIZE	0.12**	−0.18***	−0.17***	−0.17***	0.16***	0.25***	0.20***	0.08	−0.15***	−0.15***	−0.07	0.23***				
GROW	0.09*	−0.05	−0.16***	−0.15***	0.10*	0.11**	0.08**	0.19***	0.13**	−0.03	−0.03	0.08	0.57***			
ROE	0.30***	0.03	−0.14**	−0.16***	0.36***	0.12**	0.08**	0.63***	−0.01	−0.02	−0.03	0.08	0.24***	0.20***		
MCHINA	0.15***	−0.03	0.12**	0.12**	0.16***	0.12**	0.12**	0.12**	−0.04	−0.15***	−0.14***	0.15***	0.38***	0.15***	0.16***	
INVMR	−0.10*	0.89***	0.06	0.06	0.16***	0.15***	0.12***	−0.01	−0.01	0.03	−0.01	−0.05	0.06	0.02	−0.01	0.01

Firm value association regression (2)

	MV	METHOD	ASSET	LIAB	SJCELIAB	SJCENA	SIMILAR	GUAR	SIZE	GROW	ROE	MCHINA
METHOD	−0.24***											
ASSET	0.41***	−0.18***										
LIAB	0.16***	−0.10**	0.85***									
SJCELIAB	−0.06	0.06	−0.16***	−0.18***								
SJCENA	0.00	−0.05	−0.07	−0.08	0.35***							
SIMILAR	−0.10*	0.04	0.07	0.03	0.09	0.08						
GUAR	0.05	0.09	0.19***	0.17***	−0.11**	−0.11*	−0.11**					
SIZE	0.44***	−0.18***	0.35***	0.32***	−0.15***	−0.15***	−0.07	0.23***				
GROW	0.40***	−0.05	0.11**	0.16***	0.13**	−0.03	−0.03	0.08	0.57***			
ROE	0.19***	0.03	0.12**	0.03	−0.01	−0.02	−0.03	0.09	0.24***	0.20***		
MCHINA	0.04	−0.03	0.21***	0.26***	−0.04	−0.15***	−0.14***	0.15***	0.38***	0.15***	0.16***	
INVMR	−0.16***	0.89***	−0.06	0.01	−0.01	0.03	−0.01	−0.05	0.06	0.02	−0.01	0.01

AR = buy-and-hold abnormal return (adjusted for dividends and stock splits) for the 12 months beginning on the first day of the fifth month after the beginning of the accounting year, calculated using market-adjusted return.
METHOD = dummy variable to indicate whether EM or PC is used for JCE reporting during the accounting year, METHOD is set to one if PC is used during the accounting year, and zero otherwise.
INC = company's total operating income (or revenue) in the accounting year, as available from the income statements, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.
EXP = company's total operating expenses in the accounting year, as available from the income statements, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.
OINC/EXP = company's other income and expenses (net) in the accounting year, as available from the income statements, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.

INC = difference between INC in the accounting year and INC in the prior accounting year, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.
EXP = difference between EXP in the accounting year and EXP in the prior accounting year, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.
OINC/EXP = difference between OINC/EXP in the accounting year and OINC/EXP in the previous accounting year, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.
SJCELIAB = venturer's share of the JCEs' total liabilities relative to the venturer's own total liabilities at the end of the accounting year.
SJCENA = venturer's share of the JCEs' net assets relative to the venturer's net assets at the end of the accounting year.
SIMILAR = dummy variable to indicate whether the operations of the majority of the JCEs are similar to those of the venturer/venturer-group during the accounting year. SIMILAR is set to one if the operations are similar and zero otherwise.
GUAR = dummy variable to indicate whether the venturer/venturer group provides a financial guarantee for the JCE debt. GUAR is set to one if a financial guarantee is provided and zero otherwise.
SIZE = natural logarithm of the company's market capitalization at the end of the accounting year.
GROW = ratio of the company's market-to-book value of equity at the end of the accounting year.
ROE = ratio of the company's profit for the accounting year after preferred dividends divided by the equity at the beginning of the accounting year.
MCHINA = dummy variable to indicate whether the company is mainland China-based during the accounting year. MCHINA is set to one if the company is a red chip or H-share company, and zero otherwise.
INVMR = inverse Mills ratio computed from a probit regression for EM-PC choice model which includes company characteristic variables that may influence the likelihood of a company adopting EM or PC for their JCE interests:
$\text{METHOD} = x_0 + x_1\text{SJCELIAB} + x_2\text{SJCENA} + x_3\text{SIMILAR} + x_4\text{GUAR} + x_5\text{SIZE} + x_6\text{GROW} + x_7\text{ROE} + x_8\text{MCHINA} + x_9\text{IND}.$
MV = market value of common equity on the last day of the fourth month after the end of the accounting year, scaled by the number of common shares outstanding (adjusted for dividends and stock splits) on the last day of the fourth month after the end of the accounting year.
ASSET = company's total assets at the end of the accounting year, as available from the statements of financial position, scaled by the number of common shares outstanding (adjusted for dividends and stock splits) on the last day of the fourth month after the end of the accounting year.
LIAB = company's total liabilities at the end of the accounting year, as available from the statements of financial position, scaled by the number of common shares outstanding (adjusted for dividends and stock splits) on the last day of the fourth month after the end of the accounting year.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

in the entire sample (64–69% EM versus 31–36% PC), except when a financial guarantee was provided for the JCE debt; in these cases, the proportion applying PC was higher (55% EM versus 45% PC), which would be favorable to investors. When a financial guarantee was provided for the JCE debt, investors would probably prefer to have some information about the company's share of the JCE's individual assets and liabilities, and PC would easily make this information available to them.

Table 2 contains the descriptive statistics for the 342 firm-years in our sample, separated into EM and PC companies. On average, the companies that applied EM in our sample had a higher market capitalization but smaller financial statement numbers (market capitalization HK$14,805 m–15,033 m, total assets/liabilities HK $31,603 m/15,692 m and total income/expenses HK$34,139/34,018) than those that applied PC (HK$9551 m–9878 m, HK$44,907 m/24,845 m, and HK$61,273 m/60,115 m, respectively). They also, on average, had slightly higher growth and lower return on equity and offered their investors slightly higher abnormal returns (market-to-book value of equity 1.44, return of equity 4.74% and abnormal return 7.02%) than PC companies (1.32, 6.13%, and 2.42%, respectively). The scale of JCE interests held in our sample was, however, more or less similar on average, irrespective of whether the company applied EM or PC, as indicated by the share of JCE net assets over total net assets of 13.92% for EM versus 12.55% for PC; share of JCE liabilities over venturer's own total liabilities of 35.64% for EM versus 46.58% for PC; dollar amount for share of JCE profit of HK$138 m for EM versus HK$248 for PC; and dollar amount for share of JCE net assets of HK$1195 for EM versus HK$1209 for PC.

5.2. Correlation analysis

Table 3 reports the zero-order Pearson product moment corrections between the regression variables except the industry and year dummies and the interaction variables.

Among the regression variables, MV, INC, EXP, OINC/EXP, ΔINC, ΔEXP, ΔOINC/EXP, ASSET and LIAB are scaled variables. Their correlations with the other variables, especially the unscaled ones, are difficult to interpret. The discussion in this section therefore focuses more on the unscaled variables. The scaled variables MV, INC, EXP, OINC/EXP, ΔINC, ΔEXP, ΔOINC/EXP, ASSET and LIAB are included in the correlation analysis mainly to detect multicollinearity.

On the whole, the correlations reported in Table 3 are relatively low, although many are significant. The only exceptions are between INC and EXP ($r = 0.99$), ΔINC and ΔEXP ($r = 0.98$), ASSET and LIAB ($r = 0.85$) and METHOD and INVMR (0.89). These high correlations are understandable because they reflect the inclusion of variables that tend to change together or with another common firm characteristic (INC and EXP; ΔINC and ΔEXP; and ASSET and LIAB tend to change together as firm size changes) or are alternative measures of a certain firm characteristic (METHOD measures the actual JCE method used while INVMR is a statistically generated variable measuring the probability of a JCE method being selected based on firm characteristics that may influence the selection). In this study, tolerance and variance inflation factors are also assessed as part of the regression analysis to detect multicollinearity (Gujarati, 2008).

The correlations with AR are largely consistent with those with MV. Both AR and MV are negatively correlated with SIMILAR, suggesting that companies with JCEs with similar operations offer a lower AR and have a lower MV. Both AR and MR are, however, positively correlated with GUAR, SIZE, GROW, ROE and MACHINE, suggesting that companies that provide a guarantee for the JCE debt are larger and have higher growth and ROE, and companies that are mainland China-based offer higher abnormal returns and have a higher market price (measured as the market value of common equity scaled by the number of common shares outstanding). As expected, AR is positively correlated with ΔINC while MR is positively correlated with ASSET (measured as total assets scaled by the number of common shares outstanding).

The correlations of METHOD with the other variables (other than the scaled variables INC, EXP, OINC/EXP, ΔINC, ΔEXP, ΔOINC/EXP, ASSET and LIAB) are consistent with the earlier results from the descriptive statistics. For example, the significant negative correlation with SIZE (measured by natural logarithm of market capitalization) reflects that the EM companies have higher market capitalization.

5.3. Regression analysis

Table 4 reports the results from the return association and the firm value association models. The results from both models provide consistent evidence that EM has higher value relevance than PC for JCE reporting. The key summary income statement and statement of financial position amounts available from EM statements show higher associations with share prices than those from PC statements. This lends support to the elimination of PC.

Between the two models, a higher overall association, indicated by higher R^2 values and lower standard errors of residuals, is found with the firm value model. This is consistent with the typical findings in other studies that include both associations (e.g., Amir et al., 1993; Barth, 1994, Barth and Clinch, 1998; Aboody et al., 1999).

5.3.1. Return association

The results from the return association regression provide strong and consistent evidence that PC is of differentially lower relevance to investors than EM.

The signs and significance of the coefficients a_8, a_9 and a_{10} of the interaction variables ΔINC × METHOD ($t = -2.26$, $p = 0.024$), ΔEXP × METHOD ($t = 2.22$, $p = 0.028$) and ΔOINC/EXP × METHOD ($t = -1.87$, $p = 0.062$) from estimating Eq. (1) indicate that the key summary amounts from the PC income statement are of significantly lower value relevance than those from the EM income statements.

The lower value relevance of PC statements can also be observed in the change from a significant result for the EM income statements to a non-significant result for the PC income statements when they are assessed separately. The coefficients a_5, a_6 and a_7 of the respective variables ΔINC, ΔEXP, and ΔOINC/EXP in Eq. (1) represent the value relevance of the EM income statements alone (i.e., when METHOD = 0). They are found to be significant and their signs are as expected (a_5: $t = 4.44$, $p = 0.000$; a_6: $t = -4.24$, $p = 0.000$; and a_7: $t = 1.91$, $p = 0.057$). However, when the PC income statements are assessed separately by running Eq. (1) again but with METHOD set to 0 when PC is used, no significant results are observed (ΔINC: $t = -0.14$, $p = 0.892$; ΔEXP: $t = 0.20$, $p = 0.841$; and ΔOINC/EXP: $t = -0.22$, $p = 0.829$).

5.3.2. Firm value association

The results from the firm value association regression are consistent with those from the return association regression: both are in favor of EM.

The signs and significance of the coefficients b_4 and b_5 of the interaction variables ASSET × METHOD ($t = -2.15$, $p = 0.032$) and LIAB × METHOD ($t = 1.86$, $p = 0.064$) from estimating Eq. (2) indicate that the key summary amounts from the PC statements of financial position are of significantly lower value relevance than those from the EM statements.

As with the income statements, evidence of the lower value relevance of PC can also be observed from the loss of significance for the PC statements of financial position. From Eq. (2), the coefficients b_2 of ASSET and b_3 of LIAB, which summarize the value relevance of the EM statements of financial position, are significant and their signs are as expected (b_2: $t = 14.10$, $p = 0.000$; b_3: $t = -10.99$, $p = 0.000$). However, no significant results are observed when the PC statements of financial position are assessed separately (ASSET: $t = 1.46$, $p = 0.144$; LIAB: $t = -1.15$, $p = 0.25$).

5.4. Multicollinearity and heteroscedasticity

Measures of tolerance and the variance inflation factor (VIF) suggest that the independent variables in the regression analysis (i.e., INC and EXP, ΔINC and ΔEXP, ASSET and LIAB, and METHOD and INVMR) are subject to multicollinearity, with VIFs of 577.93, 622.76, 102.59, 99.59, 61.51 and 57.54, respectively, all exceeding the commonly applied rule of thumb of VIF = 10 (Hair et al., 2009). In an attempt to mitigate multicollinearity, we re-run the regressions with (1) INC, EXP and OINC/EXP combined into one variable EARN (representing profit for the year), because INC and EXP (together with OINC/EXP) are not our main variables of interest and they are included in the return model to reduce the measurement error (Brown et al., 1987; Easton et al., 1991); (2) ΔEXP and ΔOINC/EXP combined into one variable ΔEXPnetOINC/EXP rep-

Table 4
Regression results.

	Return association Eq. (1) AR		Firm value association Eq. (2) MV	
	a	*t*	*b*	*t*
Intercept	158.35	1.33	−29.01	−1.58
METHOD	−11.71	−0.27	1.55	0.23
INC	−74.93***	−5.45		
EXP	74.42***	5.38		
OINC/EXP	−27.35***	−4.66		
ΔINC	75.24***	4.40		
ΔEXP	−74.04***	−4.24		
ΔOINC/EXP	14.07*	1.91		
ΔINC × METHOD	−80.16*	−2.26		
ΔEXP × METHOD	81.57**	2.22		
ΔOINC/EXP × METHOD	−15.99***	−1.87		
ASSET			0.88***	14.10
LIAB			−1.16***	−10.99
ASSET × METHOD			−0.55**	−2.15
LIAB × METHOD			0.77**	1.86
SJCELIAB	0.03	0.73	−0.02**	−2.33
SJCENA	0.11	0.34	0.06	1.22
SIMILAR	3.87	0.54	−3.56***	−2.97
GUAR	−10.02	−0.64	−2.84	−1.13
SIZE	−5.23	−1.01	1.64**	2.04
GROW	4.27	1.10	4.26***	6.90
ROE	1.15***	5.24	0.02	0.75
MCHINA	15.86**	2.19	−4.68***	−4.22
IND dummies	*Included but not reported*			
YR dummies	*Included but not reported*			
INVMR	−1.52	−0.06	−1.59	−0.41
F	6.56***		20.73***	
Adj R^2	0.33		0.59	
N	342		342	

AR = buy-and-hold abnormal return (adjusted for dividends and stock splits) for the 12 months beginning on the first day of the fifth month after the beginning of the accounting year, calculated using market-adjusted return.
MV = market value of common equity on the last day of the fourth month after the end of the accounting year, scaled by the number of common shares outstanding (adjusted for dividends and stock splits) on the last day of the fourth month after the end of the accounting year.
METHOD = dummy variable to indicate whether EM or PC is used for JCE reporting during the accounting year. METHOD is set to one if PC is used during the accounting year, and zero otherwise.
INC = company's total operating income (or revenue) in the accounting year, as available from the income statements, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.
EXP = company's total operating expenses in the accounting year, as available from the income statements, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.
OINC/EXP = company's other income and expenses (net) in the accounting year, as available from the income statements, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.
INC = difference between INC in the accounting year and INC in the prior accounting year, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.
EXP = difference between EXP in the accounting year and EXP in the prior accounting year, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.
OINC/EXP = difference between OINC/EXP in the accounting year and OINC/EXP in the prior accounting year, scaled by the market value of common equity on the first day of the fifth month after the beginning of the accounting year.
ASSET = company's total assets at the end of the accounting year, as available from the statements of financial position, scaled by the number of common shares outstanding (adjusted for dividends and stock splits) on the last day of the fourth month after the end of the accounting year.
LIAB = company's total liabilities at the end of the accounting year, as available from the statements of financial position, scaled by the number of common shares outstanding (adjusted for dividends and stock splits) on the last day of the fourth month after the end of the accounting year.
SJCELIAB = venturer's share of the JCEs' total liabilities relative to the venturer's own total liabilities at the end of the accounting year.
SJCENA = venturer's share of the JCEs' net assets relative to the venturer's net assets at the end of the accounting year.

SIMILAR = dummy variable to indicate whether the operations of the majority of the JCEs are similar to those of the venturer/venturer-group during the accounting year. SIMILAR is set to one if the operations are similar and zero otherwise.
GUAR = dummy variable to indicate whether the venturer/venturer group provides a financial guarantee for the JCE debt. GUAR is set to one if financial guarantee is provided and zero otherwise.
SIZE = natural logarithm of the company's market capitalization at the end of the accounting year.
GROW = ratio of the company's market-to-book value of equity at the end of the accounting year.
ROE = ratio of the company's profit for the accounting year after preferred dividends divided by the equity at the beginning of the accounting year.
MCHINA = dummy variable to indicate whether the company is mainland China-based during the accounting year. MCHINA is set to one if the company is a red chip or H-share company, and zero otherwise.
IND = set of eight dummy variables IND1, IND2, IND3, IND4, IND5, IND6, IND7 and IND8 to indicate the company's industry in the accounting year, out of the nine industry sectors as classified by the HKSE – conglomerates, consumer goods, energy, industrial goods, information technology, materials, properties and construction, services and telecommunications.
YR = set of three dummy variables, YR1, YR2 and YR3, to indicate four accounting years – year ended 31 December 2005, 2006, 2007 and 2008.
INVMR = inverse Mills ratio computed from a probit regression of the EM-PC choice model, which includes company characteristic variables that may influence the likelihood of a company adopting EM or PC for their JCE interests:
$\text{METHOD} = x_0 + x_1\text{SJCELIAB} + x_2\text{SJCENA} + x_3\text{SIMILAR} + x_4\text{GUAR} + x_5\text{SIZE} + x_6\text{GROW} + x_7\text{ROE} + x_8\text{MCHINA} + x_9\text{IND}$.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

resenting total operating expenses net of other income and expenses, because ΔOINC/EXP is not expected to change with firm size as much as ΔEXP and ΔINC do; and (3) LIAB dropped from the firm value regression and INVMR dropped from both the return and firm value regressions because they replicate, to some extent, the variables ASSET and METHOD, respectively, which are already included in the regressions. The new VIFs from the re-runs show that the multicollinearity problem is largely eliminated by these changes. The new VIFs of EARN, ΔINC, ΔEXPnetOINC/EXP, and METHOD for the return model are reduced to 2.22, 11.29, 11.60 and 1.36 respectively; and the new VIFs of ASSET and METHOD for the firm value model are reduced to 1.41 and 2.08, respectively. The new results with the changes made to the variables are similar and continue to show that EM is of higher relevance, although the significance is generally weaker (for ΔINC × METHOD: $t = -1.65$, $p = 0.10$; ΔEXPnetOINC/EXP × METHOD: $t = 0.18$, $p = 0.08$; ASSET × METHOD: $t = -2.16$, $p = 0.03$). We therefore make no adjustment for multicollinearity because the inclusion of INC and EXP, ΔINC and ΔEXP, ASSET and LIAB, and METHOD and INVMR, and the consistent results we obtain from them, increase the credibility of our results.

As heteroscedasticity often occurs in cross-sectional and time-series datasets, we check for it using White's procedure (White, 1980). Unreported *t*-scores based on White's (1980) heteroscedasticity-consistent standard errors are slightly lower for most of the independent variables than those reported in Table 4, which are based on OLS *t*-scores. All parameters remain significant, suggesting that heteroscedasticity is not a problem in this data set.

5.5. Sensitivity analysis

Morgan Stanley Capital International Equity Hong Kong is used as the proxy for equity market return in Hong Kong in the calculation of market-adjusted rates of return for the return association regression. We conduct a sensitivity analysis using the Hong Kong Hang Seng Composite Index as the proxy. Except for the adjusted R^2, which is lowered by 1.47%, the results for the return association are almost the same as those obtained with the Morgan Stanley Capital International Equity Hong Kong proxy. The Hong Kong Hang Seng Composite Index covers 90% of the market capitalization of the shares listed on the Main Board of the HKSE and there are currently 200 constituent shares in this index.

We also examine whether our results are different if we drop the criterion for including only those observations with JCE net assets of ≥3%. We rerun both the return and firm value association regressions, first using larger samples of 380 and 366 observations with lower cutoffs of ≥1% and ≥2%, and then using smaller samples of 272 and 227 observations with higher cutoffs of ≥5% and ≥7%. The results do not vary signifi-

Table 5
Natural experiment results.

	Return association Eq. (1) AR		Firm value association Eq. (2) MV	
	a	*t*	*b*	*t*
Intercept	0.36*	1.91	−86.77***	−23.25
D2008	−0.15***	11.72	0.67	−1.39
INC	−21.07***	3.12		
EXP	83.74***	10.61		
OINC/EXP	−26.31***	−6.62		
ΔINC	64.86***	7.15		
ΔEXP	−92.30***	8.79		
ΔOINC/EXP	8.89***	9.83		
ΔINC × D2008	−61.14***	−2.79		
ΔEXP × D2008	93.69***	7.43		
ΔOINC/EXP × D2008	−6.66***	−7.26		
ASSET			0.31***	4.33
LIAB			−0.92***	−8.19
ASSET × D2008			−0.23***	−7.28
LIAB × D2008			0.78***	6.09
SIZE	6.51	−1.01	1.21**	24.76
GROW	−3.61***	1.10	4.80***	15.31
ROE	1.05***	5.24	0.28***	10.82
INDUSTRY dummies	*Included but not reported*			
Adj R^2	0.10		0.79	
N	97,449		97,449	

Note: D2008 = A dummy variable equals one if the fiscal year is before 2008, and zero otherwise.

cantly, and continue to suggest that EM statements are of significantly higher relevance. The only exception to this finding is that when the cutoff is lowered to ≥1%, the coefficients of the interaction variables in the firm association regression are no longer significant (b_4 of ASSET × METHOD: $t = -1.32$, $p = 0.19$; and b_5 of LIAB × METHOD: $t = 0.83$, $p = 0.41$). In practice, however, it is uncommon for companies to have such small JCEs: only 18 companies (i.e., 4.52%) of the 398 companies in our sample have JCEs with relative net assets ≥1%.

5.6. Additional test

To address the potential endogeneity concern, such as omitted variable issues, we use the replacement of EM over PC in mainland China as a research setting to conduct a difference-in-differences analysis. In mainland China, companies used PC following the "Interim Standards on Consolidated Financial Statements" before 2008. In 2008, because of the convergence to International Accounting Standards, PC was eliminated and EM was mandated from then on. This provides an appealing research setting for conducting a quasi-natural experiment to test whether PC or EM leads to more informative accounting information. We compare the value relevance before and after the replacement of PC by EM. Specifically, to test our research questions, we regress the following difference-in-difference models:

$$\mathrm{AR} = a_0 + a_1\mathrm{D2008} + a_2\mathrm{INC} + a_3\mathrm{EXP} + a_4\mathrm{OINC/EXP} + a_5\Delta\mathrm{INC} + a_6\Delta\mathrm{EXP} + a_7\Delta\mathrm{OINC/EXP} + a_8\Delta\mathrm{INC} \times \mathrm{D2008} + a_9\Delta\mathrm{EXP} \times \mathrm{D2008} + a_{10}\Delta\mathrm{OINC/EXP} \times \mathrm{D2008} + \mathit{Controls} \quad (3)$$

$$\mathrm{MV} = b_0 + b_1\mathrm{D2008} + b_2\mathrm{ASSET} + b_3\mathrm{LIAB} + b_4\mathrm{ASSET} \times \mathrm{D2008} + b_5\mathrm{LIAB} \times \mathrm{D2008} + \mathit{Controls} \quad (4)$$

D2008 is a dummy variable that equals one if fiscal year is before 2008, and zero otherwise. As Table 5 shows, the coefficients on ΔINC × D2008, ΔINC × D2008 and ΔINC × D2008 are significantly negative, positive and negative, respectively. This is consistent with the findings in Table 4. Moreover, the coefficients on ASSET × D2008 and ASSET × D2008 are significantly negative and positive, respectively, again consistent with those reported in Table 4. Overall, the results reported in Table 5 are generally consistent with those reported in Table 4, which strengthens our research findings in Table 4.

6. Conclusions

Part of the debate concerning the proposed removal of PC from IAS 31 (1990) by ED 9 (2007) is based on the view that PC offers a more detailed understanding when a portion of the operations, assets and liabilities of a JCE is horizontally aggregated with the operations, assets and liabilities of the venturer. The results of this study, however, show no evidence that investors benefit from PC financial statements. On the contrary, the higher value relevance of the EM statements found in this study suggests that the vertical aggregation of information into one number does not result in a loss of information to investors. The results show higher returns and firm value associations with the key summary accounting amounts when the statements are prepared using EM. As suggested by Milburn and Chant, 1999, it could be that PC's horizontal aggregation confuses rather than helps investors to understand the venturer's operations. The results therefore support the preference for EM. However, the empirical results should be interpreted carefully because the definitions of "joint venture" under IAS 31 and ED 9 are not exactly the same. Under IAS 31, the definition is based more on the legal form of the joint arrangement, whereas under ED 9 it is mainly driven by the economic substance of the joint arrangement.

The results of this study also have implications for companies around the world that prepare their financial statements using IFRS.

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Appendix A

Exhibit 1. Illustration of alternative accounting methods for JCE reporting

Illustrative financial statements, disclosures and selected financial ratios

(Assuming venture company/group has 40% interest in the JCE)			Panel A: Equity method	Panel B: Proportionate consolidation	
				Panel B1: Combined format	Panel B2: Separate format
	Venture company/group	JCEs			
	$	$	$	$	$
Income	1000	250	1000	1100	1000
Share of income of JCE					100
Interest expense	(500)	(70)	(500)	(528)	(500)
Share of interest expense of JCE					(28)
Other income/expense (net)	(200)	(80)	(200)	(232)	(200)
Share of other income/expense (net) of JCE					(32)
			300		
Share of profit of JCE			40		
Profit for the year	$ 300	$ 100	**$ 340**	**$ 340**	**$ 340**

	$	$	$	$	$
Plant	2200	1900	2200	2960	2200
Share of plant of JCE					760
Interest in JCE	600		640		
Total non-current assets	$ 2800	$ 1900	$ 2840	$ 2960	$ 2960
Cash	450	250	450	550	450
Share of cash of JCE					100
Inventory	650	450	750	830	650
Share of inventory of JCE					180
Total current assets	$ 1100	$ 700	$ 1100	$ 1380	$ 1380
Total assets	$ 3900	$ 2600	$ 3940	$ 4340	$ 4340
Share capital	1100	1500	1100	1100	1100
Retained earnings	900	100	940	940	940
Total equity	$ 2000	$ 1600	**$ 2040**	**2040**	**2040**
Bonds payable	1200	600	1200	1440	1200
Share of bonds payable of JCE					240
Total non-current liabilities	1200	600	1200	1440	1440
Accounts payable	700	400	700	860	700
Share of accounts payable of JCE					160
Total current liabilities	700	400	700	860	860
Total liabilities	$ 1900	$ 1000	$ 1900	$ 2300	$ 2300
Total equity and liabilities	$ 3900	$ 2600	$ 3940	$ 4340	$ 4340
Supplementary disclosure in notes to accounts			$	$	$
Share of non-current assets of JCE			760	760	–
Share of current assets of JCE			280	280	–
Share of non-current liabilities of JCE			240	240	–
Share of current liabilities of JCE			160	160	–
Share of net assets of JCE (optional)			640	640	
Share of sales of JCE			100	100	–
Share of expenses of JCE			60	60	–
Share of results of JCE (optional)			40	40	
Panel C: Selected financial ratios					
Profit margin			34%	31%	31%
Interest coverage			1.7	1.6	1.6
Return on assets			9%	8%	8%
Return on equity			**17%**	**17%**	**17%**
Leverage (debt over equity)			0.9	1.1	1.1

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Auditor human capital and financial misstatement: Evidence from China ☆

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ABSTRACT

In this study, we examine whether education, as an important component of the human capital of auditors, is related to the occurrence of financial misstatement, and investigate the moderating effect of professional experience. Using a sample of 16,651 firm-year observations from the Chinese stock market from 2003 to 2014, we find that the education level of signing auditors is significantly negatively associated with the likelihood of financial misstatement, which suggests that higher education can enhance the ethics and independence of auditors and mitigate the risk of financial misstatement. In addition, professional experience attenuates the negative relation between the education level of signing auditors and financial misstatement. Our findings are also robust to a variety of sensitivity tests, and our conclusions still hold after using a two-stage OLS-logistic regression to address the endogeneity problem. Lastly, the negative effect of education level on financial misstatement holds only for 985 Project universities, low individual-level (audit-firm-level) client importance, and state-owned enterprises.

1. Introduction

Auditor human capital is of fundamental importance in the auditing industry (a human-capital-intensive industry) (Chang et al., 2011; Pennings et al., 1998). In this study, we examine whether auditor human capital

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(proxied by the education level of the signing auditors) affects the likelihood of financial misstatement, and further investigate whether professional experience moderates the relation between education level and financial misstatement.

According to the framework proposed by DeFond and Zhang (2014), audit quality is jointly affected by the demand from the client, the supply of the auditor, and regulatory intervention. Research on the supply of the auditor has focused on how audit quality is affected by the demographic characteristics of auditors, such as industry expertise, gender, the client importance at both the audit firm and individual auditor levels, the interpersonal relations between auditors and CEOs (directors, top executives), and auditor religiosity (Aobdia et al., 2015; Carcello and Li, 2013; Carey and Simnett, 2006; Chen et al., 2010; Chin and Chi, 2009; Chi et al., 2012; Guan et al., 2016; Hardies et al., 2016; Zerni, 2012). However, the question remains as to whether auditor human capital influences audit quality. In this regard, the literature provides insufficient evidence because researchers have been unable to obtain data on the demographic characteristics of individual auditors.[1] Fortunately, the Chinese audit market provides a unique research setting in which public information on demographic characteristics of individual auditors can be obtained from the official website of the China Institute of Certified Public Accountants (CICPA; http://cmis.cicpa.org.cn).[2] Thus, in this study, we address this research gap by investigating the relation between the education level of signing auditors and financial misstatement using a unique dataset comprising the characteristics of individual auditors.

According to human capital theory (Becker, 1962; Schultz, 1960), human capital can be accumulated through education. Accordingly, we focus on the education level of auditors in developing our research hypotheses. Studies have shown that education can improve people's cognitive abilities (Barker and Mueller, 2002), affect the quality of outcomes (Kallunki et al., 2016), and result in better ethical judgment (Rest and Thoma, 1985). Therefore, we hypothesize that the education level of signing auditors is significantly negatively (positively) associated with financial misstatement (audit quality). Furthermore, signing auditors accumulate knowledge through their professional experience, which can help them better understand the error patterns in their client firms' financial statements, find potential financial misstatement, and enhance their independence (Libby and Frederick, 1990; Nelson, 2009). Therefore, we further test whether the professional experience and education level of signing auditors have substitutive effects on audit quality.

We focus on the Chinese context for several reasons. First, China provides a unique research setting in which data on the demographic characteristics of signing auditors are available (Guan et al., 2016). Second, China's highly competitive audit market (Choi and Wong, 2007; Wang et al., 2008; Yang, 2013) may weaken the ethics of auditors and created more significant cross-sectional variations in the levels of auditor independence. Finally, the changing characteristics of the Chinese audit market and the increasing regulations on external audits and signing auditors have produced time-series variations in audit quality (Guan et al., 2016).

Using a sample of 16,651 firm-year observations from the Chinese stock market from 2003 to 2014, we examine whether the education level of auditors as an important form of human capital affects the levels of financial misstatement, and further investigate whether professional experience attenuates the negative association between education and financial misstatement. Our analyses reveal the following findings. First, the education level of signing auditors is significantly negatively related with the risk of financial misstatement. Second, professional experience attenuates the negative relation between education and financial misstatement. Third, these findings are robust to various sensitivity tests using different measures of education level and financial misstatement. Fourth, our findings remain valid after using a two-stage OLS-logistic regression to address the endogeneity. Finally, cross-sectional analyses show that the negative effect of education on financial misstatement depends on the quality of the school, the importance of the client, and the type of ownership. In sum, the above relations hold only for 985 Project schools, low client importance, and state-owned enterprises.

This study contributes to the literature in several ways. First, to the best of our knowledge, this study is the first to use archival data on individual auditors and examine whether the education level of signing auditors, as a crucial form of auditor human capital, affects audit quality. Studies have investigated the effects of various

[1] Only a few economies provide data on individual auditors such as mainland China and Australia.
[2] The official website provides data on the educational background and professional experience of individual auditors.

auditor-specific characteristics (e.g., auditor industry expertise, auditor gender, the number of client firms, client importance, and cultural factors) on audit quality (C.Y. Chen et al., 2008; Y.S. Chen et al., 2008; Chin and Chi, 2009; Goodwin and Wu, 2014; Guan et al., 2016; Gul et al., 2013; Hardies et al., 2016; Ittonen et al., 2015). However, the literature provides insufficient evidence on whether auditor human capital, proxied by education level (Becker, 1962; Schultz, 1960), affects audit quality. This study fills this research gap by examining the relation between the education level of auditors and financial misstatement. In this regard, this study contributes to the growing body of research on the analysis of audit quality at the individual auditor level and provides additional evidence on the determinants of audit quality (DeFond and Zhang, 2014).

Second, extending the literature on human capital at the audit firm level, our study presents empirical evidence showing that the education level of signing auditors reduces the level of financial misstatement. Our results demonstrate that auditor human capital can play a crucial role in ensuring high quality audits and thus provide important support for human capital theory (Schultz, 1960).

Third, we examine the professional experience of individual auditors as a moderating variable. Cahan and Sun (2015), Sonu et al. (2016), and Wang et al. (2015) find that the professional experience of individual auditors reduces discretionary accruals and the likelihood of beating earnings benchmarks. However, few studies have focused on the moderating role of professional experience. In this regard, our study adds to the literature on the relation between professional experience and audit quality.

Finally, we use cross-sectional analyses to address the potential channels through which financial misstatement is affected by the education level of signing auditors. Specifically, the mitigating effect of auditor human capital on financial misstatement depends on the quality of the school, importance of the client, and type of ownership. Thus, our findings contribute to the literature on the determinants of audit quality and the relation between the demographic characteristics of auditors and audit quality.

The remainder of this study is organized as follows. In the second section, we discuss the institutional background, review the literature, and develop our hypotheses. The third section provides the specifications of the empirical model, variables, research sample, and data source. The fourth section reports the results of our hypothesis testing and robustness checks. In the fifth section, we present the endogeneity tests and additional analyses. The final section concludes the study and presents the managerial implications of our findings.

2. Institutional background, literature review, and hypothesis development

2.1. Auditor human capital and auditor independence in the Chinese audit market

According to the Law of the People's Republic of China on Certified Public Accountants, an individual can become a signing auditor only if he or she has passed the unified national examination for certified public accountants[3] and has engaged in auditing for more than two years.[4] In addition, the unified national examination for certified public accountants is only open to Chinese citizens who have graduated from college or university, earned the professional title of accountant, or gained an intermediate or higher professional title in a relevant field of study. Thus, in the past two decades, only 160,000 applicants have qualified as auditors out of more than 10 million examinees (25 million subjects of examination).[5] Accordingly, signing auditors (i.e., auditors qualified to sign audit statements), who are statutorily required to have both a certain level of education and professional experience, are a relatively scarce form of human capital in the Chinese audit market.

[3] An individual can obtain the certificate or diploma only if he or she has passed all examination subjects. Before 2009, there were five examination subjects: accounting, auditing, financial and cost management, tax law, and economic law. However, in 2009, two new examination subjects, that is, corporate strategic and risk management and comprehensive tests, were included, thus increasing the number of examination subjects to seven.

[4] "Whoever has passed the unified national examination for certified public accountants and has engaged in auditing business for more than two years may apply to the institute of certified public accountants of the province, autonomous region or municipality directly under the Central Government for registration" [Article # 9 of the Law of the People's Republic of China on Certified Public Accountants (revised and effective from January 1, 1994)].

[5] See the official website: http://www.cicpa.org.cn/topnews/201106/t20110602_28979.htm.

According to Shleifer (2004), "Competition destroys ethics and results in unethical behaviors among economic agents." In line with this, serious ethical problems relating to auditors have arisen in the less concentrated and highly competitive Chinese audit market (Wang et al., 2008; Yang, 2013) further impairs the level of auditor independence. In addition, due to the incomplete formal institutions and weak investor protection laws in China (Allen et al., 2005; Xin and Pearce, 1996), the reputation and litigation effects do not work well in the audit market. As a result, under pressure to retain clients, some audit firms and signing auditors have to compromise with CEOs (senior executives and directors), thus leading to collusion between the auditors and CEOs.

Education, an important component of human capital, can help people improve their cognitive ability (Wally and Baum, 1994) and address ethical concerns (Cacioppe et al., 2008). Accordingly, we expect to find that the education level of signing auditors plays a role in improving auditor independence and enhancing the audit quality in the highly competitive Chinese audit market.

2.2. Literature review

Human capital can be formed through education and the professional experience gained from on-the-job training to medical care, vitamin intake, and an intimate knowledge of the economic system (Mincer, 1962; Becker, 1962; Schultz, 1960). Among these factors, education and professional experience are viewed as two crucial dimensions of human capital. Moreover, research suggests that human capital can improve the capacity to work and the quality of the work completed (Mincer, 1962; Schultz; 1961). Furthermore, human capital has been shown to be associated with sustained economic growth (Benhabib and Spiegel, 1994; Islam, 1995; Mankiw et al., 1992). As a result, human capital has been included in the framework of economic growth (Lucas, 1988; Romer, 1990).

With regard to auditor-specific features, studies have investigated how audit quality is affected by auditor industry expertise (Chin and Chi, 2009; Chi and Chin, 2011; Zerni, 2012; Goodwin and Wu, 2014), the number of client firms (Ittonen et al., 2015), auditor tenure (Carey and Simnett, 2006; C.Y. Chen et al., 2008; Y.S. Chen et al., 2008), client importance at the audit firm and individual auditor levels (Chen et al., 2010; Chi et al., 2012), auditor gender (Ittonen et al., 2013; Hardies et al., 2016), and cultural factors such as religion and social ties (Aobdia et al., 2015; Gul et al., 2013; Guan et al., 2016; Omer et al., 2010).

The literature on auditor human capital has focused on the ways in which it affects financial performance, revenue, and the size of audit firms. For example, Pennings et al. (1998) document that the likelihood of an audit firm being dismissed is negatively related to its human capital, as proxied by industry experience and educational background. Bröcheler et al. (2004) validate the positive effect of human capital on the performance of audit firms. In addition, C.Y. Chen et al. (2008) and Y.S. Chen et al. (2008) find that professional experience gained from on-the-job training can improve the performance of an audit firm. Moreover, Cheng et al. (2009) find that education and professional experience are positively related to the size of an audit firm. Chang et al. (2011) find that human capital contributes about 14.3% of the revenue growth of audit firms. Furthermore, Kang et al. (2016) find that investment in the education of auditors is significantly positively related to accounting conservatism. Samagaio and Rodrigues (2016) find a positive relation between human capital and performance in younger audit firms.

To sum up, although education is a crucial source of auditor-specific human capital, the impact of an auditor's education level on audit quality has not been sufficiently investigated, which motivates us to examine the relation between education and financial misstatement.

2.3. Education level of signing auditors and financial misstatement

Education can be used to reflect a person's cognitive ability (Wally and Baum, 1994; Barker and Mueller, 2002; Bantel and Jackson, 1989; Wiersema and Bantel, 1992). Furthermore, cognitive ability is primarily embodied as the ability to process information (Christelis et al., 2010; Wally and Baum, 1994; Wiersema and Bantel, 1992). However, in most cases, people receive far more information than they can handle

(Tyler and Steensma, 1998). As such, the ability to filter information is crucial and different interpretations of the received information lead to different judgments. Thus, an individual's cognitive ability is closely related to the decisions he or she eventually makes. In this regard, studies have shown that people with better cognitive ability can quickly and precisely identify potential problems and come up with the corresponding solutions (Wally and Baum, 1994; Banks and Mazzonna, 2011; Bantel and Jackson, 1989; Dohmen et al., 2010).

Thus, better-educated signing auditors are likely to think more comprehensively and carefully (Lichtenstein and Fischhoff, 1977). Overall, the cognitive ability that originates from education has an important effect on the quality of outcomes, especially in complex tasks such as external audits (Kallunki et al., 2016). Accordingly, the cognitive ability of signing auditors can be considered to affect audit quality because complex external audits require the auditors to make numerous judgments on issues such as financial misstatement. In this regard, Alleyne and Amaria (2013) find that the education level of an auditor can increase the likelihood of the auditor discovering corporate misconduct.

Higher or elite education can increase the accumulation of human capital and create social prestige (Davies and Hammack, 2005; Finkelstein, 1992; Hitt et al., 2001; Tihanyi et al., 2000). More importantly, education has been shown to be positively associated with people's concerns about individual ethics and business ethics (Cacioppe et al., 2008; Deshpande, 1997; Rest and Thoma, 1985). For example, Cacioppe et al. (2008) find that managers with a reputable education are more likely to be hired by socially responsible firms. Rest and Thoma (1985) verify that a higher level of education can lead to better ethical judgment. In an experimental study, Deshpande (1997) reveals that respondents with a bachelor degree or above are more likely to consider false expense reimbursements as a type of immoral behavior, compared with those without an undergraduate education.

The morality of auditors is reflected in their sensitivity and judgment about ethical issues and further affects auditor independence (Sweeney and Roberts, 1997). A high sensitivity to the honesty and integrity of managers and client firms can help signing auditors to identify corporate misconduct, reduce the likelihood of catering to client firms, and maintain professional skepticism and auditor independence (Bernardi, 1994; Nelson, 2009; Ponemon, 1993; Ponemon and Gabhart, 1993).

To sum up, the education level of signing auditors is associated with their cognitive ability, strengthens their information processing abilities, enhances their sensitivity to ethical concerns, improves auditor independence, and eventually increases the likelihood of auditors' discovering misstatement in their client firms' financial statements. Therefore, Hypothesis 1 is developed in an alternative form as follows.

Hypothesis 1. Ceteris paribus, the education level of signing auditors is negatively related to financial misstatement.

2.4. The moderating role of auditors' professional experience

Studies have found that professional experience is positively associated with audit quality (Cahan and Sun, 2015; Sonu et al., 2016; Wang et al., 2015; Yuan and Han, 2012). Extending this line of research, we further examine how the professional experience of individual auditors moderates the negative relation between education and financial misstatement.

Individual auditors with vast professional experience can obtain both industry- and task-based experience (Moroney and Carey, 2011); have comprehensive knowledge about common or specific errors in financial statements (Libby and Frederick, 1990); and thus make more accurate audit judgments (Bonner, 1990; Shelton, 1999; Wright, 2001), find potential misstatement (Ashton, 1991; Libby, 1985; Tubbs, 1992), and produce high quality audits. Moreover, professional experience can strengthen professional skepticism of signing auditors (Bonner and Lewis, 1990; Nelson, 2009) and reduce the likelihood of auditor-manager compromise (Brown and Johnstone, 2009; Kaplan et al., 2008), thus leading to higher audit quality. Furthermore, professional experience can serve as a sign of auditor capability and audit service quality (Zerni, 2012). Thus, signing auditors with rich experience have valuable reputational capital, which is likely to encourage them to be more independent and ensure the quality of financial statements (Ittonen et al., 2015; Yuan and Han, 2012). As

such, it can be inferred that with regard to the reduction in financial misstatement as a result of auditors' abilities (DeAngelo, 1981; Rice and Weber, 2012),[6] because professional experience can improve the capabilities of signing auditors in identifying potential misstatement and enhance their independence, it may mitigate the negative effect of education on financial misstatement.

The predicted mitigating effect of professional experience is supported by the literature. For example, Hitt et al. (2001) show that the articulable knowledge gained from a university education can substitute for the tacit knowledge gained from experience. Moreover, Ferguson et al. (2000) find that the education level and professional experience of individual auditors have substitutive effects. Based on the above discussion, Hypothesis 2 is developed as follows.

Hypothesis 2. Ceteris paribus, professional experience attenuates the negative association between education and financial misstatement.

3. Research design

3.1. Empirical model specification for Hypothesis 1

Hypothesis 1 states that an auditor's education level is negatively associated with financial misstatement after controlling for other determinants. To test Hypothesis 1, we estimate Model (1) using a logistic regression that links financial misstatement (MIS_DUM) with the education level of signing auditors (EDU), auditor-specific variables, firm-specific characteristics, and other determinants.

$$\begin{aligned} MIS\_DUM = {} & \alpha_0 + \alpha_1 EDU + \alpha_2 EXP + \alpha_3 GENDER + \alpha_4 AGE + \alpha_5 CI\_IA + \alpha_6 IND\_SPEC_IA + \alpha_7 CI\_AF \\ & + \alpha_8 IND\_SPEC\_AF + \alpha_9 BIG10 + \alpha_{10} ANALYST + \alpha_{11} BLOCK + \alpha_{12} BOARD + \alpha_{13} INDR \\ & + \alpha_{14} DUAL + \alpha_{15} MAN\_SHR + \alpha_{16} SIZE + \alpha_{17} LEV + \alpha_{18} ROA + \alpha_{19} OCF + \alpha_{20} OR/TA \\ & + \alpha_{21} BTM + \alpha_{22} STATE + Industry, Year\ and\ Audit\ Firm\ Dummies + \mu \end{aligned} \quad \text{(Model 1)}$$

In Model (1), the dependent variable is the likelihood of financial misstatement (MIS_DUM), which is an indicator variable that equals 1 if a firm's financial statements are restated in future years and 0 otherwise. The main variable of interest (independent variable) is the education level (EDU) of a signing auditor, which is an important component of auditor human capital. An auditor's education level is measured as 4, 3, 2, and 1 for PhD, master, bachelor, and other qualifications, respectively. EDU denotes the average education level of the signing auditors.[7] In Model (1), if the coefficient on EDU (α_1) is negative and significant, then Hypothesis 1 is supported by the empirical evidence.

To isolate the incremental effect of the education level of signing auditors on financial misstatement, we include a set of control variables in Model (1) (please refer to Appendix A for the variable definitions). First, to address the effects of auditor-specific and audit-firm-specific characteristics on audit quality, in Model (1), we follow the literature and include various characteristics of signing auditors, such as their professional experience (EXP) (Cahan and Sun, 2015; Wang et al., 2015; Sonu et al., 2016), gender (GENDER) (Ittonen et al., 2013; Hardies et al., 2016), age (AGE) (Sundgren and Svanström, 2014), client importance at the audit firm level (CI_AF), client importance at the individual auditor level (CI_IA) (Chen et al., 2010; Chi et al., 2012; Gul et al., 2013), industry expertise at the audit firm level (IND_SPEC_AF), industry expertise at the individual auditor level (IND_SPEC_IA) (Chin and Chi, 2009; Zerni, 2012; Goodwin and Wu, 2014), and an indicator for the big 10 auditors (BIG10) (Becker et al., 1998; Chen et al., 2016).

[6] According to DeAngelo (1981), audit quality refers to "the joint probability of auditors' ability to detect material misstatement in client firms' financial reports and their willingness to disclose detected misstatements."

[7] In the Chinese audit market, at least two auditors (three signing auditors in some cases) are statutorily required to sign the audited financial statements of client firms. One is called the engagement auditor and the other is known as the review auditor. Therefore, the auditor-specific variables in this study are measured as the average value of two (or more) signing auditors.

Second, research shows that external and internal governance mechanisms can influence audit quality (Abbott et al., 2004; Agrawal and Chadha, 2005; Farber, 2005; Yu, 2008). Thus, Model (1) includes analyst coverage (ANALYST), the percentage of shares owned by the controlling shareholder (BLOCK), board size (BOARD), the ratio of independent directors (INDR), an indicator of CEO-chairman duality (DUAL), and managerial ownership (MAN_SHR).

Third, following the literature, firm-specific variables such as firm size (SIZE), the ratio of long-term liabilities to total assets (LEV), return on assets (ROA), operating cash flow (OCF), the ratio of other account receivables to total assets (OR/TA), and the book-to-market ratio (BTM) are included in Model (1) (Chen et al., 2016; Caskey and Hanlon, 2013; Dechow et al., 2011; Du, 2015; Francis et al., 2013; Jiang et al., 2010; Lobo and Zhao, 2013).

Fourth, an indicator variable, STATE, is included in Model (1) to determine whether the influence of auditor human capital on financial misstatement is different between state-owned and non-state-owned enterprises (Du, 2015; Guan et al., 2016).

Finally, to control for the fixed effect of industries (CSRC classification), calendar years, and audit firms, a set of dummy variables measuring the industry, year, and audit firm are included in Model (1).

3.2. Empirical model specifications for Hypothesis 2

Hypothesis 2 states that professional experience attenuates the negative association between education and financial misstatement. To test Hypothesis 2, we estimate the logistic regression Model (2) to link financial misstatement (MIS_DUM) with education level (EDU), professional experience (EXP), an interactive item of EDU × EXP, and other determinants.

$$\begin{aligned} MIS\_DUM = {} & \beta_0 + \beta_1 EDU + \beta_2 EXP + \beta_3 EDU \times EXP + \beta_4 GENDER + \beta_5 AGE + \beta_6 CI\_IA + \beta_7 IND\_SPEC\_IA \\ & + \beta_8 CI\_AF + \beta_9 IND\_SPEC\_AF + \beta_{10} BIG10 + \beta_{11} ANALYST + \beta_{12} BLOCK + \beta_{13} BOARD \\ & + \beta_{14} INDR + \beta_{15} DUAL + \beta_{16} MAN\_SHR + \beta_{17} SIZE + \beta_{18} LEV + \beta_{19} ROA + \beta_{20} OCF + \beta_{21} OR/TA \\ & + \beta_{22} BTM + \beta_{23} STATE + Industry, Year, and\ Audit\ Firm\ Dummies + \xi \end{aligned} \quad \text{(Model 2)}$$

In Model (2), the dependent variable is the likelihood of financial misstatement (MIS_DUM), and the independent variable is education level (EDU). A positive and significant coefficient on EDU × EXP ($\beta_3 > 0$) is consistent with Hypothesis 2. Moreover, a negative and significant coefficient on EDU ($\beta_1 < 0$) supports Hypothesis 1. The control variables in Model (2) are the same as those in Model (1).

3.3. Identification of the sample

The initial sample consists of all Chinese listed firms between 2003 and 2014. The sample period begins from 2003 because the original information about financial misstatement is unavailable before that year.[8] We then select our sample as follows (see Panel A of Table 1 for details): (1) we delete firm-year observations in which data on individual auditors are unavailable; (2) we exclude firm-year observations with missing data on the education level and professional experience of the signing auditors; (3) we eliminate firms pertaining to the banking, insurance, and other financial industries; and (4) we delete firm-year observations with missing data on the firm-specific control variables. Finally, we obtain a research sample of 16, 651 observations covering 2499 unique firms.

Panel B of Table 1 reports the sample distribution by year and industry. As Panel B shows, industry clustering exists in some industries such as C4, C6, and C7. Therefore, we report all of the z statistics based on standard errors adjusted for clustering at the firm and year levels (Petersen, 2009).

[8] The Correction of Financial Information and its Disclosure (Rule #19) was issued in 2003. Rule #19 first statutorily required Chinese listed firms to file an official report with the CSRC regarding any material events, including the correction of financial statements, and submit a revised and audited annual report within 45 days if the most recent annual report is incorrect (Wang and Wu, 2011).

Table 1
Sample selection and sample distribution.

Panel A: Sample selection														
Initial sample													22,371	
Eliminate firm-years in which data on individual auditors are unavailable													(781)	
Eliminate firm-years in which data on education level and professional experience are unavailable													(289)	
Eliminate firms pertaining to the banking, insurance, and other financial industries													(457)	
Eliminate firm-years in which the data required to measure the firm-specific control variables are unavailable													(4193)	
Available firm-year observations													16,651	
Unique firms													2499	
Industry code	Year												Total by industry	%
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014		
Panel B: Sample distribution by year and industry														
A	5	8	13	14	18	20	20	23	30	35	37	36	259	1.56
B	12	18	31	39	38	47	49	52	55	65	69	68	543	3.26
C0	11	25	45	53	52	54	58	66	77	90	92	90	713	4.28
C1	6	16	18	26	28	34	30	41	50	59	63	62	433	2.60
C2	1	2	5	7	6	7	8	8	10	13	14	13	94	0.56
C3	3	5	13	14	17	21	24	30	30	38	41	36	272	1.63
C4	21	45	90	111	115	123	139	150	179	225	231	222	1651	9.92
C5	14	20	34	42	45	61	63	74	98	125	132	129	837	5.03
C6	20	32	67	88	101	109	110	131	160	180	194	183	1375	8.26
C7	36	62	107	151	174	203	213	261	349	439	475	468	2938	17.64
C8	19	27	53	68	72	78	82	96	112	135	136	135	1013	6.08
C9	3	4	4	3	4	5	5	8	11	15	13	16	91	0.55
D	24	29	54	72	72	69	74	74	80	84	86	83	801	4.81
E	4	10	19	23	29	34	39	42	51	64	66	64	445	2.67
F	13	25	33	48	51	56	57	60	66	74	78	75	636	3.82
G	8	17	44	57	59	72	76	105	140	186	197	193	1154	6.93
H	32	49	72	96	96	102	106	115	124	133	137	124	1186	7.12
J	25	43	80	87	84	102	104	117	115	123	121	116	1117	6.71
K	10	20	29	40	42	49	52	61	70	81	79	74	607	3.65
L	5	8	13	14	11	18	20	22	33	37	41	42	264	1.59
M	7	9	16	22	18	23	22	21	20	21	22	21	222	1.33
Total by year	279	474	840	1075	1132	1287	1351	1557	1860	2222	2324	2250	16,651	
%	1.68	2.85	5.04	6.46	6.80	7.73	8.11	9.35	11.17	13.34	13.96	13.51		100

Note: A = agriculture, forestry, husbandry, and fishery; B = mining; C0 = food and beverage; C1 = textile, garment manufacturing, and products of leather and fur; C2 = wood and furniture; C3 = papermaking and printing; C4 = petroleum, chemical, plastics, and rubber products; C5 = electronics; C6 = metal and non-metal; C7 = machinery, equipment, and instrument manufacturing; C8 = medicine and biological products manufacturing; C9 = other manufacturing; D = production and supply of electricity, steam, and tap water; E = construction; F = transportation and warehousing; G = information technology; H = wholesale and retail; J = real estate; K = social services; L = communication and culture; M = conglomerates.

3.4. Data source

The data sources are reported below (see Appendix A for details). (1) We manually collect data on financial misstatement from the "causes for and effects of significant accounting errors" subsection in the financial statements. Specifically, we exclude restatements due to changes in accounting standards or government tax rules, or other reasons unrelated to accounting misconduct. In addition, we specify the periods of misstatement and the misstated amounts for each firm. Furthermore, we identify whether a firm's financial statements are restated in the future years (*MIS_DUM*) (Gul et al., 2013; Du and Lai, 2015; Guan et al., 2016)). (2) We hand-collect data on audit firms from a firm's annual report. More specifically, by inputting each individual auditor's full name into the enquiry system compiled by the CICPA (http://cmis.cicpa.org.cn), we obtain the signing auditors' education level and other demographic information.[9] (3) Data on *BIG10* are

[9] To ensure the accuracy of the above information, we cross-check the identities of signing auditors against the *CICPA* search website before we collect the auditors' demographic information (Gul et al., 2013; Guan et al., 2016).

obtained from the official website of the CICPA (http://www.cicpa.org.cn). (4) Other data on the control variables are collected (calculated) based on the China Stock Market and Accounting Research (CSMAR) database.

4. Empirical results

4.1. Descriptive statistics

Table 2 reports the descriptive statistics. The mean value of MIS_DUM is 0.054, which suggests that about 5.4% of Chinese listed firms restated their financial statements during the sample period. EDU has a mean value of 1.897, indicating that the average education level of signing auditors in the Chinese audit market is below the level of bachelor, which suggests that signing auditors in China have a relatively low level of education. The mean value of EXP is 5.992, which indicates that, on average, an individual auditor has had just under six years' experience signing audit reports.

With regard to the auditor-specific variables, approximately 30.2% of signing auditors are women (GENDER), the average age of the signing auditors (AGE) is 40.049, 31.6% of clients are important at the individual auditor level (CI_IA), 2.5% of auditors are industry experts at the individual auditor level (IND_SPEC_IA), 2.7% of clients are important at the audit firm level (CI_AF), 16.5% of auditors are industry experts at the audit firm level (IND_SPEC_AF), and 42.4% of Chinese listed firms are audited by Big 10 auditors (BIG10). Second, regarding the governance mechanisms, the average number of analysts covering a firm (ANALYST) is 2.85 ($e^{1.350}$-1), the percentage of shares held by the controlling shareholder (BLOCK) is 36.5%, the number of directors on corporate boards (BOARD) is 8.86 ($e^{2.182}$), the ratio of independent directors (INDR) is 36.5%, CEO-chairman duality (DUAL) exists in 19.6% of firms, and managerial ownership (MAN_SHR) is 3.5%. Third, with respect to the firm-specific financial features, the average firm size (SIZE) is RMB2.73 billion, the ratio of long-term liabilities to total assets (LEV) is 5.6%, the average return on total assets (ROA) is 3.8%, the ratio of cash flow from operations to the lagged total assets (OCF) is 5.1%, the ratio

Table 2
Descriptive statistics.

Variable	N	Mean	S. D.	Min	Q1	Median	Q3	Max
MIS_DUM	16,651	0.054	0.226	0.000	0.000	0.000	0.000	1.000
EDU	16,651	1.897	0.490	1.000	1.500	2.000	2.000	3.000
EXP	16,651	5.992	3.244	0.000	3.500	6.000	8.000	14.500
GENDER	16,651	0.302	0.346	0.000	0.000	0.000	0.500	1.000
AGE	16,651	40.049	4.994	30.000	36.500	39.500	43.000	55.000
CI_IA	16,651	0.316	0.250	0.065	0.149	0.240	0.349	1.000
IND_SPEC_IA	16,651	0.025	0.156	0.000	0.000	0.000	0.000	1.000
CI_AF	16,651	0.027	0.031	0.002	0.007	0.019	0.036	0.200
IND_SPEC_AF	16,651	0.165	0.371	0.000	0.000	0.000	0.000	1.000
BIG10	16,651	0.424	0.494	0.000	0.000	0.000	1.000	1.000
ANALYST	16,651	1.350	1.164	0.000	0.000	1.099	2.303	3.689
BLOCK	16,651	0.365	0.155	0.086	0.241	0.345	0.480	0.751
BOARD	16,651	2.182	0.202	1.609	2.079	2.197	2.197	2.708
INDR	16,651	0.365	0.051	0.273	0.333	0.333	0.385	0.571
DUAL	16,651	0.196	0.397	0.000	0.000	0.000	0.000	1.000
MAN_SHR	16,651	0.035	0.103	0.000	0.000	0.000	0.001	0.555
SIZE	16,651	21.726	1.246	19.008	20.862	21.585	22.410	25.585
LEV	16,651	0.056	0.090	0.000	0.000	0.008	0.076	0.424
ROA	16,651	0.038	0.064	-0.237	0.012	0.036	0.067	0.225
OCF	16,651	0.051	0.099	-0.276	0.002	0.049	0.102	0.381
OR/TA	16,651	0.026	0.047	0.000	0.004	0.010	0.025	0.314
BTM	16,651	0.561	0.250	0.089	0.363	0.544	0.748	1.125
STATE	16,651	0.525	0.499	0.000	0.000	1.000	1.000	1.000

Note: All of the variables are defined in Appendix A.

of other accounts receivable to total assets (OR/TA) is 2.6%, and the book-to-market ratio (BTM) is 56.1%. Finally, 52.5% of Chinese listed firms are state-owned enterprises (STATE).

4.2. Pearson correlation analysis

Table 3 reports the results of Pearson correlation analyses. As shown in Table 3, there is a negative and significant correlation between MIS_DUM and EDU, suggesting that the education level of signing auditors is associated with reduced financial misstatement, thus providing preliminary support for Hypothesis 1. In addition, EXP is significantly negatively correlated with MIS_DUM, implying that the increasing professional experience of signing auditors is associated with reduced financial misstatement. Furthermore, MIS_DUM is negatively (positively) and significantly correlated with AGE, IND_SPEC_AF, BIG10, ANALYST, BLOCK, INDR, DUAL, MAN_SHR, SIZE, ROA, and OCF (CI_IA, CI_AF, BOARD, LEV, OR/TA, BTM, and STATE), which suggests that it is appropriate to include these variables in the regression models.

Most of the correlation coefficients of the control variables are relatively low (<0.30). In addition, untabulated results show that all of the variance inflation factors (VIFs) are less than 10. Taken together, the above findings confirm that our results are unlikely to be affected by multicollinearity.

4.3. Multivariate tests of Hypothesis 1

Hypothesis 1 states that the education level of signing auditors is negatively related to the likelihood of financial misstatement. Table 4 reports the results for Hypothesis 1. All of the z-statistics are based on standard errors adjusted for clustering at the firm and year levels (Petersen, 2009).

As shown in Table 4, the coefficient on EDU is negative and significant at the 1% level (-0.143 with $z = -2.60$), thus validating Hypothesis 1. This also suggests that the likelihood of financial misstatement is reduced in line with the increased education level of the signing auditors. Based on the coefficient estimate on EDU, the marginal effect of education level on the likelihood of financial misstatement is about 9.26%. In addition to being statistically significant, this percentage is clearly economically significant.

With respect to the signs and significance of the control variables: (1) the coefficient on EXP is significantly negative, suggesting that the professional experience of signing auditors reduces the level of financial misstatement. (2) The coefficient on AGE is significantly positive, implying that the risk of financial misstatement increases with the average age of the signing auditors. (3) The coefficient on BIG10 is negative and significant at the 1% level, which suggests that the likelihood of financial misstatement is significantly lower for BIG10-audited firms than for non-BIG10-audited firms. (4) ANALYST and BLOCK both have significantly negative coefficients, indicating that greater analyst coverage (an external monitoring mechanism) and higher blockholder ownership (an internal monitoring mechanism) can mitigate the risk of financial misstatement to some extent. (5) SIZE has a positive and significant coefficient, suggesting that larger-scale firms have a higher risk of financial misstatement than smaller ones. (6) The coefficients on ROA and OCF are both significantly negative, implying that better financial performance on the basis of both accruals and cash flow are associated with lower risk of financial misstatement. Finally, (7) OR/TA has a significantly positive coefficient, meaning that the risk of financial misstatement increases with the increase in the ratio of other accounts receivable to total assets.

4.4. Multivariate tests of Hypothesis 2

Table 5 reports the logistic regression results for Hypothesis 2, which states that professional experience attenuates the negative association between education level and financial misstatement.

As shown in Table 5, the coefficient on EDU × EXP is positive and significant at the 5% level (0.060 with $z = 2.40$), thus verifying Hypothesis 2. This also shows that the negative association between education level and financial misstatement is attenuated by professional experience. In addition, EDU has a significantly negative coefficient, thus lending additional support to Hypothesis 1.

Table 3
Pearson correlation analysis.

Variable		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
MIS_DUM	(1)	1.000											
EDU	(2)	−0.021***	1.000										
EXP	(3)	−0.067***	0.033***	1.000									
GENDER	(4)	0.001	−0.026***	−0.027***	1.000								
AGE	(5)	−0.013*	−0.083***	0.364***	−0.020***	1.000							
CI_IA	(6)	0.021***	−0.045***	−0.300***	0.066***	−0.001	1.000						
IND_SPEC_IA	(7)	−0.003	0.029***	−0.042***	0.027***	−0.024***	0.053***	1.000					
CI_AF	(8)	0.092***	−0.010	−0.161***	0.025***	0.036***	0.195***	0.027***	1.000				
IND_SPEC_AF	(9)	−0.040***	0.019**	0.007	0.029***	−0.010	0.034***	0.329***	−0.209***	1.000			
BIG10	(10)	−0.084***	0.017**	0.028***	0.010	−0.036***	0.038***	0.089***	−0.442***	0.398***	1.000		
ANALYST	(11)	−0.103***	0.033***	0.054***	0.002	0.005	0.054***	0.106***	−0.124***	0.090***	0.175***	1.000	
BLOCK	(12)	−0.037***	0.040***	−0.054***	0.024***	−0.062***	0.037***	0.082***	0.006	0.051***	0.047***	0.126***	1.000
BOARD	(13)	0.019**	0.018**	−0.029***	0.000	−0.065***	0.042***	0.081***	0.061***	0.028***	0.006	0.120***	0.018**
INDR	(14)	−0.027***	0.007	0.030***	0.013	0.054***	0.025***	0.033***	−0.066***	0.035***	0.051***	0.049***	0.026***
DUAL	(15)	−0.014*	−0.015*	0.004	−0.016**	−0.008	−0.047***	−0.035***	−0.084***	−0.003	0.042***	0.039***	−0.071***
MAN_SHR	(16)	−0.038***	−0.008	0.003	−0.022***	−0.003	−0.050***	−0.049***	−0.132***	0.003	0.074***	0.145***	−0.066***
SIZE	(17)	−0.045***	0.063***	0.049***	0.024***	0.002	0.139***	0.254***	−0.039***	0.224***	0.205***	0.460***	0.263***
LEV	(18)	0.029***	0.017**	−0.021***	0.002	−0.016**	0.056***	0.081***	0.036***	0.056***	0.013*	0.029***	0.074***
ROA	(19)	−0.125***	0.035***	0.048***	0.027***	−0.017**	−0.013*	0.009	−0.057***	0.021***	0.060***	0.438***	0.114***
OCF	(20)	−0.037***	0.015*	0.008	0.022***	−0.037***	−0.002	0.034***	0.024***	0.027***	0.007	0.200***	0.083***
OR/TA	(21)	0.113***	−0.025***	−0.087***	0.004	−0.030***	−0.016**	0.002	0.142***	−0.052***	−0.133***	−0.260***	−0.110***
BTM	(22)	0.025***	0.036***	−0.023***	0.001	−0.033***	0.042***	0.114***	0.081***	0.086***	0.010	−0.078***	0.123***
STATE	(23)	0.042***	0.048***	−0.067***	0.041***	−0.034***	0.104***	0.066***	0.105***	0.018**	−0.035***	−0.038***	0.230***

Variable		(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
BOARD	(13)	1.000										
INDR	(14)	−0.399***	1.000									
DUAL	(15)	−0.159***	0.091***	1.000								
MAN_SHR	(16)	−0.141***	0.104***	0.402***	1.000							
SIZE	(17)	0.256***	0.047***	−0.142***	−0.159***	1.000						
LEV	(18)	0.134***	0.002	−0.119***	−0.152***	0.359***	1.000					
ROA	(19)	0.027***	−0.005	0.031***	0.129***	0.115***	−0.114***	1.000				
OCF	(20)	0.073***	−0.041***	−0.034***	−0.019**	0.068***	−0.042***	0.340***	1.000			
OR/TA	(21)	−0.037***	−0.021***	−0.016**	−0.098***	−0.203***	−0.030***	−0.275***	−0.119***	1.000		
BTM	(22)	0.170***	−0.046***	−0.138***	−0.172***	0.512***	0.290***	−0.227***	−0.104***	−0.029***	1.000	
STATE	(23)	0.252***	−0.090***	−0.256***	−0.342***	0.291***	0.194***	−0.089***	0.057***	−0.017**	0.244***	1.000

Notes: *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$; All of the variables are defined in Appendix A.

Table 4
Influence of signing auditors' education level on the likelihood of financial misstatement.

Variable	Dependent variable: Likelihood of financial misstatement (MIS_DUM)	
	Coefficient	z-value
EDU	−0.143***	−2.60
EXP	−0.040***	−2.85
GENDER	−0.030	−0.29
AGE	0.017**	2.37
CI_IA	0.218	1.28
IND_SPEC_IA	0.007	0.02
CI_AF	2.210	1.22
IND_SPEC_AF	−0.083	−0.50
BIG10	−0.351***	−3.34
ANALYST	−0.200***	−3.43
BLOCK	−1.252***	−4.30
BOARD	−0.083	−0.29
INDR	−0.636	−0.70
DUAL	0.103	0.95
MAN_SHR	0.882	1.38
SIZE	0.228***	3.66
LEV	0.323	0.73
ROA	−4.443***	−5.39
OCF	−0.950**	−2.09
OR/TA	1.403**	1.99
BTM	−0.212	−0.98
STATE	0.141	1.20
INTERCEPT	−5.373***	−4.19
Industry		Yes
Year		Yes
Audit firm		Yes
Observations		16,651
Pseudo R^2		0.115
LR_Chi^2 value		806.414***

Notes: *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$ (two-tailed). All reported z-statistics are based on standard errors adjusted for clustering at the firm and year levels (Petersen, 2009). All of the variables are defined in Appendix A.

4.5. Robustness checks using the dummy variable for the average education level of the signing auditors

To test whether our findings in Tables 4 and 5 are robust, we construct an additional variable for education level (EDU_M). EDU_M is an indicator variable for the average education level of signing auditors, which equals 1 for master and above and 0 otherwise (Gul et al., 2013). As shown in Column (1) of Table 6, the coefficient on EDU_M is significantly negative (−0.232 with $z = -1.75$), thus confirming Hypothesis 1. In Column (2), EDU_M×EXP has a positive and significant coefficient (0.109 with $z = 1.97$), thus lending additional support to Hypothesis 2.

4.6. Robustness checks using the maximum value of signing auditors' education level

In the main tests, we use the mean value of the education level of the signing auditors. To further verify our results, we calculate the maximum value of the education level of signing auditors.[10] The results in Table 7 show that EDU_MAX has a significantly negative coefficient and EDU_MAX× EXP_MAX has a significantly positive coefficient, thus further validating Hypotheses 1 and 2.

[10] To ensure consistency, we also calculate the maximum values of the signing auditors' other characteristics [professional experience (EXP_MAX), gender (GENDER_MAX), and age (AGE_MAX)].

Table 5
Effects of the signing auditors' education level, professional experience, and other determinants on the likelihood of financial misstatement.

Variable	Dependent variable: Likelihood of financial misstatement (MIS_DUM)	
	Coefficient	z-value
EDU	−0.452***	−3.32
EXP	−0.153***	−3.11
EDU × EXP	0.060**	2.40
GENDER	−0.032	−0.31
AGE	0.016**	2.27
CI_IA	0.212	1.26
IND_SPEC_IA	−0.013	−0.05
CI_AF	2.141	1.14
IND_SPEC_AF	−0.091	−0.54
BIG10	−0.357***	−3.46
ANALYST	−0.200***	−3.45
BLOCK	−1.219***	−4.17
BOARD	−0.079	−0.27
INDR	−0.636	−0.71
DUAL	0.099	0.92
MAN_SHR	0.838	1.33
SIZE	0.235***	3.65
LEV	0.316	0.74
ROA	−4.443***	−5.39
OCF	−0.948**	−2.12
OR/TA	1.408**	2.04
BTM	−0.239	−1.09
STATE	0.139	1.16
INTERCEPT	−4.905***	−4.02
Industry		Yes
Year		Yes
Audit firm		Yes
Observations		16,651
Pseudo R^2		0.115
LR_Chi^2 value		808.493***
Coefficient difference test:		
Coef.(EXP)+ Coef. (EDU × EXP)=0		12.52***

Notes: *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$ (two-tailed). All reported z-statistics are based on standard errors adjusted for clustering at the firm and year levels (Petersen, 2009). All of the variables are defined in Appendix A.

4.7. Robustness checks after differentiating the roles of review auditors and engagement auditors

Review and engagement auditors perform distinct roles in the audit process, with review auditors providing quality reviews of audits and engagement auditors conducting the actual audits. Thus, as a further robustness check, we differentiate the roles of review auditors and engagement auditors. Following Chen et al. (2016), we treat the first signing partner for each financial report as the review auditor and the second signing partner as the engagement auditor. The results in Table 8 show that the coefficient on EDU_REV is insignificant while the coefficient on EDU_ENG is significantly negative, which suggests that the engagement auditors play the pivotal function in the audit work, which echoes the findings of Wang et al. (2015) and Yuan and Han (2012). The coefficient on EDU_ENG×EXP is also significantly positive, which suggests that education and professional experience have substitutive effects on audit quality.

4.8. Robustness checks using other measures of financial misstatement

Table 9 presents the results using the magnitude of financial misstatement (MIS_MAG) and the likelihood of overstatement (OVER_DUM) as the other dependent variables. MIS_MAG is measured as the amount of financial misstatement in a firm's financial statements in year t scaled by the absolute value of the net profit.

Table 6
Robustness checks using the dummy variable for the average education level of the signing auditors.

Variable	Dependent variable: Likelihood of financial misstatement (MIS_DUM)			
	(1)		(2)	
	Coefficient	z-value	Coefficient	z-value
EDU_M	−0.232*	−1.75	−0.833***	−2.78
EXP	−0.040***	−2.85	−0.057***	−3.42
EDU_M×EXP			0.109**	1.97
GENDER	−0.029	−0.28	−0.029	−0.28
AGE	0.019***	2.61	0.018**	2.48
CI_IA	0.229	1.34	0.225	1.33
IND_SPEC_IA	0.008	0.03	−0.019	−0.08
CI_AF	2.211	1.23	2.166	1.17
IND_SPEC_AF	−0.082	−0.49	−0.094	−0.55
BIG10	−0.347***	−3.31	−0.351***	−3.40
ANALYST	−0.200***	−3.44	−0.200***	−3.44
BLOCK	−1.248***	−4.31	−1.218***	−4.19
BOARD	−0.081	−0.28	−0.075	−0.26
INDR	−0.642	−0.71	−0.625	−0.69
DUAL	0.104	0.96	0.098	0.90
MAN_SHR	0.877	1.38	0.832	1.32
SIZE	0.225***	3.58	0.232***	3.57
LEV	0.335	0.76	0.346	0.81
ROA	−4.438***	−5.41	−4.426***	−5.41
OCF	−0.960**	−2.11	−0.967**	−2.15
OR/TA	1.390**	1.98	1.376**	2.01
BTM	−0.208	−0.97	−0.241	−1.10
STATE	0.138	1.18	0.137	1.15
INTERCEPT	−5.614***	−4.43	−5.655***	−4.50
Industry		Yes		Yes
Year		Yes		Yes
Audit firm		Yes		Yes
Observations		16,651		16,651
Pseudo R^2		0.115		0.115
LR_Chi^2 value		805.504***		807.376***

Notes: *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$ (two-tailed). All reported z-statistics are based on standard errors adjusted for clustering at the firm and year levels (Petersen, 2009). All of the variables are defined in Appendix A.

OVER_DUM is an indicator variable that equals 1 if a firm's financial statements are restated downward in future years and 0 otherwise. The results in Columns (1) and (3) of Table 9 show a significantly negative relation between MIS_MAG (OVER_DUM) and EDU; thus, Hypothesis 1 is supported. In addition, in Columns (2) and (4), the coefficients on EDU × EXP are both positive and significant, thus providing additional support for Hypothesis 2.

5. Endogeneity and additional tests

5.1. Endogeneity tests using the two-stage OLS-logistic regression approach

Our findings in Tables 4 and 5 may be contingent on whether firms with less risk are more likely to appoint signing auditors who have a higher level of education. To address this potential endogenous selection problem, we conduct a two-stage OLS-logistic regression. In the first stage, we identify three instrumental variables: LNGDP, TRANS, and UNV. LNGDP is the natural logarithm of GDP *per capita* in the province in which a firm is located. TRANS is the transport status of the province in which a firm is located, measured as the natural logarithm of the total mileage of highway at the province level (in kilometers). UNV denotes the educational atmosphere, measured as the number of finance and economic universities within a radius of 100 km around a firm's registered address.

Table 7
Robustness checks using the maximum value of signing auditors' education level.

Variable	Dependent variable: Likelihood of financial misstatement (MIS_DUM)			
	(1)		(2)	
	Coefficient	z-value	Coefficient	z-value
EDU_MAX	−0.098**	−2.16	−0.411***	−3.90
EXP_MAX	−0.032***	−3.33	−0.120***	−4.30
EDU_MAX×EXP_MAX			0.041***	2.94
GENDER_MAX	0.007	0.07	0.006	0.06
AGE_MAX	0.012**	2.13	0.011**	2.01
CI_IA	0.203	1.31	0.189	1.19
IND_SPEC_IA	0.013	0.05	0.017	0.07
CI_AF	1.949	1.19	1.959	1.16
IND_SPEC_AF	−0.073	−0.44	−0.077	−0.46
BIG10	−0.305***	−4.21	−0.303***	−4.19
ANALYST	−0.197***	−3.35	−0.199***	−3.41
BLOCK	−1.270***	−4.18	−1.279***	−4.21
BOARD	−0.085	−0.29	−0.090	−0.30
INDR	−0.722	−0.79	−0.699	−0.77
DUAL	0.087	0.81	0.084	0.79
MAN_SHR	0.789	1.23	0.809	1.28
SIZE	0.224***	3.43	0.226***	3.47
LEV	0.380	0.89	0.367	0.86
ROA	−4.491***	−5.37	−4.494***	−5.36
OCF	−0.987**	−2.19	−0.972**	−2.15
OR/TA	1.398**	2.00	1.337*	1.92
BTM	−0.194	−0.87	−0.209	−0.92
STATE	0.134	1.12	0.137	1.13
INTERCEPT	−5.219***	−3.91	−4.544***	−3.53
Industry		Yes		Yes
Year		Yes		Yes
Audit firm		Yes		Yes
Observations		16,651		16,651
Pseudo R^2		0.112		0.114
LR_Chi^2 value		789.317***		798.486***

Notes: *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$ (two-tailed). All reported z-statistics are based on standard errors adjusted for clustering at the firm and year levels (Petersen, 2009). All of the variables are defined in Appendix A.

Following Sargan (1958), Basmann (1960), and Wooldridge (1995), we perform three over-identification tests to analyze whether the chosen instrumental variables are suited to the data. In Panel A of Table 10, all of the χ^2—values are insignificant, suggesting that three instruments are not correlated with the error items and thus are suitable for use as instrumental variables in this study.

Panel A of Table 10 reports the results of the first-stage OLS regression. The coefficients on LNGDP and TRANS are significantly positive, consistent with our theoretical expectations. Panel B of Table 10 reports the results of the second-stage logistic regression. In Column (1) of Panel B, the coefficient on EDU* (the fitted value of EDU) is significantly negative (−5.932 with $z = -4.53$), thus confirming Hypothesis 1. Moreover, in Column (2) of Panel B, EDU* × EXP has a positive and significant coefficient (0.203 with $z = 2.61$), thus further validating Hypothesis 2.

In summary, the results in Table 10 are qualitatively similar to those in Tables 4 and 5, which suggests that our main findings are unlikely to be affected by endogeneity.

5.2. Additional tests considering school quality, client importance, and type of ownership

Hitt et al. (2001) argue that individuals who graduate from the best universities are likely to have more and better knowledge and greater intellectual potential. Research has also shown that client importance and the type of ownership can affect audit quality (Guan et al., 2016; Gul et al., 2013). To address these issues, we

Table 8
Robustness checks differentiating review auditors from engagement auditors.

Variable	Dependent variable: Likelihood of financial misstatement (MIS_DUM)			
	(1)		(2)	
	Coefficient	z-value	Coefficient	z-value
EDU_REV	0.009	0.12	0.060	0.69
EDU_ENG	−0.191**	−2.57	−0.155**	−2.14
EXP	−0.040***	−2.71	−0.097***	−2.65
EDU_ REV × EXP			0.033**	2.11
EDU_ ENG × EXP			0.035*	1.72
GENDER	−0.099	−0.59	−0.128	−0.77
AGE	0.020**	2.16	0.021**	2.40
CI_IA	0.207	1.43	0.233	1.57
IND_SPEC_IA	−0.264	−0.82	−0.270	−0.85
CI_AF	0.544	0.31	0.339	0.18
IND_SPEC_AF	0.082	0.50	0.081	0.50
BIG10	−0.403***	−4.39	−0.627***	−6.14
ANALYST	−0.215***	−3.52	−0.226***	−3.81
BLOCK	−1.265***	−3.98	−1.306***	−4.15
BOARD	−0.034	−0.11	−0.094	−0.31
INDR	−0.402	−0.41	−0.361	−0.36
DUAL	0.192*	1.77	0.205*	1.86
MAN_SHR	0.768	1.21	0.816	1.34
SIZE	0.195***	2.95	0.252***	3.69
LEV	0.657	1.37	0.393	0.81
ROA	−4.098***	−4.10	−4.073***	−4.15
OCF	−0.924	−1.43	−0.932	−1.49
OR/TA	0.887	1.24	0.686	0.92
BTM	−0.252	−1.02	−0.412	−1.63
STATE	0.180	1.37	0.185	1.48
INTERCEPT	−4.790***	−3.27	−5.530***	−3.83
Industry		Yes		Yes
Year		Yes		Yes
Audit firm		Yes		Yes
Observations		14,630		14,630
Pseudo R^2		0.117		0.127
LR_Chi^2 value		705.030***		767.580***

Notes: *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$ (two-tailed). All reported z-statistics are based on standard errors adjusted for clustering at the firm and year levels (Petersen, 2009). All of the variables are defined in Appendix A.

conduct subsample tests to determine whether the effect of education level on financial misstatement depends on the school quality, client importance, and type of ownership.

First, in China, 985 Project schools are often recognized as the top universities (Zhang et al., 2013). Thus, we divide the full sample into 985 schools and non-985 schools based on whether a signing auditor graduated from a 985 Project school. The findings in Panel A of Table 11 suggest that Hypotheses 1 and 2 hold for the 985 schools subsample (see Columns (1) and (3) of Panel A), but not for the non-985 schools subsample (see Columns (2) and (4) of Panel A).

Second, we partition the full sample into high CI_IA and low CI_IA subsamples to consider the effects of client importance at the individual auditor level. As Panel B of Table 11 shows, Hypotheses 1 and 2 hold for the low CI_IA subsample (see Columns (1) and (3) of Panel B), but not for the high CI_IA subsample (see Columns (2) and (4) of Panel B).

Third, to consider client importance at the audit firm level, we divide the full sample into high CI_AF and low CI_AF subsamples. Similar to the findings in Panel B of Table 11, the results in Panel C, taken together, suggest that Hypotheses 1 and 2 are valid only for the low CI_AF subsample but not for the high CI_AF subsample.

Table 9
Robustness checks using other measures of financial misstatement.

Variable	Dependent variable: Magnitude of financial misstatement (MIS_MAG)				Dependent variable: Likelihood of overstatement (OVER_DUM)			
	(1)		(2)		(3)		(4)	
	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
EDU	−0.017***	−3.15	−0.072***	−7.38	−0.135*	−1.71	−0.378**	−2.34
EXP	−0.007***	−7.01	−0.026***	−14.43	−0.046***	−2.90	−0.143**	−2.39
EDU × EXP			0.010***	8.16			0.052*	1.76
GENDER	0.001	0.07	0.000	0.04	−0.043	−0.35	−0.047	−0.38
AGE	0.003***	4.36	0.003***	4.21	0.014	1.25	0.013	1.16
CI_IA	0.024**	2.05	0.023*	1.93	0.156	0.79	0.165	0.83
IND_SPEC_IA	−0.010	−0.35	−0.011	−0.38	−0.020	−0.05	−0.089	−0.25
CI_AF	0.403	1.44	0.403	1.44	3.868*	1.71	3.544	1.52
IND_SPEC_AF	−0.009	−0.65	−0.009	−0.67	−0.020	−0.09	−0.033	−0.15
BIG10	−0.065***	−6.51	−0.065***	−6.55	−0.224	−1.52	−0.279*	−1.94
ANALYST	−0.034***	−5.85	−0.034***	−5.88	−0.153**	−2.09	−0.149**	−2.06
BLOCK	−0.190***	−6.78	−0.190***	−6.81	−1.388***	−3.67	−1.301***	−3.30
BOARD	−0.020	−0.70	−0.021	−0.72	−0.000	−0.00	0.001	0.00
INDR	−0.070	−0.45	−0.071	−0.46	−0.500	−0.61	−0.528	−0.63
DUAL	0.020*	1.78	0.019*	1.72	0.139	1.04	0.132	0.99
MAN_SHR	0.089	0.90	0.091	0.93	1.579**	2.24	1.505**	2.16
SIZE	0.028***	3.96	0.028***	3.99	0.188**	2.35	0.201**	2.35
LEV	0.050	0.92	0.046	0.86	0.007	0.02	−0.003	−0.01
ROA	−0.758***	−5.09	−0.757***	−5.10	−4.421***	−4.83	−4.389***	−4.72
OCF	−0.143*	−1.94	−0.141*	−1.92	−1.581***	−2.92	−1.574***	−2.95
OR/TA	0.346***	2.69	0.342***	2.70	2.033**	2.54	2.064***	2.61
BTM	−0.017	−0.71	−0.017	−0.75	0.219	0.64	0.156	0.46
STATE	0.023**	2.19	0.023**	2.21	0.162	1.24	0.162	1.24
INTERCEPT	−0.805***	−5.55	−0.693***	−4.98	−5.212***	−3.04	−4.901***	−2.74
Industry		Yes		Yes		Yes		Yes
Year		Yes		Yes		Yes		Yes
Audit firm		Yes		Yes		Yes		Yes
Observations		16,651		16,651		16,651		16,651
Pseudo R^2		0.139		0.141		0.118		0.118
LR_Chi^2 value		774.153***		780.725***		625.398***		621.530***

Notes: *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$ (two-tailed). All reported z-statistics are based on standard errors adjusted for clustering at the firm and year levels (Petersen, 2009). All of the variables are defined in Appendix A.

Table 10
Endogeneity tests using two-stage OLS-logistic regressions.

Variable	Dependent variable: Signing auditors' education level	
	Coefficient	z-value
Panel A: Results of the first-stage OLS regression		
LNGDP	0.074***	3.78
TRANS	0.041***	3.42
UNV	0.002	0.46
GENDER	−0.026	−0.94
AGE	−0.004***	−3.41
CI_IA	−0.102***	−3.78
IND_SPEC_IA	0.033	0.82
CI_AF	0.826**	2.36
IND_SPEC_AF	0.025	1.57
BIG10	−0.011	−0.55
ANALYST	−0.004	−0.72
BLOCK	−0.042	−0.94
BOARD	−0.031	−0.92
INDR	0.113	0.87
DUAL	−0.022	−1.53
MAN_SHR	0.063	1.24
SIZE	0.006	0.67
LEV	0.057	0.71
ROA	0.158*	1.89
OCF	−0.008	−0.20
OR/TA	−0.062	−0.58
BTM	0.029	0.89
STATE	0.054***	3.05
INTERCEPT	0.864***	3.14
Industry/Year		Yes
Audit firm		Yes
Observations		16,579
Adj R^2		0.109
F value		27.668***
Over identification test:		
Sargan(Chi2)		1.032(p = 0.60)
Basmann(Chi2)		1.026(p = 0.60)
Wooldridge (Chi2)		1.036(p = 0.60)

Variable	Dependent variable: MIS_DUM			
	Hypothesis 1 (1)		Hypothesis 2 (2)	
	Coefficient	z-value	Coefficient	z-value
Panel B: Results of the second stage logistic regression				
EDU*	−5.932***	−4.53	−7.037***	−4.47
EXP	−0.041***	−2.87	−0.423***	−2.83
EDU*×EXP			0.203***	2.61
GENDER	−0.147	−1.43	−0.149	−1.44
AGE	−0.008	−0.82	−0.009	−0.96
CI_IA	−0.384	−1.47	−0.412	−1.55
IND_SPEC_IA	0.208	0.69	0.214	0.71
CI_AF	7.085***	3.21	7.691***	3.35
IND_SPEC_AF	0.058	0.32	0.067	0.36
BIG10	−0.400***	−3.72	−0.407***	−3.82
ANALYST	−0.225***	−3.84	−0.226***	−3.85
BLOCK	−1.461***	−5.24	−1.491***	−5.37
BOARD	−0.265	−0.89	−0.273	−0.92
INDR	0.156	0.16	0.195	0.20

(*continued on next page*)

Table 10 (*continued*)

Variable	Dependent variable: MIS_DUM			
	Hypothesis 1 (1)		Hypothesis 2 (2)	
	Coefficient	z-value	Coefficient	z-value
DUAL	−0.017	−0.15	−0.022	−0.19
MAN_SHR	1.452**	2.42	1.454**	2.43
SIZE	0.294***	4.39	0.296***	4.43
LEV	0.444	1.01	0.466	1.06
ROA	−3.551***	−4.41	−3.511***	−4.35
OCF	−1.062**	−2.33	−1.094**	−2.37
OR/TA	0.972	1.40	0.884	1.30
BTM	−0.134	−0.59	−0.150	−0.66
STATE	0.419***	3.18	0.418***	3.19
INTERCEPT	4.612*	1.94	6.689**	2.41
Industry/Year/Audit firm		Yes		Yes
Observations		16,579		16,579
Pseudo R^2		0.120		0.121
LR_Chi^2 value		839.149***		845.586***

Notes: *: $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$ (two-tailed). All reported t/z-statistics are based on standard errors adjusted for clustering at the firm and year levels (Petersen, 2009). All of the variables are defined in Appendix A.

Finally, the results in Columns (1) and (3) of Panel D show that Hypotheses 1 and 2 are supported for state-owned enterprises. However, the results in Columns (2) and (4) of Panel C do not support Hypotheses 1 and 2 for non-state-owned enterprises.

Overall, the results in Table 11 reveal that the effect of education on financial misstatement depends on the quality of the school, different levels of client importance, and the type of ownership.

6. Conclusion

Our findings on the Chinese audit market show that the education level of signing auditors is associated with reduced financial misstatement. Furthermore, professional experience attenuates above negative relation. Finally, the effects of education and professional experience on financial misstatement depend on the school quality, client importance, and type of ownership, such that our findings only hold for 985 Project schools, low client importance (at both the individual and audit firm levels), and state-owned enterprises.

In addition to the theoretical contributions documented in the Introduction, our study has several managerial implications. First, our finding that education has a negative (positive) effect on financial misstatement (audit quality) suggests that steps should be taken to systematically increase the education level of signing auditors to reduce the risk of financial misstatement and enhance audit quality. In most cases, in the Chinese audit market, applicants must pass all of the required examinations to qualify as a signing auditor. In this regard, the CICPA as the regulatory body should encourage highly educated people (e.g., those with bachelor, master, and higher degrees) to take the qualification exams. Second, considering the negative (positive) association between the professional experience of signing auditors and financial misstatement (audit quality), the China Securities Regulatory Commission (CSRC) and CICPA should introduce statutory requirements on the professional experience of signing auditors and set a minimum threshold for the number of years before an auditor can sign the financial statements of Chinese listed firms. Third, the financial statements of Chinese listed firms must be signed by two or more auditors. Therefore, given our findings on the substitutive effects of education and experience in mitigating the risk of financial misstatement, we suggest that to better improve audit quality, audit firms should consider the combination of experience and education when assigning two or more signing auditors. Finally, given that the association between education and financial misstatement depends on the importance of the client and type of ownership, the CSRC and CICPA should keep a careful eye on the inverse effects of client importance (at both the individual auditor and audit firm levels) and state ownership on auditor independence and audit quality.

Table 11
Subsample tests considering school quality, client importance, and the nature of the ultimate owner.

Variable	Dependent variable: MIS_DUM							
	Hypothesis 1				Hypothesis 2			
	(1) 985 Project school subsample		(2) Non-985 school subsample		(3) 985 Project school subsample		(4) Non-985 school subsample	
	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
Panel A: Subsample tests considering signing auditors' school quality								
EDU	−0.344**	−2.55	−0.058	−1.05	−0.890***	−2.64	−0.267	−1.53
EXP	−0.042	−1.13	−0.038**	−2.33	−0.257***	−3.31	−0.112**	−2.03
EDU × EXP					0.107**	2.02	0.039	1.27
GENDER	−0.222	−0.81	0.010	0.08	−0.266	−1.00	0.014	0.12
AGE	0.043**	2.30	0.009	1.55	0.043**	2.27	0.010	1.63
CI_IA	0.292	0.92	0.165	1.20	0.287	0.89	0.162	1.20
IND_SPEC_IA	−0.153	−0.26	−0.010	−0.04	−0.131	−0.23	0.102	0.36
CI_AF	−0.632	−0.19	1.697	1.04	−0.586	−0.18	1.761	1.02
IND_SPEC_AF	−0.246	−0.85	−0.005	−0.03	−0.236	−0.82	0.014	0.08
BIG10	−0.029	−0.13	−0.398***	−3.57	−0.036	−0.16	−0.393***	−3.41
ANALYST	−0.372***	−3.49	−0.153**	−2.26	−0.365***	−3.44	−0.152**	−2.22
BLOCK	−1.894***	−2.67	−1.053***	−3.20	−1.916***	−2.65	−1.106***	−3.33
BOARD	−0.655***	−2.61	0.087	0.23	−0.659***	−2.66	0.076	0.21
INDR	0.169	0.13	−1.110	−0.98	0.231	0.17	−1.152	−1.02
DUAL	0.014	0.06	0.102	0.93	0.004	0.02	0.103	0.92
MAN_SHR	2.102***	2.68	0.227	0.29	2.127***	2.77	0.291	0.36
SIZE	0.267**	2.19	0.227***	2.76	0.262**	2.16	0.212***	2.59
LEV	0.153	0.17	0.504	1.21	0.093	0.10	0.559	1.37
ROA	−2.232**	−2.11	−5.366***	−5.13	−2.199**	−2.02	−5.385***	−5.21
OCF	−2.024**	−2.39	−0.550	−0.96	−1.944**	−2.27	−0.532	−0.91
OR/TA	1.241	0.87	1.534	1.59	1.248	0.88	1.463	1.50
BTM	−0.561	−1.09	−0.120	−0.58	−0.527	−1.01	−0.082	−0.40
STATE	0.193	1.04	0.142	1.01	0.194	1.03	0.146	1.06
INTERCEPT	−20.632***	−8.36	−5.884***	−3.16	−18.053***	−7.00	−5.187***	−2.87
Industry		Yes		Yes		Yes		Yes
Year		Yes		Yes		Yes		Yes
Audit firm		Yes		Yes		Yes		Yes
Observations		4960		11,691		4960		11,691
Pseudo R^2		0.151		0.117		0.153		0.119
LR_Chi^2 value		305.880***		584.251***		310.677***		594.239***
Chow tests				99.85**				99.60**

Variable	Dependent variable: MIS_DUM							
	Hypothesis 1				Hypothesis 2			
	(1) Low CI_IA subsample		(2) High CI_IA subsample		(3) Low CI_IA subsample		(4) High CI_IA subsample	
	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
Panel B: Subsample tests considering client importance at the individual auditor level								
EDU	−0.191*	−1.89	−0.012	−0.13	−0.780***	−3.58	−0.144	−0.97
EXP	−0.037**	−2.10	−0.010	−0.55	−0.232***	−3.49	−0.070	−1.16
EDU×EXP					0.100***	2.99	0.032	1.07
GENDER	0.039	0.25	−0.071	−0.37	0.036	0.24	−0.075	−0.39
AGE	0.012	1.37	0.019	1.43	0.010	1.10	0.019	1.45
CI_IA	2.501***	2.81	−0.029	−0.17	2.397***	2.70	−0.036	−0.21
IND_SPEC_IA	−0.066	−0.22	0.205	0.49	−0.075	−0.25	0.213	0.51
CI_AF	−2.665	−1.35	2.650	1.25	−2.661	−1.11	2.633	1.24
IND_SPEC_AF	−0.077	−0.40	−0.241	−1.19	−0.068	−0.35	−0.242	−1.19
BIG10	−0.533***	−3.18	−0.380**	−2.39	−0.526***	−3.05	−0.382**	−2.40

(*continued on next page*)

Table 11 (*continued*)

Variable	Dependent variable: MIS_DUM							
	Hypothesis 1				Hypothesis 2			
	(1) Low CI_IA subsample		(2) High CI_IA subsample		(3) Low CI_IA subsample		(4) High CI_IA subsample	
	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
ANALYST	−0.247***	−3.33	−0.144**	−2.22	−0.247***	−3.34	−0.143**	−2.20
BLOCK	−0.980**	−2.52	−1.783***	−4.47	−0.948**	−2.46	−1.782***	−4.43
BOARD	0.118	0.32	−0.429	−1.09	0.129	0.34	−0.428	−1.08
INDR	−0.240	−0.19	−0.883	−0.57	−0.182	−0.14	−0.887	−0.57
DUAL	0.238*	1.73	−0.156	−0.65	0.217	1.59	−0.157	−0.64
MAN_SHR	0.205	0.28	2.021**	2.37	0.242	0.33	2.019**	2.37
SIZE	0.374***	5.09	0.047	0.53	0.378***	5.13	0.045	0.50
LEV	0.305	0.51	0.319	0.59	0.285	0.47	0.311	0.57
ROA	−5.320***	−6.59	−3.493***	−2.98	−5.353***	−6.57	−3.501***	−2.99
OCF	−1.647***	−2.80	−0.019	−0.02	−1.622***	−2.83	−0.019	−0.02
OR/TA	0.325	0.41	3.447***	2.73	0.200	0.26	3.443***	2.73
BTM	−0.667***	−3.20	0.377	0.76	−0.694***	−3.20	0.378	0.75
STATE	0.111	0.77	0.189	1.51	0.118	0.80	0.189	1.50
INTERCEPT	−8.176***	−4.52	−2.755**	−2.08	−7.183***	−4.31	−2.460*	−1.72
Industry		Yes		Yes		Yes		Yes
Year		Yes		Yes		Yes		Yes
Audit firm		Yes		Yes		Yes		Yes
Observations		10,897		5754		10,897		5754
Pseudo R^2		0.122		0.144		0.124		0.144
LR_Chi^2 value		526.185***		388.026***		535.811***		388.670***
Chow tests				106.51***				112.59***

Variable	Dependent variable: MIS_DUM							
	Hypothesis 1				Hypothesis 2			
	(1) Low CI_AF subsample		(2) High CI_AF subsample		(3) Low CI_AF subsample		(4) High CI_AF subsample	
	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
Panel C: Subsample tests considering client importance at the audit firm level								
EDU	−0.175*	−1.95	−0.115	−0.92	−0.672***	−3.88	−0.011	−0.05
EXP	−0.058***	−3.86	0.004	0.21	−0.251***	−3.95	0.042	0.53
EDU×EXP					0.100***	3.15	−0.020	−0.55
GENDER	−0.111	−0.77	0.233*	1.68	−0.102	−0.73	0.237*	1.71
AGE	0.038***	4.43	−0.018*	−1.68	0.037***	4.25	−0.017*	−1.66
CI_IA	0.146	0.88	0.245	1.02	0.130	0.78	0.248	1.03
IND_SPEC_IA	−0.049	−0.14	0.045	0.08	−0.021	−0.06	0.048	0.09
CI_AF	19.720***	2.65	3.598	1.19	20.277***	2.59	3.589	1.19
IND_SPEC_AF	−0.045	−0.26	−0.498*	−1.67	−0.066	−0.39	−0.497*	−1.67
BIG10	−0.368***	−2.90	−0.006	−0.01	−0.341***	−2.71	0.003	0.01
ANALYST	−0.235***	−2.62	−0.181**	−2.48	−0.232***	−2.59	−0.181**	−2.48
BLOCK	−1.100***	−3.31	−1.611***	−3.15	−1.125***	−3.37	−1.613***	−3.17
BOARD	0.161	0.45	−0.811*	−1.77	0.188	0.54	−0.808*	−1.76
INDR	−0.403	−0.38	−1.291	−0.81	−0.345	−0.32	−1.301	−0.81
DUAL	0.231	1.54	−0.210	−1.25	0.237	1.59	−0.207	−1.22
MAN_SHR	0.954	1.21	0.723	0.63	1.025	1.33	0.711	0.62
SIZE	0.241***	3.20	0.143*	1.71	0.235***	3.14	0.141*	1.68
LEV	0.685	1.10	−0.354	−0.58	0.472	0.73	−0.365	−0.60
ROA	−5.526***	−5.80	−2.308**	−2.08	−5.516***	−5.78	−2.314**	−2.07
OCF	−0.783	−1.52	−1.244*	−1.84	−0.815	−1.55	−1.248*	−1.85
OR/TA	0.590	0.76	2.711**	2.47	0.553	0.72	2.721**	2.48

(*continued on next page*)

Table 11 (*continued*)

Variable	Dependent variable: MIS_DUM							
	Hypothesis 1				Hypothesis 2			
	(1) Low CI_AF subsample		(2) High CI_AF subsample		(3) Low CI_AF subsample		(4) High CI_AF subsample	
	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
BTM	−0.132	−0.47	−0.233	−0.62	−0.141	−0.49	−0.225	−0.61
STATE	0.039	0.25	0.317	1.41	0.047	0.31	0.316	1.41
INTERCEPT	−7.517***	−4.78	−2.036	−1.55	−6.175***	−3.57	−2.232	−1.63
Industry		Yes		Yes		Yes		Yes
Year		Yes		Yes		Yes		Yes
Audit firm		Yes		Yes		Yes		Yes
Observations		11,192		5459		11,192		5459
Pseudo R^2		0.130		0.126		0.134		0.126
LR_Chi^2 value		598.974***		302.898***		616.607***		303.154***
Chow tests				123.90***				131.47***
Variable	Dependent variable: MIS_DUM							
	Hypothesis 1				Hypothesis 2			
	(1) State-owned enterprises		(2) Non-state-owned enterprises		(3) State-owned enterprises		(4) Non-state-owned enterprises	
	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
Panel D: Subsample tests considering the nature of the ultimate owner								
EDU	−0.126*	−1.78	−0.150	−1.44	−0.396***	−2.64	−0.061	−0.57
EXP	−0.037**	−2.09	−0.032	−1.21	−0.139**	−2.55	−0.127	−1.37
EDU×EXP					0.053*	1.93	0.057	1.30
GENDER	0.052	0.38	−0.101	−0.72	0.045	0.32	−0.071	−0.49
AGE	0.018**	2.17	0.007	0.48	0.018**	2.13	0.007	0.43
CI_IA	0.033	0.17	0.504**	2.04	0.023	0.12	0.507**	2.17
IND_SPEC_IA	−0.258	−0.66	0.288	0.70	−0.271	−0.69	0.521	1.10
CI_AF	4.232*	1.71	−4.087	−1.44	4.142*	1.68	0.859	0.28
IND_SPEC_AF	0.018	0.09	−0.246	−1.09	0.013	0.07	−0.343*	−1.69
BIG10	−0.270*	−1.79	−0.463**	−2.11	−0.272*	−1.81	−0.560***	−2.82
ANALYST	−0.141*	−1.72	−0.271***	−3.24	−0.139*	−1.69	−0.265***	−3.20
BLOCK	−1.032***	−2.73	−1.687***	−2.66	−1.032***	−2.73	−1.768***	−2.74
BOARD	0.127	0.40	−0.484	−1.32	0.117	0.37	−0.531	−1.47
INDR	−0.693	−0.49	−1.530	−0.99	−0.682	−0.48	−1.418	−0.90
DUAL	0.018	0.12	0.125	0.76	0.014	0.09	0.101	0.60
MAN_SHR	−0.414	−0.08	1.140	1.52	−0.248	−0.05	1.198	1.59
SIZE	0.150**	2.44	0.332***	2.82	0.152**	2.47	0.382***	3.11
LEV	0.470	0.76	−0.613	−0.80	0.441	0.71	−0.598	−0.80
ROA	−4.834***	−4.46	−3.992***	−4.32	−4.858***	−4.47	−3.984***	−4.05
OCF	−0.745*	−1.86	−1.363*	−1.83	−0.738*	−1.81	−1.309*	−1.72
OR/TA	1.415**	2.20	1.024	1.00	1.426**	2.18	0.911	0.90
BTM	0.227	0.69	−0.950**	−1.97	0.228	0.70	−1.079**	−2.24
INTERCEPT	−4.725***	−3.26	−5.255**	−2.26	−4.193***	−3.01	−20.445***	−7.93
Industry		Yes		Yes		Yes		Yes
Year		Yes		Yes		Yes		Yes
Audit firm		Yes		Yes		Yes		Yes
Observations		8734		7917		8734		7917
Pseudo R^2		0.106		0.146		0.107		0.160
LR_Chi^2 value		436.669***		417.989***		439.723***		459.655***
Chow tests				413.86***				441.89***

Note: ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively (two-tailed). All reported z-statistics are based on standard errors adjusted for clustering at the firm level and year level (Petersen, 2009). All of the variables are defined in Appendix A.

This study has two limitations that can be further addressed by future research. First, our empirical analyses focus on the education level of the signing auditors. However, as human capital theory (Becker, 1962; Mincer, 1962; Schultz, 1960) suggests, medical care, vitamin intake, and an intimate knowledge of the economic system are also components of human capital. Accordingly, it is worth examining whether the other three dimensions of human capital, especially an intimate knowledge of the economic system, can reduce the risk of financial misstatement and enhance audit quality. Second, this study is conducted based on the Chinese context. Thus, future research should investigate whether our findings are applicable to other contexts. Until such research has been completed, caution should be taken when generalizing our findings to other economies.

Appendix A. Variable definitions

Variable		Definition	Data Source
Variables for main tests			
MIS_DUM	=	A dummy variable that equals 1 if a firm's financial statements are restated in the future years and 0 otherwise.	Hand-collected
EDU	=	The average education level of signing auditors (engagement and review auditors). An auditor's education level is measured as 4, 3, 2, and 1 for PhD, master, bachelor, and others, respectively).	Hand-collected
EXP	=	The average auditor experience of signing auditors. An auditor's experience is measured as the time lag between the current signing period and the first signing period (Wu, 2009).	Hand-collected
GENDER	=	The gender of signing auditors, measured using a dummy variable that equals 1 if an auditor is a woman and 0 otherwise (Gul et al., 2013).	Hand-collected
AGE	=	The average age of signing auditors.	Hand-collected
CI_IA	=	Client importance at an individual auditor level, measured as "$LN(TA_j^{AF})/\sum_{k=1}^{m}\sum_{t=1}^{n}LN(TA_t^{AF})$" (*LN* denotes the natural log; *TA* denotes a client's total assets; *IA* denotes an individual auditor; *n* denotes the number of an auditor's clients; *m* denotes the number of auditors signing the report; *j* denotes a client) (Gul et al., 2013).	Calculated based on CSMAR
IND_SPEC_IA	=	An indicator for auditor industry specialization at the individual auditor level, equaling 1 if the total assets of all of a signing auditor's clients in the industry rank the first or a signing auditor's market share is greater than 10% and 0 otherwise (Chen et al., 2010).	Calculated based on CSMAR
CI_AF	=	Client importance at the audit firm level, measured as "$LN(TA_j^{AF})/\sum_{t=1}^{n}LN(TA_t^{AF})$" (*LN* denotes the natural log; *TA* denotes a client's total assets; *AF* denotes audit firm; *n* denotes the number of an audit firm's clients; *j* denotes a client) (Gul et al., 2013).	Calculated based on CSMAR
IND_SPEC_AF	=	An indicator for auditor industry specialization at the audit firm level, equaling 1 if the total assets of all of an audit firm's clients in the industry rank the first or an audit firm's market share is greater than 10% and 0 otherwise (Chen et al., 2010).	Calculated based on CSMAR
BIG10	=	A dummy variable that equals 1 if an audit firm is a Big 10 accounting firm (including affiliated firms) and 0 otherwise (Chen et al., 2016).	www.cicpa.org.cn

ANALYST	=	The natural log of (1 + the number of analysts following).	Calculated based on CSMAR
BLOCK	=	The percentage of shares held by the controlling shareholder.	CSMAR
BOARD	=	Board size, measured as the natural log of the number of directors on the board (Lobo and Zhao, 2013).	CSMAR
INDR	=	The percentage of independent directors (Lobo and Zhao, 2013).	CSMAR
DUAL	=	A dummy variable that equals 1 if one person serves as both the chairman and the CEO and 0 otherwise (Lobo and Zhao, 2013).	CSMAR
MAN_SHR	=	The percentage of shares held by the top managers.	CSMAR
SIZE	=	Firm size, measured as the natural log of total assets at the end of the year (Lobo and Zhao, 2013).	CSMAR
LEV	=	Financial leverage, measured as the ratio of long-term liabilities to total assets (Lobo and Zhao, 2013).	CSMAR
ROA	=	Returns on total assets, measured as net profit scaled by total assets at the end of the year.	CSMAR
OCF	=	The ratio of cash flow from operations to the lagged total assets.	CSMAR
OR/TA	=	The ratio of other accounts receivable to total assets (Chen et al., 2016).	CSMAR
BTM	=	The book-to-market ratio (Francis et al., 2013).	CSMAR
STATE	=	An indicator of the nature of the ultimate owner that equals 1 if a firm's ultimate owner is a (central or local) government agency or government controlled state-owned enterprise and 0 otherwise (Du, 2015; Guan et al., 2016).	CSMAR
Variables for the robustness checks and endogeneity tests			
OVER_DUM	=	An indicator variable for overstatement that equals 1 if a firm's financial statements are restated downward in future years and 0 otherwise.	Hand-collected
MIS_MAG	=	The amount of financial misstatement in a firm's financial statements in year t scaled by the absolute net profit.	Hand-collected
EDU_M	=	An indicator variable for the average education level of signing auditors, equaling 1 for master and above and 0 otherwise (Gul et al., 2013).	Hand-collected
EDU_MAX	=	The maximum education level of signing auditors (engagement and review auditors). An auditor's education level is measured as 4, 3, 2, and 1 for PhD, master, bachelor, and others, respectively).	Hand-collected
FEMALE_MAX	=	The gender of the signing auditors, measured using a dummy variable that equals 1 if an auditor is a woman and 0 otherwise.	Hand-collected
AGE_MAX	=	The maximum age of the signing auditors.	Hand-collected
EDU_REV	=	The education level of the review auditor.	Hand-collected
EDU_ENG	=	The education level of the engagement auditor.	Hand-collected
LNGDP	=	The natural logarithm of the GDP per capita in the province in which a firm is located.	China Statistical Yearbook
TRANS	=	The transport status of the province in which a firm is located, measured as the natural logarithm of the total highway mileage at the province level.	China Statistical Yearbook
UNV	=	The number of finance and economic universities within a radius of 100 km around a firm's registered address.	China Statistical Yearbook

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Local corruption and corporate cash holdings: Sheltering assets or agency conflict?

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ABSTRACT

This study investigates the impact of corruption on corporate cash holdings in China. The political extraction argument predicts that firms might shelter liquid assets to avoid extraction by corrupt officials. Using data on A-shared listed firms between 2007 and 2012, we find that firms located in more corrupt regions hold less cash, supporting this hypothesis. Political resources help to diminish the risk of exploitation, reducing the extent to which liquid assets are sheltered. We find that the negative association between corruption and cash holding is more significant for non-state-owned enterprises (Non-SOEs) than for state-owned enterprises (SOEs). Moreover, the cash holdings of Non-SOEs without political connections are more sensitive to corruption than those of Non-SOEs with political connections. These findings demonstrate that expropriation by corrupt officials is an important factor driving firms to manage liquidity.

1. Introduction

Corruption has always been an eye-catching issue in both emerging economics and developed countries. Corruption damages market institutions and business systems and is considered "the biggest obstacle of economic and social development" (World Bank, 2000). A report from the World Economic Forum in 2013 documented that the total cost of corruption is about 260 billion dollars, more than 5% of global GDP and resulting in a 10% increase in business costs.

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Many papers discuss the impact of corruption on economic growth and social inequity at the macro level (Shleifer and Vishny, 1993; Mo, 2001). However, studies linking corruption to firm-level activities are still rare. Corruption is an important dimension of the institutional environment, and it harms market competition and breeds distortionary political-business relations. Corruption plays a vital role in determining corporate governance and organization behaviors (La Porta et al., 2000). Dass et al. (2017) document that corrupt cultures influence firm decisions by shaping business rules and relations. Smith (2016) examines the impact of official corruption on corporate financial policy and finds that local corruption motivates firms to shelter liquid asset. Paunov (2016) shows that political corruption increases the costs of gaining government innovation services and saps firms' willingness to innovate. Sun (2014) states that government corruption greatly impacts firms' tax avoidance strategies.

This study investigates the impact of local corruption on corporate cash holdings in China. There are several reasons to do this. Firstly, firms are the foundation for economic vitality and high-quality economic growth. Asset structure plays a significant role in sustaining firm operation. Cash is the most valuable asset and cash allocation directly influences firm performance. Secondly, the effect of corruption on corporate cash holding is controversial. Some argue that corruption results in a higher risk of political extraction, motivating firms to shelter their liquidity assets and reduce their cash holdings (Caprio et al., 2013; Smith, 2016). Others argue that corruption damages market-based rules and institutional constraints, leading to poor corporate governance and serious agency conflicts (La Porta et al., 2000; Chen, 2011; Liu, 2016). Agency conflicts arise because management prefers to hoard more cash to satisfy its private interests (Jensen and Meckling, 1976). It is thus an empirical question how local corruption impacts corporate cash holdings. Thirdly, the huge differences in corruption between provinces in China provide an opportunity to explore this topic and the anti-corruption campaign launched by the Chinese government in 2012 offers a unique chance to execute an event study.

We begin by formulating two competing hypotheses. The political extraction argument predicts that firms located in more corrupt regions will shelter more liquid assets to avoid exploitation by officials. The agency hypothesis predicts that serious agency conflicts in more corrupt regions will lead firms to hoard more cash for private gain. Using data on A-shared listed firms between 2007 and 2012, we find evidence in favor of the cash sheltering motivation: firms located in more corrupt regions hold less cash. Further analysis shows that the effect of local corruption on corporate cash holding is more significant for non-state-owned enterprises (Non-SOEs) than for state-owned enterprises (SOEs). The cash policies of Non-SOEs without political connections are more sensitive to official corruption than those of Non-SOEs with political connections. In addition, we find that the increase in sheltering cash caused by corruption moves firms away from their optimal cash holding, harming firm value. These findings remain after considering the issue of endogeneity and a series of robustness tests.

This study contributes to the literature in several ways. Firstly, from the perspectives of both political extraction and agency cost, this study explores two different mechanisms for how corruption impacts corporate cash holdings. Empirical evidence supports the cash sheltering motivation for firms located in more corrupt regions shelter more cash to avoid political extraction. This extends the findings of Caprio et al. (2013) and adds to the studies of corporate cash holding in China's weak institutional environment.

Secondly, this study reveals that there is a relation-based preference for different kinds of firms when political extraction is a worry. Studies that discuss political extraction view firms as homogeneous individuals (Cheung et al., 2010; Caprio et al., 2013), neglecting the fact that firms can take different actions to avoid the risk of expropriation. Our study relates political resources to political extraction and finds that good relations with the government helps firms reduce their risk of being targeted by corrupt officials. This alleviates the need to shelter liquid assets. This result contributes to the literature on political extraction and political connection.

Thirdly, this study examines the consequences of official corruption at the firm level. Several studies discuss the impact of corruption on economic growth and social inequity at the macro level (Shleifer and Vishny, 1993; Mo, 2001). Some recent studies examine the impact of corruption on firm behaviors in western countries (Chen, 2011; Paunov, 2016; Smith, 2016). Our study explores the relation between corruption and corporate cash holding in China. This contributes to the literature linking weak institutional environments to firm behaviors.

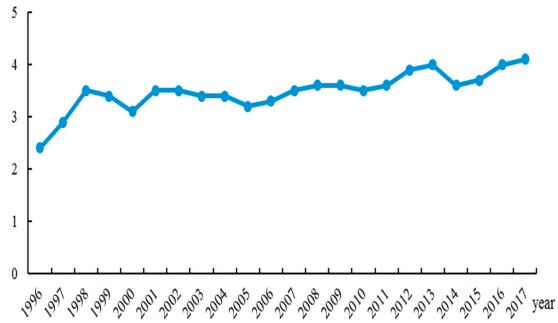


Fig. 1. Corruption Perception Index of China between 1996 and 2017. Note: Data for Fig. 1 obtained from http://www.transparency.org/. The corruption level decreases with the score. The score uses a 10-point system from 1995 to 2011 and a centesimal system after 2012. So scores after 2012 are divided by ten.

The paper proceeds as follows. Section 2 presents institutional background and develops our hypotheses. Section 3 describes the research design and Section 4 reports the empirical results. Section 5 considers some robustness tests, and we present our conclusions in Section 6.

2. Institutional background and hypothesis development

2.1. Corruption in China

China has experienced problems with corruption in recent years, although the economy has continued to grow rapidly. A report by Transparency International indicates the severity of corruption by showing that China's Corruption Perceptions Index (CPI) between 1998 and 2017 ranked about 80 out of 170 nations. Fig. 1 shows that the CPI is between 3 and 4 across these years. Corruption reduces the efficiency of social resources, distorts the investment environment, impedes economic growth and endangers political stability. To control the spread of corruption, the Chinese government launched an anti-corruption war to reduce endemic graft and malfeasance after the Eighteenth National Congress of China in 2012. According to an official report, more than 220 provincial and ministerial level officials and more than 1,119,000 officials overall have been investigated for corrupt behavior (See Fig. 2). The large number of corrupt officials highlights the extent of corruption in China and the government's determination to fight corruption.

Shleifer and Vishny (1993) define corruption as officials illegally using public power for private gain. Allen and Qian (2007) suggest that corruption is grabbing behavior by government officials which destroys the efficiency of resource allocation. In this study, we consider corruption as criminal behavior related to public officials abusing their power to intervene and exploit resources in the pursuit of personal interests (e.g. political achievements, career promotion, rent-seeking and bribe-taking).[1] Aidt (2003) argues that there are at least three necessary conditions for corruption to arise and persist. Firstly, public officials must possess discretionary power to design regulations and policies as they see fit. Secondly, there must be economic rents that can be extracted. Thirdly, institutions must be weak and offer officials chances to use their discretionary power to extract rents.

Corruption in China has been greatly influenced by China's special political system and business culture. The reformation of the Chinese economy, which began in the 1980s, involved extensive governmental decentralization, giving local governments lots of discretionary power over economic development. Local governments can intervene to ensure economic growth and political stability or to provide a public service. Guriev (2004) points out that the powers of discretion and intervention left officials with the ability to seek rents. Fan et al. (2011) argue that corruption would not be effectively controlled if governments at all levels still dominate

[1] For example, government officials often force corporations in their jurisdiction to acquire bankrupt firms to ensure employment, tax income and social stability. Sometimes, the government charges firms for the construction of major municipal project or asks for donations from firms to help rebuild disaster areas.

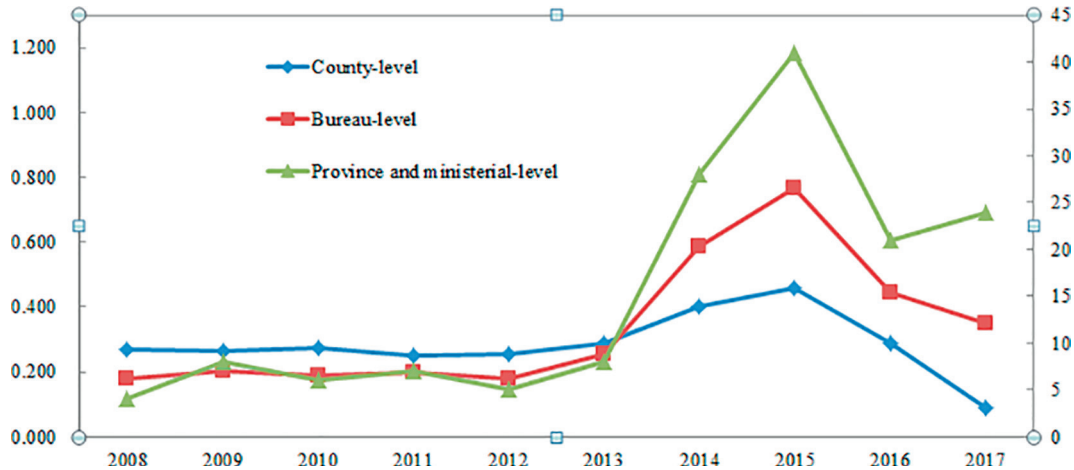


Fig. 2. The number of corrupt officials being investigated. Data for Fig. 2 obtained from the reports of The Supreme People's Procuratorate of China (http://www.spp.gov.cn/gzbg/). The left Y-axis presents the number of corrupt officials at the county level (scaled by ten thousand) and bureau-level (scaled by thousand). The right Y-axis presents the number of corrupt officials at the province and ministerial level.

resource allocation and can intervene in business. Yao (2002) states that privileged politicians abusing their power for grabbing is the source of rent-seeking. The weak legal institutions accelerate the spread of corruption.

2.2. Local corruption and corporate cash holdings: shielding hypothesis

Political extraction exists in every country and is especially prevalent in emerging economies (Shleifer and Vishny, 1998; Caprio et al., 2013). For example, public officials may use threats of regulation to solicit bribes (McChesney, 1988) or delay administrative approval deliberately to extort firms (Kusnadi et al., 2015). Government officials extract rents through operation licenses, export permissions, government contracts and even the nationalization of companies or industries.[2] A report by the World Bank shows that 20% of firms around the world have experienced a request for a bribe from officials at least once between 2005 and 2014.[3]

In the middle of an economic transition, China has poor market-based regulations, an inefficient legal system and extensive government intervention (Allen, 2005; Fan et al., 2011). Such a weak institutional environment, in which the government controls labor, land, energy, infrastructure and resources, makes political extraction possible. In China, a political tournament based on regional GDP performance motivates government officials to develop the local economy. However, the pressure of political competition also forces the government to abuse its unchecked power to exploit firms for private interests (Frye and Shleifer, 1997; Li and Zhou, 2005). These intentions lead officials to exploit firms to ensure employment, political stability and public services and result in strong incentives for officials to gain personally through targeted taxation, resource misallocation and illegal penalties. Djankov et al. (2003) demonstrate that corruption undermines the constraints of institutions and social norms in which firms operate. This in turn leads to abnormal political-business relationships. Kusnadi et al. (2015) argue that a corrupt environment offers government officials more discretionary power and rent-seeking chances, leading to more severe political deprivation. Paunov (2016) suggests that corruption increases the costs of obtaining government services and weakens protections for firm property.

The institution-based view suggests that the institutional environment affects firms' strategic decisions and resource allocations (Peng, 2002, 2003). In cases of political corruption, rational firms adjust their strategies to

[2] For example, in 2008 and 2009, the government of Shanxi introduced several regulations meant to reform mining enterprises that resulted in the nationalization of more than 2840 private mining firms through mergers and acquisitions by state-owned mining groups. However, this government-controlled behavior has been questioned and its legality challenged by the public.

[3] Data Source: the Doing Business group of the World Bank investigated 130,000 firms in more than 135 countries between 2005 and 2014.

avoid the risk of their profits being extracted. For example, Uhlenbruck et al. (2006) find that multinational corporations often respond to corruption in a host country by changing their selection between equity and non-equity financing. Smarzynska and Wei (2002) show that corruption in a country increases risk for foreign investors, reduce investors' enthusiasm for fully-financed acquisitions. In particular, because governments extort firms according to the firms' perceived payment ability, the more a firm can pay, the more it must pay (Svensson, 2003). Spiller and Savedoff (1999) find that state-owned enterprises often employ excess staff to consume firm resources and then evade government deprivation. Durnev and Fauver (2008) argue that firms prefer to disclose information in a vague way to protect firm assets if firms are challenged by higher political extraction risks. Thus, firms might reduce their capacity to pay public officials by shielding assets to limit the scope for political exploitation.

Liquid assets are more likely to be extracted by corrupt officials than non-liquid assets because non-liquid assets can be more easily traced. Myers and Rajan (1998) emphasize that liquid assets such as cash and bonds are easier to steal than fixed assets. Using a sample of multinational countries, Caprio et al. (2013) find that firms hold significantly less cash and more fixed assets (property, plant, equipment and inventory) in more corrupt regions. Smith (2016) shows that firms located in more corrupt regions hold less cash and are more leveraged. Based on this, we predict that firms headquartered in areas with more corruption are more likely to reduce their asset liquidity and hold less cash. The first hypothesis is formulated as follows:

Hypothesis 1. Firms headquartered in more corrupt regions hold less cash than firms located in less corrupt areas.

2.3. Local corruption and corporate cash holdings: agency hypothesis

Corruption destroys market-based rules and the competitive environment. This significantly influences corporate governance. Firstly, corruption is an important factor impacting the institutions and social norms under which firms operate (Djankov et al., 2003). A corrupt environment aggravates firms' agency conflicts by weakening the institutional constraints on large shareholders and management. La Porta et al. (2000) suggest that firms located in more corrupt regions usually have worse corporate governance. Secondly, the culture of corruption is highly contagious. This means that it is very easy for bureaucratic corruption to permeate into firms and influence firm behavior. Dass et al. (2017) argue that local public corruption, viewed as illegal social norms, causes greater agency problems in companies and hurts shareholder value. Thirdly, the collusion between politicians and businesses impairs the monitoring role of external governance in the long run. This results in worse agency behavior by corporate managers. Liu (2016) finds that firms located in more corrupt areas take significantly more opportunistic actions such as earning management, financial fraud and insider trading.

The self-interest motivation for cash holdings posits that firms' agency conflicts will lead management to hoard more cash to pursue perk consumption, career advancement, emperor building and other self-service behaviors (Jensen and Meckling, 1976). Corruption harms corporate governance and aggravates agent conflicts, leading to increased corporate cash holdings. Examining data from 47 countries, Chen (2011) finds that firms located in more corrupt countries have significantly higher asset liquidity. Thus, the second hypothesis is formulated as follows:

Hypothesis 2. Firms headquartered in more corrupt regions hold more cash than firms located in less corrupt areas.

3. Research design

3.1. Sample selection and data source

This section describes the data collection process. The initial sample consists of A-share listed firms on the Shanghai and Shenzhen Stock Exchange over the period 2007 to 2012. Because the Chinese government launched an anti-corruption war after the Eighteenth National Congress of China in November 2012, the

number of officials investigated for corruption increased rapidly in 2013. To avoid any influence of this policy, we limit the sample to 2012. We drop financial firms as their capital structure differs systematically. Special Treatment (ST) firms are also excluded. Then, we delete any firm observations for which the registration address and office address are inconsistent. Observations with missing values are also deleted. This results in a sample that is an unbalanced panel of 6721 firm-year observations. To mitigate the effect of outliers, all continuous firm-level observations are winsorized at the 1st and 99th percentiles.

Data for this study are obtained from several sources. The data on corruption is hand collected from the report of the People's Procuratorate of China, which reports officials' criminal acts such as bribery, pirating and fraud. These reports are extracted from the China Procuratorial Yearbook before 2009 and from the official website of the People's Procuratorate of each province after 2009. For each firm, we use the corruption level of the province where the firm is headquartered as the local corruption measure. The data on cash holdings and other firm-level variables are taken from China Stock Market and Accounting Research (CSMAR), which collects detailed accounting and financial information on companies listed on the Shanghai and Shenzhen Stock Exchange. Firms' ultimate controllers are obtained from the WIND Financial Database. The amount of loans provided by financial institutions in each province comes from the China's Regional Financial Operation Report, published by the People's Bank of China. Other provincial data comes from the China Statistical Yearbook.

3.2. Model specification

To estimate the relationship between local corruption and firm cash holdings, we construct the following model:

$$Cash = \alpha + \beta_1 Corrupt + \beta_2 SOE + \beta_3 Size + \beta_4 Lev + \beta_5 MB + \beta_6 NWC + \beta_7 CF + \beta_8 Capital + \beta_9 Div + \beta_{10} \text{Zindex} + Year + Ind + \varepsilon \quad (1)$$

Cash is the dependent variable representing a firm's cash ratio. *Corrupt* is the independent variable of interest which measures the level of local corruption. The remaining variables are controls. Year and industry fixed effects are captured by *Year* and *Ind* and ε is a random error term. Standard errors are all heteroskedasticity-robust and are clustered both by province and year to account for potential within-province-year correlation of residuals. We predict a negative sign for β_1 if hypothesis 1 is correct and a positive sign if hypothesis 2 is supported.

3.3. Variable construction

3.3.1. Corporate cash holdings

Following Ozkan and Ozkan (2004), corporate cash holding (*Cash*) is defined as cash and cash equivalents divided by total assets net of cash and cash equivalents at the end of year. In a robustness test, we also use the ratio of cash and cash equivalents to total assets to measure corporate cash holdings ($Cash_1$).

3.3.2. Local corruption

Corruption is usually secret behavior, making it difficult to measure precisely. Inspired by Del Monte and Papagni (2007) and Smith (2016), we use the average number of registered cases of corruption per 10 thousand residents in each province as a proxy of corruption level (*Corrupt*). Registered cases mainly include accusations of extorting and accepting bribes, abusing power and dereliction. We also use the average number of registered cases of corruption per 10 thousand public servants in each province as an alternative proxy of corruption ($Corrupt_2$).

3.3.3. Other variables

Two variables are used to measure a firm's political resources. Firstly, SOEs have more political resources than Non-SOEs. Thus, a binary variable named *SOE* is constructed, equal to 1 if the ultimate controlling shareholder is a state-owned entity and 0 otherwise. Secondly, the political connections of Non-SOEs also

relate to political resources. Accordingly, a dummy variable (*Political*) is constructed, equal to 1 if the chairman or CEO has a political identity and 0 otherwise. Political identity refers to the chairman or CEO being a member of the Chinese People's Political Consultative Conference, being a member of the People's Congress or holding a position in a government department.

In addition, following the literature on corporate cash holdings (Opler et al., 1999; Caprio et al., 2013; Chen et al., 2015; Smith, 2016), we include a series of control variables that might affect cash holdings, including the firm's assets (*Size*), leverage (*Lev*), book-to-market ratio (*MB*), net working capital (*NWC*), cash flow (*CF*), capital expenditure (*Capital*), dividend payout (*Div*) and ownership concentration (*Zindex*). The detailed definitions of all variables are presented in Table 1.

4. Empirical results

4.1. Descriptive statistics

Table 2 provides descriptive statistics for the variables used in our empirical analysis. The average of corporate cash holdings (*Cash*) in our sample is 0.463 and its standard deviation is 0.628. This suggests a large cross-firm variation in the cash ratio. The value of local corruption (*Corrupt*) varies from 0.112 to 0.525, with an average value of 0.233 and a median value of 0.219.

Table 3 presents the differences in corporate cash holdings between two subsamples. The two groups of samples contain firm-year observations with different corruption levels. A firm is included in the less-corrupt group if its corruption level is lower than the sample median and included in the more-corrupt group otherwise. Results in Table 3 indicate that the cash holdings of the less-corrupt group are significantly higher than the cash holdings of the more-corrupt group. The average cash ratio for the more-corrupt group is 0.364, while the figure is 0.530 for the less-corrupt group. These differences are also significant for SOEs and Non-SOEs. These results suggest that local corruption is negatively related to corporate cash holdings.

4.2. The effect of local corruption on corporate cash holdings

We examine the relation between local corruption and corporate cash holdings using Eq. (1). Results are presented in Table 4. The standard errors are all heteroskedasticity robust and areclustered both by province and year. Column I presents the results without control variables, while Column II presents the results with a full set of control variables. Column II shows that the coefficient on *Corrupt* is negative and statistically significant at the 1% level (coefficient is −0.384 with a t-statistic of −3.80), suggesting that local corruption is negatively associated with the corporate cash ratio. These results support the shielding hypothesis that firms located in more corrupt provinces tend to hold less cash to avoid the political extraction.

The results for control variables are as follows. The coefficient of *SOE* is significantly negative, suggesting that SOEs hold less cash than Non-SOEs. The results also show a negative association between *Cash* and firm

Table 1
Variable definitions.

Variable	Definition
Cash	Cash and cash equivalents /(total assets − cash and cash equivalents)
Corrupt	Average number of registered cases of corruption per 10 thousand residents
SOE	A binary variable equal to 1 if the ultimate controlling shareholder is a state-owned entity and 0 otherwise
Political	A dummy variable equal to 1 if the chairman or CEO of a Non-SOE has a political identity and 0 otherwise
Size	Natural logarithm of total assets
Lev	(Long-term debt + debt in current liabilities)/total assets
MB	Total assets/market value of the stock
NWC	(Working capital − cash and cash equivalents)/(total assets − cash and cash equivalents)
CF	(Net cash flow from operating activities/total assets) * 100
Capital	Capital expenditures/(total assets − cash and cash equivalents)
Div	A dummy equal to 1 if a firm paid a cash dividend in a year and 0 otherwise
Zindex	Shareholdings of largest shareholder/shareholdings of second shareholder

Table 2
Descriptive statistics.

Variables	N	Mean	SD.	Min	25th	Median	75th	Max
Cash	6721	0.463	0.628	0.012	0.117	0.228	0.514	3.592
Corrupt	6721	0.233	0.058	0.112	0.193	0.219	0.264	0.525
SOE	6721	0.433	0.495	0	0	0	1	1
Size	6721	21.622	1.239	19.531	20.757	21.397	22.213	25.878
Lev	6721	0.419	0.221	0.034	0.242	0.415	0.589	0.940
MB	6721	0.834	0.770	0.108	0.363	0.593	0.998	4.949
NWC	6721	0.004	0.273	−0.900	−0.157	0.007	0.185	0.615
CF	6721	0.042	0.077	−0.184	0.001	0.043	0.087	0.248
Capital	6721	0.098	0.081	0	0.035	0.076	0.141	0.365
Div	6721	0.714	0.452	0	0	1	1	1
Zindex	6721	1.339	2.479	0.100	0.194	0.425	1.229	15.449

Note: Descriptive statistics of the main variables used in the empirical analysis. Variable definitions are provided in Table 1.

Table 3
Differences in corporate cash holdings between two subsamples.

	Less corrupt	More corrupt	Test of difference	
			Dif.	t
Total sample	0.530	0.364	0.166***	10.57
SOE	0.311	0.225	0.086***	6.48
Non-SOE	0.674	0.506	0.168***	6.62
Non-SOEs with political connections	0.491	0.398	0.094***	3.12
Non-SOEs without political connections	0.733	0.511	0.223***	8.12

Note: T-statistics for the differences in the means of corporate cash holdings between less corrupt and more corrupt groups. The number of firm-year observations in the less corrupt and more corrupt groups is equal. The observations in each group are 3360 for the total sample, 1454 for the SOE sample, 1906 for the Non-SOE sample, 516 for the Non-SOEs with political connections sample and 1390 for the Non-SOEs without political connections sample. Variable definitions are provided in Table 1.
*Indicates significance at the 10% level.
**Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

size (*Size*), leverage (*Lev*), ownership concentration (*Zindex*) and net working capital (*NWC*). By contrast, firms with a higher market-to-book ratio (*MB*) hold significantly more cash. Dividend-paying (*Div*) firms also hold more cash, indicating that Chinese firms may hold more cash to pay dividends.

4.3. Local corruption and corporate cash holdings: the role of political resources

Firms can take measures other than lowering their asset liquidity to prevent political grabbing. The culture of *Guanxi* in China has strong business implications. Firms are keen to keep close relationships with the government (commonly known as wearing a "red hat") to seek political asylum or favorable treatment. Allen et al. (2005) argue that Non-SOEs' lack of inherent political ties makes them more exposed to governmental exploitation. Voss et al. (2008) argue that a firm's political resources reflect its ability to deal with threats in certain circumstances. Political connections provide the advantages of lobbying local governments, reducing the threat of being encroached upon (Boubakri et al., 2013). As such, firms without political resources are at a higher risk of having their assets extracted and hence will have a stronger motive to shelter cash than firms with political resources.

Studies also document that firms with more political resources are entrusted more social responsibilities such as maintaining low unemployment (Fan et al., 2007). Lin and Li (2008) argue that SOEs are burdened with the tasks of ensuring economic growth, political stability and public services while enjoying the benefits of political relation. For example, when the government faces financial troubles or resource scarcity, officials are more likely to shift their financial burden to SOEs. Moreover, the inherent responsibility of SOEs to provide

Table 4
Results for the impact of local corruption on corporate cash holdings.

	Cash	
	I	II
Constant	0.519***	1.429***
	(7.31)	(10.56)
Corrupt	−1.053***	−0.384***
	(−5.66)	(−3.80)
SOE		−0.080***
		(−4.88)
Size		−0.013**
		(−2.20)
Lev		−1.914***
		(−19.19)
MB		0.086***
		(9.00)
NWC		−0.664***
		(−12.79)
CF		0.070
		(0.71)
Capital		−0.095
		(−1.03)
Div		0.091***
		(7.84)
Zindex		−0.001***
		(−6.28)
Year	Yes	Yes
Ind	Yes	Yes
Adj-R^2	0.169	0.427
N	6721	6721

Note: Regression results for the impact of local corruption on corporate cash holdings. T-statistics are presented in parentheses. Standard errors are all heteroskedasticity-robust and are clustered both by province and year. Variable definitions are provided in Table 1.
*Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

social services gives more opportunity for political grabbing. Thus, firms with more political resources may suffer more political exploitation than firms without political resources.

What role, then, do political resources play when a firm encounters the possibility of political exploitation? To explore this question, we investigate whether political resources influence the association between political corruption and corporate cash holdings by including an interaction term of corruption and political resources (*Corrupt*PR*) in Eq. (1). Political resources (*PR*) are measured by whether the firm is a state-owned enterprise (*SOE*) and, if the firm is a Non-SOE, whether it is politically connected (*Political*). The model is as follows:

$$Cash = \alpha + \beta_1 Corrupt + \beta_2 PR + \beta_3 Corrupt \times PR + \beta_4 Size + \beta_5 Lev + \beta_6 MB + \beta_7 NWC + \beta_8 CF + \beta_9 Capital + \beta_{10} Div + \beta_{11} Zindex + Year + Ind + \varepsilon \quad (2)$$

Results are presented in Table 5. Column I shows that the coefficient of *Corrupt* is −0.714 (t = −3.26) and is significant at the 1% level. The coefficient of *SOE* is significantly negative at the 1% level, indicating that SOEs hold less cash than Non-SOEs. More importantly, the coefficient on *Corrupt*SOE* is positive and significant at the 5% level (coefficient of 0.605 and t-statistic of 2.12). This result demonstrates that the negative effect of local corruption on corporate cash holdings is more prominent in Non-SOEs.

Column II in Table 5 shows that the coefficient on *Corrupt*Political* is also positive and significant at the 10% level (coefficient of 0.959 and t-statistic of 1.89). These results indicate that political connections lower the motivation of Non-SOEs to shelter cash in corrupt environments. We also examine the relationship in sub-samples. We divided the Non-SOEs into two groups according to whether they have a political connection.

Table 5
Results for the role of political resources.

	Cash			
	I Total sample	II Non-SOEs	III Non-SOEs with political connections	IV Non-SOEs without political connections
Constant	1.491***	1.272***	0.782*	1.495***
	(10.82)	(4.53)	(1.97)	(4.41)
Corrupt	−0.714***	−0.665**	0.094	−0.583**
	(−3.26)	(−2.49)	(0.26)	(−2.20)
SOE	−0.222***			
	(−3.13)			
Corrupt*SOE	0.605**			
	(2.12)			
Political		−0.318**		
		(−2.59)		
Corrupt*Political		0.959*		
		(1.89)		
Size	−0.013**	0.005	0.024	−0.012
	(−2.06)	(0.33)	(1.15)	(−0.62)
Lev	−1.912***	−2.546***	−2.267***	−2.614***
	(−19.27)	(−17.06)	(−11.50)	(−14.92)
MB	0.085***	0.080***	0.027	0.096***
	(9.07)	(3.51)	(0.85)	(3.87)
NWC	−0.665***	−0.873***	−0.537***	−0.956***
	(−12.81)	(−11.83)	(−4.66)	(−10.94)
CF	0.074	0.104	0.033	0.155
	(0.76)	(0.60)	(0.17)	(0.76)
Capital	−0.103	−0.415***	−0.572**	−0.390**
	(−1.11)	(−3.19)	(−2.45)	(−2.34)
Div	0.091***	0.127***	0.059*	0.136***
	(7.86)	(6.53)	(1.77)	(5.36)
Zindex	−0.001***	−0.001***	−0.002**	−0.001*
	(−6.47)	(−3.12)	(−2.48)	(−1.79)
Year	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes
Adj-R^2	0.427	0.438	0.371	0.456
N	6721	3813	1033	2780

Note: Results for the role of political resources in influencing the relation between political corruption and corporate cash holdings. T-statistics are presented in parentheses. Standard errors are all heteroskedasticity-robust and are clustered both by province and year. Variable definitions are provided in Table 1.

* Indicates significance at the 10% level.

** Indicates significance at the 5% level.

*** Indicates significance at the 1% level.

Columns III and IV in Table 5 show that the coefficient on *Corrupt* is significantly negative when firms are not politically connected and insignificant when firms are politically connected. These results suggest that the negative effect of corruption on corporate cash holdings is more prominent in Non-SOEs without political connections.

Overall, these findings suggest that firms with political resources have the privilege of political protection, making them less likely to shelter their cash assets. However, firms without political resources have a greater incentive to decrease their ratio of cash holdings to avoid extraction. The government presents a relation-based preference for different kinds of firms when extracting rents.

4.4. Does local corruption lead to shortage of corporate cash holdings?

In this section, we address the issue of whether shielding assets causes a shortage of corporate cash holdings by investigating the relation between corruption and negative excess cash holdings. Following Zhang and Wu

Table 6
Results for relation between local corruption and shortage of cash holdings.

	Under-cash		
	I	II	III
Constant	0.680***	−0.126***	−0.038
	(4.77)	(−3.22)	(−0.05)
Corrupt	−0.223**	−0.091***	1.090*
	(−2.28)	(−2.87)	(1.77)
SOE	−0.055***	−0.006*	0.300***
	(−3.70)	(−1.69)	(3.79)
Size	0.0004	−0.001	−0.089**
	(0.07)	(−0.72)	(−2.48)
Lev	−1.899***	−0.286***	8.797***
	(−19.01)	(−13.52)	(23.64)
MB	0.113***	0.012***	−0.357***
	(11.07)	(4.87)	(−4.35)
NWC	−0.718***	−0.051***	3.018***
	(−13.72)	(−3.76)	(15.48)
CF	0.010	−0.004	−0.875
	(0.10)	(−0.13)	(−1.42)
Capital	−0.044	0.140***	−0.520
	(−0.45)	(5.12)	(−1.19)
Div	0.083***	0.026***	−0.520***
	(7.04)	(6.25)	(−6.42)
Zindex	−0.001***	−0.0001**	0.002
	(−3.96)	(−2.20)	(1.17)
Year	Yes	Yes	Yes
Ind	Yes	Yes	Yes
Adj-R^2	0.307	0.662	–
Pseudo R^2	–	–	0.248
N	6721	4611	6721

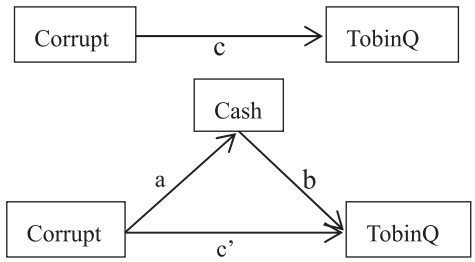
Note: Results for the relation between local corruption and shortages of cash holdings. T/Z-statistics are presented in parentheses. Standard errors are all heteroskedasticity-robust and are clustered both by province and year. Variable definitions are provided in Table 1.
* Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

(2012), we first calculate the mean of corporate cash holdings in each industry and use the differences between a firm's cash holding and the mean value to measure the firm's shortage of cash holdings (*Under-cash*). If the difference is negative, the firm lacks cash holdings. Column I of Table 6 reports the relation between *Under-cash* and *Corrupt* in the total sample, while Column II presents the results for the sample of observations with a negative value of *Under-cash*. The coefficients of *Corrupt* are significantly negative, suggesting that the degree of cash shortage increases with local corruption. In Column III, we measure *Under-cash* with a dummy variable equal to 1 if *Under-cash* is less than zero and 0 otherwise.[4] The coefficient of *Corrupt* is positive and significant at the 10% level, indicating that firms located in more corrupt regions are more likely to have shortages of cash holdings. Therefore, political corruption leads firms to shelter cash assets and results in a shortage of corporate cash holdings.

4.5. Local corruption and firm value: the mediating role of cash holdings

Corporate cash holding is an important factor impacting firm value. In this section, we explore whether corruption harms firm value because of the increase in sheltered assets. Using the mediating effect model of

[4] In Column III of Table 6, we use the Logit model.



$$TobinQ = \alpha + cCorrupt + Control + e \quad (1)$$

$$Cash = \alpha + aCorrupt + Control + e \quad (2)$$

$$TobinQ = \alpha + c'Corrupt + bCash + Control + e \quad (3)$$

Fig. 3. Mediating effect model.

Table 7
Local corruption and corporate value: the mediating effect of cash holding.

	TobinQ					
	I		II		III	
		Total sample		SOEs		Non-SOEs
Constant	13.51***	12.95***	10.69***	10.12***	19.29***	18.73***
	(23.44)	(24.00)	(18.70)	(17.89)	(16.18)	(16.93)
Corrupt	−0.892***	−0.706**	−0.916***	−0.772***	−0.683*	−0.471
	(−2.89)	(−2.38)	(−3.17)	(−2.68)	(−1.78)	(−1.27)
Cash		0.374***		0.451***		0.373***
		(9.12)		(5.18)		(8.39)
SOE	0.050	0.052				
	(1.33)	(1.39)				
Size	−0.418***	−0.406***	−0.282***	−0.273***	−0.702***	−0.688***
	(−15.64)	(−15.65)	(−10.07)	(−9.80)	(−12.78)	(−13.35)
Age	−0.102***	−0.045	−0.146***	−0.094***	−0.034	0.017
	(−3.31)	(−1.52)	(−4.30)	(−2.76)	(−0.90)	(0.46)
Lev	−1.834***	−1.537***	−1.945***	−1.729***	−1.715***	−1.332***
	(−12.56)	(−10.95)	(−11.07)	(−9.79)	(−8.47)	(−6.77)
ROA	3.114**	3.130**	5.500***	5.429***	0.606	0.650
	(2.26)	(2.31)	(3.91)	(3.78)	(0.32)	(0.35)
Zindex	−0.002***	−0.002***	−0.001**	−0.001**	−0.002**	−0.003**
	(−3.79)	(−4.05)	(−2.29)	(−2.08)	(−1.99)	(−2.27)
APS	−0.173***	−0.192***	−0.128***	−0.134***	−0.212***	−0.236***
	(−10.56)	(−11.34)	(−7.21)	(−7.66)	(−8.81)	(−9.40)
EPS	0.941***	0.941***	0.445***	0.417***	1.613***	1.617***
	(5.91)	(6.03)	(3.31)	(3.05)	(6.15)	(6.38)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes	Yes	Yes
Adj-R^2	0.507	0.517	0.527	0.535	0.514	0.528
N	6721	6721	2908	2908	3813	3813

Note: Results for the mediating role of corporate cash holdings on the relation between corruption and firm value. T-statistics are presented in parentheses. Standard errors are all heteroskedasticity-robust and are clustered both by province and year. Variable definitions are provided in Table 1.

* Indicates significance at the 10% level.

** Indicates significance at the 5% level.

*** Indicates significance at the 1% level.

Baron and Kenny (1986), we run the regressions accompanying Fig. 3.[5] Firstly, we examine the effect of corruption on firm value using Eq. (1). Column I of Table 7 shows that the coefficient of *Corrupt* is significantly negative at the 1% level. Secondly, the results of Eq. (2), presented in Table 4, suggest a significantly negative

[5] In Eqs. (1) and (3), firm value is measured with TobinQ. The control variables are *SOE*, firm size (*Size*), firm age (*Age*), firm leverage (*Lev*), return of asset (*ROA*), ownership concentration (*Zindex*), Net asset of per share (*APS*) and earnings per share (*EPS*). Year (*Year*) and industry (*Ind*) fixed effects are included.

relation between local corruption and corporate cash holding. Thirdly, we run Eq. (3) and find that the coefficient of *Cash* is positive and significant after controlling for corruption. In addition, the coefficient of *Corrupt* is still negative and significant. These results show that corporate cash holdings play a mediating role between corruption and firm value. The results of the SOE and Non-SOE subsamples in Columns II and III also support a mediating effect.

5. Robustness test

We conduct various tests to confirm the robustness of our findings.

5.1. Omitted variables

In the main model, we control for the major firm-level variables. However, the corporate cash holdings are also influenced by economical and financial conditions. Considering the unequal economic development and institutions across provinces, we add variables measuring economic development (*GDP*), financial institutions (*Finance*) and the legal system (*Law*) into the main model[6] and then run the regression again. Results in Table 8 show that the main findings are qualitatively unchanged after controlling for these economic and financial factors.

5.2. The influence of external financial institutions

Corporate cash holdings are constrained by external financial institutions. Bates et al. (2009) find that firms headquartered in regions with weak financial institutions usually hold more cash. As such, the relationship between local corruption and corporate cash holdings may be affected by external financing institutions. We address this concern by using monetary policy as a proxy for the external financial environment. Monetary policy can be classified as either loose or tight. Looser monetary policy makes it easier for firms to gain financial support, allowing firms to hold less cash.

Monetary policy is measured as the growth rate of Generalized Currency in each year. Monetary policy is considered loose if the annual growth is higher than the median across all years and considered tight otherwise. A dummy variable (*Monetary*) is created, equal to 1 if the policy is loose and 0 otherwise. Column I in Table 9 presents the results. The coefficient of *Corrupt* is negatively significant in both subsamples. While the coefficient is −0.317 (t-statistic: −2.83) for the subsample with tight monetary policy, the coefficient is −0.410 (t-statistic: −2.88) for subsample with loose monetary policy. The Chow Test finds no obvious difference in the coefficient of corruption between the two subsamples. These findings suggest that our hypothesis is not influenced by external financial institutions.

5.3. The influence of firm risks

Operational risks may affect our results. Firms in industries with more overall risk may hold more cash assets, a concern if these firms also do business in less corrupt regions. For example, high-tech firms usually need more cash reserves to deal with higher innovation risks and innovation activities are more likely to succeed in less corrupt areas. To address this issue, we measure firm risks as the standard deviation of cash flow. We first calculate the standard deviation of cash flow for each firm over the sample window. Then, we create a dummy variable (*CFrisk*) equal to 1 if the firm's operation risk is larger than the median across all firms and 0 otherwise. Column II in Table 9 shows that the coefficient of *Corrupt* in both subsamples is significantly negative. The Chow Test finds no statistically significant difference between the two subsamples. These findings suggest that our hypothesis is not influenced by firms' operation risks.

[6] *GDP* is measured as the natural logarithm of GDP per capital in each province. *Finance* is defined as the amount of loans divided by GDP in each province. The measurement of *Law* comes from the Report of Marketing Index provided by Fan et al. (2011). We use their Intermediary Organization and Legal Environment index as the proxy of legal system.

Table 8
Results for controlling for economic conditions.

	Cash		
	I	II	III
Constant	0.969***	1.008***	−0.010
	(4.51)	(4.73)	(−0.02)
Corrupt	−0.364***	−0.724***	−0.481**
	(−3.16)	(−3.35)	(−1.97)
SOE	−0.085***	−0.240***	
	(−5.04)	(−3.48)	
Corrupt*SOE		0.661**	
		(2.39)	
Political			−0.296***
			(−3.01)
Corrupt*Political			0.907**
			(2.31)
Size	−0.019***	−0.018***	0.005
	(−2.84)	(−2.74)	(0.34)
Lev	−1.905***	−1.902***	−2.365***
	(−18.74)	(−18.85)	(−16.19)
MB	0.089***	0.088***	0.098***
	(9.09)	(9.17)	(4.54)
NWC	−0.667***	−0.668***	−0.852***
	(−12.67)	(−12.69)	(−12.06)
CF	0.066	0.071	0.091
	(0.68)	(0.74)	(0.63)
Capital	−0.097	−0.106	−0.308**
	(−1.04)	(−1.13)	(−2.50)
Div	0.094***	0.094***	0.107***
	(7.74)	(7.77)	(6.62)
Zindex	−0.001***	−0.001***	−0.001***
	(−6.06)	(−6.25)	(−3.87)
GDP	0.058**	0.061***	0.123***
	(2.60)	(2.79)	(3.09)
Finance	0.053***	0.054***	0.054**
	(3.53)	(3.74)	(2.31)
Law	−0.005**	−0.006**	−0.009**
	(−2.05)	(−2.23)	(−2.49)
Year	Yes	Yes	Yes
Ind	Yes	Yes	Yes
Adj-R^2	0.429	0.430	0.425
N	6665	6665	4752

Note: Results for the effect of local corruption on corporate cash holdings after controlling for economic conditions. T-statistics are presented in parentheses. Standard errors are all heteroskedasticity-robust and are clustered both by province and year. Variable definitions are provided in Table 1.
*Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

5.4. Difference-in-differences model

The Chinese government launched an anti-corruption campaign to crack down on endemic graft and malfeasance after the Eighteenth National Congress of China in 2012. We regard this anti-corruption war as an exogenous event to do a quasi-natural experiment to explore the relation between anti-corruption and firm's motivations for shielding assets. Since the anticorruption war began in late 2012, 2013 to 2015 is classified as the after-event window and 2010 to 2012 is considered as the before-event window. In the difference-in-differences model, *Post* is a binary variable equals to 1 for the after-event window and 0 for

Table 9
Results for the influence of external financial institutions and firm risks.

	Cash			
	I		II	
	Monetary = 1	Monetary = 0	CFrisk = 1	CFrisk = 0
Constant	1.446***	1.276***	0.900***	1.843***
	(8.90)	(5.89)	(4.81)	(11.15)
Corrupt	−0.410***	−0.317***	−0.372***	−0.344**
	(−2.88)	(−2.83)	(−3.71)	(−1.99)
Control	Yes			
Year	Y	Y	Y	Y
Ind	Y	Y	Y	Y
Adj-R^2	0.445	0.379	0.373	0.484
N	4399	2322	3692	3029
Chi^2 (p)	0.27		0.02	
	(0.602)		(0.880)	

Note: Results for the effect of local corruption on corporate cash holdings after considering external financial institutions and firm risks. T-statistics are presented in parentheses. Standard errors are all heteroskedasticity-robust and are clustered both by province and year. Variable definitions are provided in Table 1.
*Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

the before-event window. Then, we use a dummy variable to represent the control and treatment group. A binary variable (*Corrupt*) equals 1 if the firm falls into the treatment group and equals 0 if it falls into the control group. Firms located in provinces with corruption above the median form the treatment group and firms located in the other provinces form the control group.

Column I of Table 10 shows that the coefficient of *Corrupt* is significantly negative at the 1% level, suggesting that firms located in more corrupt regions hold less cash. More importantly, the coefficient of *Corrupt*Post* is positive and significant at the 1% level. This indicates that the effect of anti-corruption on cash holdings is more significant in more corrupt regions than in less corrupt regions. These findings support the

Table 10
Results of the difference-in-differences estimation.

	Cash	
	I	II
Constant	1.450***	1.566***
	(14.76)	(11.71)
Post	−0.313***	−0.344***
	(−9.49)	(−8.81)
Corrupt	−0.049***	−0.081***
	(−2.76)	(−3.57)
Corrupt*Post	0.081***	0.109***
	(3.78)	(4.23)
Control	Yes	
Year	Y	Y
Ind	Y	Y
Adj-R^2	0.371	0.384
N	10,424	6484

Note: Results of the difference-in-differences estimation. T-statistics are presented in parentheses. Standard errors are all heteroskedasticity-robust and are clustered both by province and year. Variable definitions are provided in Table 1.
*Indicates significance at the 10% level.
**Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

argument that the anti-corruption war helps to curb political extraction and reduce firms' cash sheltering motivation. This effect is especially significant in more corrupt regions. As a robustness check, we redefine the treatment and control groups. Firms located in provinces with corruption in the upper quartiles form the treatment group and firms located in the lower quartiles form the control group otherwise. Column II in Table 10 shows that our findings are robust.

5.5. Alternative measurements

In this section, we consider alternative measurements of our main variables. Firstly, we measure corporate cash holdings as the ratio of cash and cash equivalents to total assets ($Cash_1$). All of the above control variables are included. Secondly, we apply another corruption measurement, the registered cases of corruption scaled by the number of public servants ($Corrupt_1$). The untabulated results are identical to our previous results that corporate cash holdings are negatively related to both alternative measures.

6. Conclusions

The political environment plays a significant role in influencing corporate governance and firm behavior. This study investigates the effect of local corruption on corporate cash holdings in China. Based on the view of political extraction and agency conflicts, we formulate two competing hypotheses. Using data on A-shared listed firms between 2007 and 2012, we find evidence in favor of a cash sheltering motivation. Firms located in more corrupt regions hold less cash. Further study shows that political resources help to avoid the risk of being exploited, alleviating the motivation to shield liquid assets. Our results indicate that the effect of local corruption on corporate cash holding is more significant in non-state-owned enterprises than in state-owned enterprises. Compared to Non-SOEs with political connections, the cash policies of Non-SOEs without political connections are more sensitive to local corruption. In addition, we find that sheltering cash in corrupt environments causes firms to move away from their optimal cash holdings, harming firm value. These findings are robust to a series of robustness tests.

Overall, our findings have several implications. Firstly, firm behavior is affected by the institutional environment. This study adds to the literature by relating corruption to corporate cash holdings. Most of the literature on corruption either focuses on developed economics or across-country settings (Mo, 2001; Anderson and Tverdova, 2003; Méndez and Sepúlveda, 2006; Aidt, 2009; Wu and Zhu, 2011). Some recent studies do discuss the impact of corruption on corporate governance and firm decision (De Rosa, 2015; Paunov, 2016; Dass et al., 2017). However, these studies ignore the relation between corruption and firms' basic capital raising activity, corporate cash holdings. Our findings address this gap and highlight the importance of fighting corruption in China.

Our findings contribute to the research on corporate cash holdings in China's weak institutional environment. Our results suggest that official corruption exacerbates the risks of political extraction and increases firms' motivation to shield liquid assets. These results help us to understand firms' assets allocation and imply that anti-corruption activities help firms to optimize their asset structure. This in turn promotes the healthy development of business.

This study also sheds light on the role that political resources play in business. In China, the inherent political connections of SOEs function as a risk-aversion mechanism, giving SOEs an advantage in seeking political protection. This phenomenon results in more serious political grabbing in firms without political resources. This finding provides insight into the issue of how property rights and business relationships affect corporate decisions. It is also strongly supports the guidelines for building friendly government-business relationships in China.

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Is the quality of female auditors really better? Evidence based on the Chinese A-share market☆

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ABSTRACT

Unlike previous studies in which a single index was used to measure audit quality, this study establishes a new comprehensive index to measure audit quality via Discretionary Accrual, as estimated by Jones' basic model (1991) and Audit Opinions. The former is used to measure the quality of financial statements, and the latter is used to measure the auditors' independence in the mainstream international literature. We examine whether and how an auditor's gender affects the quality of his or her audits under the framework of empathy theory and gender role socialization theory. Using a large sample of 9861 auditor-firm-year observations from Chinese A-share–listed companies from 2011 to 2015, we find that the audit quality of signed auditors shows significant gender differences: these significant gender differences differ from the findings of previous studies that female auditors could provide a higher-quality audit than male auditors; that is, in our study the audit quality of the male auditors exceeds that of the female auditors. After distinguishing the positive and negative directions of the Discretionary Accrual, we find no significant gender differences in audit quality between male and female auditors when the earnings had been adjusted upward by the client; that is, female and male auditors had the same audit risk perception. However, when the client adjusted earnings downward, which indicates a lower audit risk for the

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auditor, the audit quality of female auditors was significantly lower than that of the male auditors. After controlling for the age and position of the auditors, we also find that the gender differences in the auditors' audit quality decreased significantly or even disappeared when the auditor's age exceeded 45 years and/or their position was manager or above. These results are consistent with the empathy theory and gender role socialization theory.

Contents

1. Introduction

In recent decades, increasing numbers of women have become executives, entrepreneurs, and senior government officials, and researchers are paying increasing attention to gender differences in management decision-making. The differences in brain and physiological structures inherent in men and women result in significant differences in thinking, psychology, behavior patterns, emotional cognition, and expression; differences in the social gender roles between men and women (Eckel et al., 2008; Hardies et al., 2010; Walter, 2012; Zaki, 2014); and differences in management decisions and behaviors such as financing, investment, mergers, acquisitions, and financial fraud (Adams et al., 2009; Barua et al., 2010; Francis et al., 2013; Huang et al., 2013; Srinidhi et al., 2011; Francis et al., 2015; Fisher et al., 2017). These studies found that company decision-making by female executives differs significantly from that of male executives, but these conclusions were inconsistent. Some studies found that female executives can lower financing costs (Francis et al., 2013), improve corporate

governance (Adams et al., 2009), restrain overinvestment (Barua et al., 2010; He et al., 2011), reduce financial fraud, and promote accounting information conservatism (Peni et al., 2010; Srinidhi et al., 2011; Ittonen et al., 2013; Francis et al., 2015; Fisher et al., 2017). Other studies found no significant gender differences in the decision and risk preferences of tax avoidance and earning management (Schubert et al., 1999; Dyreng et al., 2010; Zang, 2012).

Previous studies of gender differences in the audit market had inconsistent conclusions. Some studies found that female auditors were more prudent and provided higher-quality audits than male auditors (Sun et al., 2011; Niskanen et al., 2011; Ittonen et al., 2013; Hardies et al., 2012, 2016), but other studies found no significant differences between female and male auditors (O'Donnell et al., 2001; Gul et al., 2013; Hottegindre et al., 2017). Some studies also found that the audit quality of male auditors was higher than that of female auditors (Chung et al., 2001; Gold et al., 2009; Hardies et al., 2010; Hossain et al., 2016; Ye et al., 2011; Zhang et al., 2014). For example, Chung et al. (2001) indicated that female audit partners processed information more efficiently than male audit partners in a complex audit task but also found that male audit partners showed more accurate audit judgement. O'Donnell et al. (2001) indicated that female auditors processed information more efficiently under a highly complex analytical procedure task and that male auditors processed information more efficiently under a less complex procedure task. Gold et al. (2009) analyzed whether the client's gender and the auditor's gender affected the auditor's judgement. They found that male auditors' judgments were more accurate than those of female auditors; compared with female clients, male and female auditors are more interested in male clients, but female auditors were more prominently affected by male clients. Male clients were more likely than female clients to persuade auditors to adjust their original accounting entries. Hardies et al. (2010) noted that female auditors can discover more misreporting and that male auditors show greater accuracy in judging misreporting. Niskanen et al. (2011) found that the income reports provided by female auditors were more prudent. Ittonen et al. (2013) found that the financial statements audited by female auditors had less absolute abnormal accrual and that female auditors could constrain the clients' earning management upward and downward. These findings indicate that female auditors may be the constraint mechanism for earning management. Hardies et al. (2016) found that female auditors were more likely than male auditors to publish Going Concern Opinions, and this significant gender difference exists even with important and high-risk clients. However, the findings of Hossain et al. (2016) were exactly the opposite; they found that female auditors were less likely to publish Going Concern Opinions for companies facing financial distress. Hottegindre et al. (2017) used factor analysis to explore the level of Professional Ethics of Certified Auditors in France; they found that male auditors were more likely to engage in behavior that undermines their professional image and that female auditors were mainly guilty of disciplinary violations related to audit quality and violations of professional peer review procedures. Most studies of auditor gender and audit quality in the Chinese audit market found that female auditors provided greater audit quality of financial reporting (Ding et al., 2012; Guo, 2014) and that their accounting information was more conservative (Luo et al., 2014) than that of male auditors. However, some studies found that male auditors provided greater audit quality than female auditors (Ye et al., 2011; Zhang et al., 2014); and no difference was found between female and male auditors (Li et al., 2012a, b; Wang et al., 2014).

After a review of the literature of gender differences in accounting and auditing, we find that it was deemed a hypothetical premise or a fact that women are more risk-averse and more prudent in behavior than men. Based on this hypothesis, scholars believed that female auditors' behavior was more prudent and that their audit quality was higher than that of male auditors. These conclusions have become a stereotype of scholars (Holt et al., 2002; Dinky, 2007; Säve-Söderbergh, 2012), and this stereotype was used as a premise hypothesis in various studies of gender differences (Gold et al., 2009; Hardies et al., 2010). There are fewer questions to this premise hypothesis and these stereotypical research conclusions, which leads to a lack of diversity in theoretical explanations of the gender differences in auditors' audit quality and greatly limits the innovation of theoretical research and the integration development of theory and practice. Based on this awkward situation of existing theory explanation on gender differences in auditors' audit quality, our explorative study finds that the theory explanation of empathy theory and gender role socialization theory on gender difference shows interesting differences from previous explanations of risk preference. The empathy theory and gender role socialization theory are simply our study's theoretical principle.

Empathy is the ability to experience another person's situation, to have a sense and understanding of other people's emotions, and to display the emotions and behavior that others expect or desire (Hogan, 1969;

Mehrabian et al., 1972; Davis, 1983; Chlopan et al., 1985; Blair, 2005; Walter, 2012; Zaki, 2014). Empathy theory holds that women have higher levels of emotional empathy and cognitive empathy than men. However, because of this high level of empathy, women are more easily disturbed by others' emotions and attitudes and are more likely to show the desired behavior (De et al., 2006; Singer et al., 2009; Walter, 2012; Zaki, 2014; Yue et al., 2016). A person with a high level of empathy may communicate more easily and get along better with others and thus have better customer relationships, but at the same time he or she may have weaknesses, such as being insufficiently firm on position, more easily influenced by other people's opinions, and greater likelihood of compromising with others. Gender role socialization holds that a person acquires a set of basic attitudes, emotions, and behavioral conventions that is compatible with his or her gender via imitative learning under a certain cultural cognition (Kazdin, 2000; Li et al., 2012a, b). The significant differences in the inherent brain and physiological structure and social gender roles between men and women are two main reasons for the significant differences in empathy seen between men and women (Karniol et al., 2003; Schulte-Rüther et al., 2008; Yang et al., 2009; Mercadillo et al., 2011; Woodruff et al., 2011). Gender role socialization theory holds that the gender role of social identity has a more profound and obvious effect on human social behavior than the physical gender role. Related studies found that men achieve the social expectations of the male role by paying more attention to tasks, goal requirements, and fair and just rule; the socialization path of the male role is thus task-oriented. Women achieve the social expectations of the female role by paying more attention to others and by maintaining interpersonal relationships; the socialization path of the female role is thus relationship-oriented (Ma, 2005; Liang et al., 2006; Liu et al., 2011; Li et al., 2012a, b; Jiang et al., 2012; Yang et al., 2014; Chen et al., 2016). The male task-oriented gender role leads men to display stronger behavior and an emphasis on power, rules, authority, and goal outcomes, but it can lead men to more easily ignore the feelings of others and to prefer centralized control, and it can weaken emotional relationships. The female relationship-oriented gender role leads women to be more quiet, democratic, and communicative, but it may also lead women to more easily surrender their positions and compromise their professional principles.

In summary, although female auditors may be more risk-averse, they are more likely to be influenced by their clients and more likely to compromise with them, because of the influence of their higher empathy level and relationship-oriented gender role. Female auditors are thus more likely to relax audit principles, which may lead to lower audit quality. The literature regarding auditor behavior shows that female auditors had a higher premium of audit fee because of their better client relationships and audit quality (Hardies et al., 2012; Ittonen et al., 2012). This conclusion, on the one hand, reflects the inherent advantages of female auditors. On the other hand, it shows the potential risk that a female auditor is more likely to compromise with her client or economic interests to maintain a better relationship. This potential risk is supported by psychological evidence (Ceci et al., 2011; Diekman et al., 2010; Hardies et al., 2010; Liang et al., 2015). With the support of empathy theory and gender role socialization theory, we use the personal characteristics of auditors (released by the China Institute of Certified Public Accountants [CICPA]) to establish an innovative comprehensive measure index of audit quality and research design and explore the influence of auditor gender on audit quality under the special circumstances of China's Capital Market. After controlling for the factors of audit clients and firms that could affect the audit quality frequently used in the literature, we report four findings.

First, the female auditors showed significantly lower audit quality than the male auditors, which is related to women's higher empathy and relationship-oriented social gender role. **Second,** after distinguishing the positive and negative directions of the Discretionary Accrual (DA), we find no significant gender differences in audit quality between male and female auditors. When the earnings had been adjusted upward by the clients, female and male auditors have the same audit risk perception and audit quality. However, when the clients adjusted earnings downward that faced lower audit risk for auditors, the audit quality of the female auditors is significantly lower than that of the male auditors. This finding indicates that female auditors are more likely to compromise with customers than male auditors when the auditors face a lower audit risk in which earnings had been adjusted downward. **Third,** age diminishes the significant gender difference in audit quality between female and male auditors after they reach 45 years of age. This result may be related to the trend of converging empathy levels between men and women when men's testosterone levels begin to decline sharply after they reach 40 years of age and women's estrogen levels begin to decline sharply after they reach 45 years of age. **Fourth,** no gender difference is seen in the audit quality of auditors who are senior executives in the accounting firm. This result may be related to undifferentiated social gender roles between female and male executives when they all are

senior executives; that is to say, the social gender roles of female senior executives are similar to those of male senior executives. After 35 robustness tests in four major categories and 7 endogenous tests in four major categories, our assumptions and findings of female auditors' significantly lower audit quality remain robust.

Our study contributes to the literature in several important ways. **First,** to the best of our knowledge, this study is the first to directly examine the different effects of an auditor's gender on his or her audit quality using the empathy theory and the gender role socialization theory. Distinguishing the theory of risk preference upon which the mainstream literature is based, the empathy theory and gender role socialization theory can help us more profoundly understand the internal mechanism of the effects of gender on audit quality. Our study extends the theoretical boundary of the effects of auditors' gender on audit quality. **Second,** two frequently used indexes of audit quality are used to creatively establish a new comprehensive measure index of audit quality that helps us measure audit quality in a more comprehensive and more accurate manner. **Third,** this study provides a decision reference for accounting firms to improve their audit quality and for regulators to improve the regulatory system design. The paper proceeds as follows. The next section includes the theoretical analysis and research hypothesis. The third section describes the research design. The fourth section presents our regression results and tests our hypothesis. The final section concludes the paper and discusses possible directions for future research.

2. Theoretical analysis and research hypothesis

Empathy theory is a comprehensive theory that integrates fields such as clinical psychology, cognitive neuroscience, sociology, and philosophy (Eisenberg et al., 2009; Singer et al., 2009; Fan et al., 2011; Miklikowska et al., 2011; Liu et al., 2009; Chen et al., 2014). Empathy is the ability to experience another person's situation, to have a sense and understanding of other people's emotions, and to display the desired emotions and behavior; it is a psychological phenomenon that occurs in the process of interpersonal interaction and is a form of thinking of standing on the other side (Hogan, 1969; Mehrabian et al., 1972; Davis, 1983; Chlopan et al., 1985; Blair, 2005; Walter, 2012; Zaki, 2014). Empathy generally includes emotional empathy and cognitive empathy. Emotional empathy comprises a person's emotional reactions to the emotions of others; that is, that a person has a similar emotional experience as others when in the same setting. This reaction can be the reaction of paying attention to others (i.e., empathy attention) or the reaction of paying attention to oneself (i.e., personal distress) (Chen et al., 2014). Cognitive empathy is an understanding of the causes of others' mood swings and appropriate responses to them in terms of emotional and behavioral tendencies.

Studies have shown no significant gender differences in empathy level during the preschool stage. As the body matures, girls' empathy levels generally exceed those of boys after they enter the school-age stage (Rueckert et al., 2011; Auyeung et al., 2012; Fields et al., 2011; Gouveia et al., 2012; Yuan et al., 2010). Male and female infants can only sense the emotions of others via sounds and expressions because their cognitive skills are not yet mature. Empathy at this stage is generally emotional empathy, and no significant gender difference exists. In the school-age stage, children have the ability to identify, receive, analyze, and process information about others' emotions. Cognitive empathy can thus be realized, and the gender differences in cognitive empathy and emotional empathy continue to expand with increasing age. Psychological studies have indicated that female subjects showed significantly greater cognitive empathy and emotional empathy than male subjects regardless of age category (i.e., school age, adolescent, or adult), and this difference is consistent across cultures (Wood et al., 2002; Marton et al., 2009; Auyeung et al., 2012). Studies in cognitive neuroscience have shown that women use the mirror nerve system more than men when they are sensing other people's emotions. The μ rhythm[1] showed a significant positive correlation with empathy. The μ rhythm of women was inhibited more significantly than that of men when they were sensing other people's emotions, which means that women show a significantly higher level of emotional empathy than men (Yang et al., 2009;

[1] Mu rhythm (μ rhythm), also known as the central rolandic orsensorimotor rhythm, has been consistently observed over the primary sensorimotor cortex. Mu suppression and enhancement echo sensorimotor processing in frontoparietal networks. Mu rhythm recorded from electrodes at scalp location over sensorimotor cortex can be attenuated by self-initiated movements, imagined movements, as well as action observation. The mu suppression has also been reported to be closely linked to the mirror-neuron activity. Accordingly, the mu suppression can be a reliably indicator of sensorimotor involvement, supported by the mirror-neuron system, when participants perceive other people in painful situations (Yang et al., 2009).

Woodruff et al., 2011). At the same time, when processing emotional information about others, a significant increase was seen in the reaction of the mirror nervous system core region at the right side of the female brain, such as the inferior frontal, superior temporal sulcus, and amygdala. These are the three brain regions that are responsible for emotional responses and for matching perceptual information with outputted action information. This indicates that women make more use of mirror nerves than men when processing others' information, thus creating a higher level of cognitive empathy (Williams et al., 2005; Schulte-Rüther et al., 2008; Mercadillo et al., 2011).

Scholars tend to agree that the comprehensive impact of innate physiological characteristics and postnatal social and psychological development resulted in women having a higher level of empathy. In terms of innate physiological characteristics, neurobiological studies have found that the empathy level shows a significant negative correlation with the testosterone level (Van et al., 2011); a significant positive correlation with female hormones (Pascual-Sagastizabal et al., 2013); and a significant positive correlation with the oxytocin level (Dadds et al., 2011). Men's testosterone levels continue to decline after 40 years of age, and women commonly show a sharp decline in female hormones after 45 years of age. These changes may weaken or even negate the gender difference in empathy level (Feldman et al., 2002) and lessen the gender differences in management decisions and behavioral outcomes (Sundgren et al., 2014). Therefore, based on biological, medical, and physiologic evidence, we expect that gender differences in auditors' audit quality may narrow or even disappear with age.

From the perspective of social and psychological development, the socialization of gender roles is another important cause of gender differences in the level of individual empathy (Karniol et al., 2003; Ma, 2005; Liang et al., 2006; Liu et al., 2011; Li et al., 2012a, b; Chen et al., 2016) and is a direct reason for the gender convergence of individual behavior (Petersen et al., 2010; Jiang et al., 2012; Yang et al., 2014; Liang et al., 2015). Gender role socialization is a comprehensive theory based on the theories of cognitive neuroscience, cognitive psychology, social psychology, physiological science, and others. Gender role socialization is defined as the acquisition of a set of basic attitudinal, emotional, and behavioral conventions that is compatible with his or her gender via imitative learning under a certain cultural cognition (Kazdin, 2000; Li et al., 2012a, b). After humans developed patriarchal societies, especially after the industrial age, the social demands and expectations for women were to care for the family, care for others, and maintain harmonious relationships. Especially against the background of Chinese culture, women are often associated with tenderness, kindness, solicitude, and encouragement. Women are considered to be relationship-oriented and to focus on task coordination, interpersonal harmony, and democratic decision-making in the execution task process. In practice, women are usually more likely to engender mentality and behavior tendencies of empathic attention for others. Women usually pay more attention to democratic decision-making and interpersonal relationships, but they can show hesitance and are more susceptible to outside interference. These factors lead women to be less efficient in practice (Bass et al., 1990; Guido-Dibrito et al., 1996; Gardiner et al., 1999; Liang et al., 2006). In the process of socialization, men are often considered to be associated with traits such as power, majesty, independence, and reason, and they are primarily responsible for the family's financial resources. Men are considered to be task-oriented, focusing on the goals, results, and rules of the task process, emphasizing problem analysis and hands-on manipulation, working more efficiently, being more principled, taking a firmer stand, and making decisions more decisively. Men are not as good at expressing emotions, sympathy to the emotions of others, and sympathetic concern about others' plight (Karniol et al., 2003). As society becomes more open and tolerant, gender roles are no longer restricted to the two social genders of ''male (masculine)'' and ''female (feminine)'' gender (Gilbert, 1985). The fusion of ''male'' and ''female'' of the two genders engenders neuter social genders, such as the ''tough girl'' (i.e., a masculine woman) and the ''pseudo-girl'' (i.e., a feminine man). To adapt to male-dominated social rules, women may adjust their social gender roles with the promotion of their positions, which leads their gender roles to gradually converge with those of men. Relevant studies have shown that when women have a higher position in an organization, their masculinity, social gender role, and psychological and behavior characteristics are likely to be seen as more masculine (Jiang et al., 2009; Petersen et al., 2010; Li et al., 2011; Jiang et al., 2012; Yang et al., 2014; Liang et al., 2015). This possible change in the gender roles of female executives has also led to inconsistencies in the literature on the outcome of female executives' behavior. For example, Francis et al. (2013, 2015), Faccio et al. (2016) and Li et al. (2012a, b) found that female executives are more likely to avoid risk and less likely to com-

mit financial fraud, but Du et al. (2017) and Zhou et al. (2016) found that women were not always averse to financial fraud and reduce earnings management. Hardies et al. (2012) found that women were also more confident than men because of occupational socialization. Thus, we expect that women in a higher position were more similar to men in terms of psychological and behavioral characteristics, and the gender differences in management decisions and behavioral consequences between women and men are smaller.

In summary, because women generally have higher empathy levels and a relationship-oriented social gender role, women are affected greatly by physiological emotion, psychological disposition, and behavioral patterns, which leads women to be hesitant and more likely to show behavior tendencies such as compromise or altruism. Similar to the studies of Ceci et al. (2011), Diekman et al. (2010), and Liang et al. (2015), Lyons (1983) found that women may have higher moral standards, but they are more likely than men to compromise with another person, so that their actual consequences are no better than those of men. Thus, we believe that the quality of audit services provided by female auditors is not higher than that of male auditors. Therefore, we put forward the testable hypothesis.

Hypothesis 1. Ceteris paribus, female auditors may have significantly lower audit quality than male auditors.

3. Research design

3.1. Empirical model and variables definition

3.1.1. Empirical model structure

We follow the method developed by Gul et al. (2013), DeFond et al. (2014), Zhang et al. (2014), and Hardies et al. (2016) to construct an empirical model and estimate the impact of auditor gender on audit quality. The empirical model as below:

$$AudQuality_{it} = \beta_0 + \beta_1 Aud\_gender_{it} + \Sigma Controls_{it} + \Sigma Year + \Sigma Indu + \varepsilon_{it} \quad (1)$$

3.1.2. Dependent variables

The dependent variable of empirical model (1) is audit quality. In reference to the method of Gul et al. (2013) and Zhang et al. (2014), we use the Jones basic model to estimate the Discretionary Accrual (DA), which measures the quality of a listed company's financial statement, and we then use DA and the actual Audit Opinion (AO), which measure the independence of the auditors, to match a proxy variable (DA_AO) of audit quality. It measures as follows. If the absolute value of DA is higher than its median and AO is a modified audit opinion, or if the DA is lower than its median and AO is a standard audit opinion, the audit quality will be considered high, i.e., DA_AO equals 1. If the absolute value of DA is lower than its median and AO is a modified audit opinion, or if the DA is higher than its median and AO is a standard audit opinion, the audit quality will be considered low, i.e., DA_AO equals 0. Because the positive and negative directions of DA represent different management behaviors and consequences, we use positive DA and negative DA to match AO respectively, obtain two new proxy variables (DA_AO2 and DA_AO3) of audit quality, and investigate the effects of auditor gender on audit quality under different earnings manipulation directions. At the same time, we further use positive DA and negative DA to match standard AO (i.e., the situation of AO equals 0), obtain two new proxy variables (DA_AO4 and DA_AO5) of audit quality, and investigate the effects of auditor gender on audit quality if the attitude and independence of auditors are uncertain. Detailed audit quality measurement methods are shown in Table 1.

According to DeAngelo (1981a), the definition of audit quality is the joint probability of market assessments in which auditors discover their customers' irregularities and report them. According this widely accepted definition, audit quality includes two connotations: that all illegal problems should be discovered by the auditors and that the auditors should report these illegal problems. These two connotations have logical and procedural order. DA reflects the quality of the financial statement; the greater the absolute value of the DA, the lower the quality of the customers' financial statement. The use of the DA as the measurement index of audit quality reflects only the first connotation of audit quality. AO reflects the quality of the auditors' audit report; it is generally considered that a modified AO reflects a higher-quality audit report. The use of the AO

Table 1
Measurement method of audit quality.

Prerequisite	Discretionary Accrual (DA)	Audit Opinion (AO)	
		If it is modified AO, AO equals 1	If it is standard AO, AO equals 0
Absolute value of DA	If DA is higher than its median, DA equals 1	DA_AO equals 1	DA_AO equals 0
	If DA is lower than its median, DA equals 0	DA_AO equals 0	DA_AO equals 1
DA is positive	If DA is higher than its median, DA equals 1	DA_AO2 equals 1	DA_AO2 equals 0
	If DA is lower than its median, DA equals 0	DA_AO2 equals 0	DA_AO2 equals 1
DA is negative	If DA is lower than its median, DA equals 1	DA_AO3 equals 1	DA_AO3 equals 0
	If DA is higher than its median, DA equals 0	DA_AO3 equals 0	DA_AO3 equals 1
DA is positive	If DA is higher than its median, DA equals 1		DA_AO4 equals 0
	If DA is lower than its median, DA equals 0		DA_AO4 equals 1
DA is negative	If DA is lower than its median, DA equals 1		DA_AO5 equals 0
	If DA is higher than its median, DA equals 0		DA_AO5 equals 1

as the measurement index of audit quality reflects only the second connotation of audit quality. On the one hand, the measurement indexes of audit quality in our study can fully absorb the advantages of DA for large samples to study and explore potential misstatements, and AO can uniquely capture the advantages of auditor independence and poor quality of audit reports. On the other hand, our new measurement indexes of audit quality can complement the defects of large deviations, high errors, inconsistent DA, small count, and poor validity of measurement of modified AO, and measurement of the audit quality is more accurate and clean (DeFond et al., 2014; Francis, 2011; Kaplan et al., 2013). Our measuring method of audit quality reflects perfectly the connotation of definition on audit quality by DeAngelo (1981a).

3.1.3. Independent variables

We introduce an independent variable, the gender of the auditor (Aud_gender), which is a dummy variable that equals 1 if the auditor is male and 0 otherwise. According to the rules of treasury,[2] the audit report issued by the partnership accounting firm should be signed by a partner who is ultimately responsible for the audit project review and a Signed CPA who is responsible for the audit project; the audit report issued by a limited liability accounting firm should be signed by the chief accountant of the accounting firm or the deputy chief accountant authorized by the accountant firm and a Signed CPA who is responsible for the audit items. According to the institution arrangement of audit responsibility and the traditional Chinese culture of respecting leadership (partner), the first place for signatures on the audit report is most likely signed by the partner who is ultimately responsible for the audit project review, who is defined as the first signed auditor (i.e., Aud_gender1); the second place for signatures on the audit report is signed by the CPA who is specifically responsible for the audit items, who is defined as the second signed auditor (i.e., Aud_gender2). This signature order was confirmed by the partners of the accounting firm in our actual survey. The second signed auditor (aud_gender2) participated directly in the scene audit work of the audit items, is the first gatekeeper of audit risk control, has the greatest and most direct effect on the quality of the audit report, and is directly responsible for the audit risk. Therefore, we choose the gender of the second signed auditor (aud_gender2) as the main explanatory variable to explore the impact of the auditor's gender on his or her audit quality.

3.1.4. Control variables

According to the control variables of audit quality researched by DeFond et al. (2014), Wang et al. (2014), Yuan et al. (2012), and Zhang et al. (2014), we choose the control variables to include the two factors of company level and accounting firm level and distinguish the effect of year and industry. The influencing factors of the company level include the basic financial characteristics of size, financial leverage, return on assets, growth opportunity, financial distress, and listed ages and the corporate government characteristics of equity

[2] The notice of treasury on some problems concerning the signature and seal of the audit report by the CPA [OL]. 4 November 2012, http://www.cicpa.org.cn/Professional_standards/otherfiles/201211/t20121104_39521.html.

concentration and the power of the CEO. The influencing factors of the accounting firm level include the brand and the audit opinion issued in the previous year of the accounting firm. Table 2 exhibits the definitions and measurement methods of other variables in regression models.

3.2. Data source and sample selection

First, we obtained the auditors' information from the annual audit report of China's A-share listed companies from the Wind database for the 2011–2015 period. **Second,** we eliminated firm-year observations for firms that belong to financial industries. **Third,** the industry information inquiry system on the official website of the Chinese Institute of Certified Public Accountants (CICPA) was used for manual collection of the signed auditor's gender, age, position, and other information and to match the auditor's information with that of the listed companies in the sample period and obtain a full sample of 12,306 firm-year-auditor observations. A small number of samples had three signed auditors. According to the regulations of treasury and practical experience, we used only the first two signed auditors as our object of investigation. **Finally,** after eliminating the samples of signed auditors with incomplete information and the companies with IPOs in the current year and the ST companies, we ultimately retained a sample of 9861 firm-year-auditor observations with two signed auditors. Table 3 shows the process of sample selection. The information regarding the names of the auditors and accounting firms, types of audit opinion, and the data on finance and corporate government of the listed companies were taken from the Wind database. The domestic ranking of the accounting firms that reflects the brand of the accounting firms was taken from the annual comprehensive ranking list issued by CICPA. To reduce the influence of outliers on the study results, we winsorized the top and bottom 1% of each continuous variable to control the influence of outliers and processed the data with stata12.

4. Empirical analysis

4.1. Descriptive statistics

Table 4 reports the descriptive statistics for the main study variables. The data show that the mean audit quality as measured by the five methods was about 0.5. These results indicate that the audit quality of more than 50% of listed companies is high. In the full sample, about 75% of the first signed auditors were men, and about 65% of the second signed auditors were women. In the subsample of auditor twosome combination, the

Table 2
Definition and measurement of main variables.

Panel A: Independent variables	
Aud_gender1	Equals 1 if the gender of the first signed auditor is male, otherwise 0
Aud_gender2	Equals 1 if the gender of the second signed auditor is male, otherwise 0
All_male	Equals 1 if the gender of two signed auditors is male, otherwise 0
Panel B: Control variables	
Size	Size of company; equals the natural logarithm of total assets at the end of the year
Lev	Financial leverage; equals total liabilities divided by total assets at the end of the year
ROA	Return on assets; equals net profit divided by total assets at the end of the year
Growth	Growth opportunity; equals the sum of the value of floating stock's market value, book value of non-floating stock, and total debt divided by total assets at the end of the year
Dnetprof	Financial distress; equals 1 if net profit <0, otherwise 0
Lnage	Listed age; equals natural logarithm of the statistics year minus the listing year
Ownership_conc	Ownership concentration; equals the shareholding ratio of large shareholders
Doul	CEO power; equals 1 if the chairman and CEO are the same person, otherwise 0
Big_ten	Brand of accounting firm; equals 1 if the accounting firm is among the ten largest domestic firms, otherwise 0.
AO_lag	Audit opinion; equals 1 if auditor issues a modified audit opinion, otherwise 0
Year	Time effect
Indu	Industry effect

Table 3
Sample selection process and distribution.

Year	Initial samples for non-financial industry	IPO samples in current year	ST samples	Samples of the first auditor missing data	Samples of the second auditor missing data	Samples of two auditor missing data	Final observations
2011	2249	278	118	138	243	31	1503
2012	2393	154	127	101	225	13	1799
2013	2397	2	104	73	176	8	2050
2014	2521	124	76	53	119	6	2155
2015	2746	219	76	33	66	2	2354
Total	12,306	777	501	398	829	60	9861

Table 4
Descriptive statistics of variables.

Variable	N	Mean	Std. Dev.	Min	Med	Max
DA_AO	9861	0.5023	0.5	0	1	1
DA_AO2	5187	0.5003	0.5	0	1	1
DA_AO3	4674	0.5002	0.5001	0	1	1
DA_AO4	5057	0.5001	0.5	0	1	1
DA_AO5	4543	0.5001	0.5001	0	1	1
Aud_gender1	9861	0.7492	0.4335	0	1	1
Aud_gender2	9861	0.6468	0.478	0	1	1
All_male	5823	0.8353	0.3709	0	1	1
Size	9861	22.0227	1.2564	19.2256	21.8472	25.809
Lev	9861	43.7194	21.7405	4.6463	43.2736	97.7221
ROA	9861	4.0256	5.6284	-19.8679	3.6001	22.6216
Growth	9861	2.0453	1.7122	0.4032	1.5525	12.1028
Lnage	9861	1.9427	0.9157	0	2.1972	3.091
Ownership_conc	9861	35.62	15.1522	8.75	33.73	75
Dnetprof	9861	0.1002	0.3003	0	0	1
Doul	9861	0.2434	0.4291	0	0	1
AO_lag	9861	0.0226	0.1487	0	0	1
Big_ten	9861	0.5671	0.4955	0	1	1

combination of two male auditors comprised about 49% of all auditor twosome combinations and about 84% of the same-sex auditor combinations. Table 4 reports the detailed descriptive statistics of the control variables.

Studies have shown that a man's testosterone level decrease from 40 years of age and that a woman's estrogen level decreases from 45 years of age. This phenomenon indicates a significant negative correlation between age and sex hormones; in addition, a significant negative correlation has been shown between male sex hormones and empathy level, and a significant positive correlation has been shown between female sex hormones and empathy level. We thus divided the sample into two groups according to the age of the second signed auditor (younger than 45 years and older than 45 years). Studies have also shown that women with a higher position displayed more similar social gender roles to men and that their empathy level was similar to that of men. We thus divided the sample into two groups based on the position of the second signed auditor (the senior executive group, in which the auditors are above the manager, and the non–senior executive group, in which the auditors are below the manager). Table 5 reports the descriptive statistics on the age of various sample groups of the second signed auditors. In the full samples of the second auditors, female auditors comprise about 35%, and male auditors comprise about 65%. Like the mean of all auditors, the average ages of both female auditors and male auditors are about 38 years; the gender difference in age is small. In the younger group, the average age of female and male auditors is 36.18 years, and no gender difference is seen; in the older group, the average ages of female and male auditors are 49.16 and 49.6, respectively (i.e., a small gender

Table 5
Age descriptive statistics of the second signed auditors.

Aud2_age		N	Mean	Std. Dev.	Mix	Max	Proportion of full samples
Full samples	Female	3483	38.2188	6.6307	23	70	35.32%
	Male	6378	38.2504	6.6954	24	73	64.68%
Group of low age	Female	2935	36.1754	4.6743	23	44	29.76%
	Male	5385	36.1833	4.5902	24	44	54.61%
Group of older age	Female	548	49.1624	4.5048	45	70	5.56%
	Male	993	49.6022	4.9835	45	73	10.07%
Group of senior executive	Female	372	39.3656	5.4566	29	61	3.77%
	Male	724	41.2735	7.7125	28	68	7.34%
Group of non–senior executive	Female	3111	38.0817	6.7451	23	70	31.55%
	Male	5654	37.8633	6.4530	24	73	57.34%

difference). The average age of the male auditors in the group of senior executives is significantly greater than that of female auditors, but no significant gender difference was found in the non–senior executive group.

Through practical investigation, the internal managerial hierarchy of an accounting firm generally includes partners (shareholders), senior executive, managers, item leaders, and general practitioners. The position information found in the CICA industry information system includes partner, senior executive, manager, item manager, and others, which is basically consistent with the position setting in the practical field. We refer to the partners (shareholders), senior executive, and managers as the executive stratum. Table 6 reports the descriptive statistics of the second signed auditors' positions. The proportion of the executive stratum is 11.12% in the full sample. The proportion of female auditors is 3.77%, and that of male auditors is 7.34% in the full sample. The proportion of non–senior executive stratum is 88.88%, which includes 31.55% women and 57.33% men.

Table 7 reports the descriptive statistics of audit quality (DA-AO) under various subsamples of second signed auditors. In the full sample, the audit quality of male auditors (mean, 0.51) is higher than that of female auditors (mean, 0.48). In the younger age group, the audit quality of male auditors is higher than that of female auditors, and this gap (0.038) is slightly larger than the gap of the full sample group (0.033) and significantly larger than the gap in the older age group (0.005; T-value is significant, i.e., above 10%). This indicates that male auditors provide higher audit quality than female auditors, and this gender difference in audit quality continues to diminish with age. Moreover, the audit quality of female auditors improves with age (by 6%), whereas the audit quality of male auditors declines slightly (0.7%). This change in audit quality with age may be related to the improvement in the men's empathy levels caused by a decline in testosterone level from 40 years of age and may also be related to the decline in the women's empathy levels caused by a decline in the levels of female hormones from 45 years of age.

The audit quality of male auditors is higher than that of female auditors in both the senior executive group and the non–senior executive group. This indicates that the gender difference in audit quality between male and female auditors is universal and that this gender gap in audit quality is widening with the promotion of position (i.e., the gap rises to 0.055 in the senior executive group from 0.033 in the non–senior executive

Table 6
Position descriptive statistics of the second signed auditors.

Aud2_rank	Female		Male		Total proportion
	N	Proportion	N	Proportion	
Equals 1 if his (her) position is partner.	84	0.85%	217	2.20%	3.05%
Equals 2 if his (her) position is senior executive or manager.	288	2.92%	507	5.14%	8.06%
Group of senior executive	372	3.77%	724	7.34%	11.11%
Equals 3 if his (her) position is item manager	660	6.69%	1118	11.34%	18.03%
Equals 4 if his (her) position is others	2451	24.86%	4536	46.00%	70.85%
Group of non–senior executive	3111	31.55%	5654	57.34%	88.88%
Total	3483	35.32%	6378	64.68%	100.00%

Table 7
Descriptive statistics of gender, age, and position difference on audit quality.

DA_AO		N	Mean	Std. Dev.	Min	Max	T-value
Full sample	Female	3483	0.4812	0.4997	0	1	−3.0961***
	Male	6378	0.5138	0.4998	0	1	
Group of low age	Female	2935	0.4767	0.4995	0	1	−3.2907***
	Male	5385	0.5144	0.4998	0	1	
Group of older age	Female	548	0.5055	0.5004	0	1	−0.1916
	Male	993	0.5106	0.5001	0	1	
Group of non–senior executive	Female	3111	0.4857	0.4999	0	1	−2.6928***
	Male	5654	0.5157	0.4998	0	1	
Group of senior executive	Female	372	0.4435	0.4975	0	1	−1.7287*
	Male	724	0.4986	0.5003	0	1	

Note: Robustness standard errors in parentheses.
* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

group). However, the audit quality of both male and female auditors shows a downward trend with the promotion of position, and the audit quality of female auditors declined more significantly (i.e., the audit quality of male auditors declines by 3% to 0.017, and the audit quality of female auditors declines by 0.9% to 0.042). This downward trend may be associated with the fact that senior auditors are usually older, and the empathy levels of female auditors decline with age; it also may be associated with the fact that a senior auditor is often is overconfident and feels greater performance pressure. The partners and senior executives in an accounting firm are similar to the CEOs of a company. The literature shows that CEO overconfidence would encourage firms to increase investment and earnings management manipulation (He et al., 2011; Zhou et al., 2014; Zhou et al., 2016). When partners or senior executives face competitive pressure and performance pressure in audit market, the likelihood of audit collusion increases; as a result, senior executives or partners may have relaxed their tolerance for audit risk (Lei, 2004; Song et al., 2008; Dong et al., 2010; Chen, 2011).

4.2. Correlation analysis and T-test of gender differences in audit quality

Table 8 reports the correlation coefficient matrix of the variables used in the regression model. It shows that the gender of both the first and second signed auditors and the gender of the two same-sex auditor combinations have significant positive correlations with audit quality, and it indicates that male auditors have a significantly higher audit quality than female auditors. Table 9 reports the *t*-test results of gender differences on audit quality. The results show that for either a single signed auditor or a combination of two same-sex auditors, male or male combination auditors have a higher mean audit quality than female or female combination auditors, and this gender difference in audit quality is significant to at least a significance level of 10%. This result gives preliminary support to Hypothesis 1.

4.3. Empirical results

Table 10 reports the empirical results of regression model (1). Column 2 in Table 10 reports the influence of the regression results of auditor gender on audit quality without differentiating the DA direction. The result shows a significant positive correlation between auditor gender and audit quality, which indicates that male auditors have a significantly higher audit quality than female auditors; conversely, female auditors showed a significantly lower audit quality than male auditors. Therefore, this result supports Hypothesis 1 that female auditors show a significantly lower audit quality than male auditors.

The empirical results after distinguished DA direction show that the relationship between auditor gender and audit quality remains positive; however, the relationship between auditor gender and audit quality is not significant when DA is positive (column 3 in Table 10). This result indicates that although male auditors

Table 8
Correlation coefficient matrix of variables in regression model.

	DAAO	Aud_genderl	Aud_gender2	All_male	Size	Lev	ROA	Growth	Lnage	Ownership_cons	Dnetprof	Doul	AO_lag	Big_ten
DA AO	1													
Aud_genderl	0.018*	1												
Aud_genderZ	0.031***	0.042***	1											
All_male	0.039***	1	1	1										
Size	−0.107***	0.01	−0.019*	−0.006	1									
Lev	−0.157***	0.006	0.016	0.014	0.514***	1								
ROA	0.023**	−0.014	−0.019*	−0.008	0.004	−0.389***	1							
Growth	0.057***	−0.002	−0.013	−0.013	−0.413***	−0.253***	0.073***	1						
Lnage	−0.130***	0.011	−0.019*	−0.007	0.329***	0.449***	−0.195***	0.079***	1					
Ownership_cons	−0.047***	0.009	−0.012	0.002	0.270***	0.071***	0.090***	−0.171***	−0.068***	1				
Dnetprof	0.008	0.019*	0.025**	0.022*	−0.051***	0.208***	−0.612***	0.075***	0.128***	−0.057***	1			
Doul	0.056***	0.003	0.005	−0.004	−0.182***	−0.143***	0.045***	0.059***	−0.235***	−0.055***	−0.032***	1		
AO_lag	−0.003	0.017*	0.025**	0.019	−0.099***	0.105***	−0.136***	0.139***	0.095***	−0.063***	0.163***	−0.008	1	
Big_ten	−0.011	0.025**	−0.023**	0.017	0.119***	0.011	0.021**	−0.011	−0.024**	0.068***	−0.008	0.035***	−0.003	1

Note: Robustness standard errors in parentheses.
* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

Table 9
Gender difference *t*-test for audit quality.

Variables		Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]		T-value
Aud_gender1	0	2473	0.4865	0.0101	0.4999	0.4667	0.5062	−1.8189*
	1	7388	0.5076	0.0058	0.5000	0.4962	0.5190	
Aud_gender2	0	3483	0.4812	0.0085	0.4997	0.4646	0.4978	−3.0961***
	1	6378	0.5138	0.0063	0.4998	0.5015	0.5261	
All_male	0	959	0.4661	0.0161	0.4991	0.4345	0.4977	−2.9564***
	1	4864	0.5183	0.0072	0.4997	0.5043	0.5323	

Note: Robustness standard errors in parentheses.
* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

Table 10
Results of model regression analysis.

VARIABLES	DA_AO	DA_AO2	DA_AO3	DA_AO4	DA_AO5
Aud_gender2	0.131***	0.0354	0.173***	0.0213	0.182***
	(0.0443)	(0.0604)	(0.0657)	(0.0613)	(0.0673)
Size	0.0134	−0.0338	0.0606*	−0.0331	0.0857**
	(0.0258)	(0.0375)	(0.0365)	(0.0383)	(0.0374)
Lev	−0.00911***	0.00208	−0.0194***	0.00196	−0.0213***
	(0.00142)	(0.00192)	(0.00225)	(0.00200)	(0.00236)
ROA	−0.00727	0.00881	−0.0275***	0.00326	−0.0318***
	(0.00538)	(0.00714)	(0.00824)	(0.00741)	(0.00859)
Growth	0.0188	0.0620***	−0.0165	0.0555**	−0.0142
	(0.0175)	(0.0231)	(0.0276)	(0.0242)	(0.0304)
Lnage	−0.0938***	−0.0708*	−0.104**	−0.0790*	−0.114**
	(0.0292)	(0.0404)	(0.0437)	(0.0411)	(0.0449)
Ownership_conc	−0.00388***	0.000317	−0.00684***	−0.000316	−0.00749***
	(0.00151)	(0.00207)	(0.00224)	(0.00210)	(0.00229)
Dnetprof	0.0625	−0.126	0.0526	−0.189	0.0495
	(0.0918)	(0.122)	(0.140)	(0.125)	(0.145)
Doul	0.0593	−0.0366	0.126	−0.0441	0.137*
	(0.0514)	(0.0669)	(0.0798)	(0.0680)	(0.0812)
AO_lag	0.143	−0.265	0.252	−0.383	−0.344
	(0.172)	(0.218)	(0.282)	(0.315)	(0.387)
Big_ten	−0.0264	−0.0123	−0.0484	−0.0181	−0.0508
	(0.0435)	(0.0591)	(0.0647)	(0.0598)	(0.0664)
Constant	0.637	1.155	0.142	1.284	−0.199
	(0.559)	(0.820)	(0.792)	(0.836)	(0.810)
Year	Control	Control	Control	Control	Control
Indu	Control	Control	Control	Control	Control
Observations	9861	5187	4674	5057	4445
Pseudo R2	0.0771	0.0526	0.1062	0.0571	0.1031

Note: Robustness standard errors in parentheses.
* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

show higher audit quality than female auditors, the gender difference in audit quality is not obvious. When DA is negative, a significant positive correlation can be seen between auditor gender and audit quality (column 4 in Table 10). This indicates a significant gender difference on audit quality, and the audit quality of the female auditors is significantly lower than that of the male auditors. This result further supports Hypothesis 1.

After further examination of the sample of modified audit opinions issued by auditors, we find a positive correlation between auditor gender and audit quality when DA is positive, but it is no longer significant

(column 5 in Table 10), which indicates that there is no significant gender difference in the audit quality. When DA is negative, a significant positive correlation exists between auditor gender and audit quality (column 6 in Table 10), which indicates a significant gender difference in audit quality; female auditors show a significantly lower audit quality than male auditors. This result further supports Hypothesis 1.

After the positive and negative directions of DA are distinguished, the empirical results show that client manipulation of the earning upward (i.e., DA is positive) adds audit risk for the auditors, which can have very bad consequences. Faced with this high-risk case, both female and male auditors showed the same degree of prudence and quality control and provided the same level of audit quality; the result is that the gender difference in audit quality is not significant. Client manipulation of the earning downward (i.e., DA is negative) has fewer negative consequences for the auditor (compared to adjusting the earning upward) because it would present a smaller audit risk. When faced with this low-risk case, female auditors are more likely to be affected by their high level of empathy and are more likely than male auditors to relax rules and compromise with their clients. The result is that female auditors show a significantly lower audit quality because of their higher empathy level. Against the background of an accounting firm strengthening its internal governance and quality control, this empirical evidence has positive significance for the rational arrangement of signed auditors in practice.

The regression results of control variables on the company level show a similar correlation between most control variables and audit quality when DA is negative or an absolute value, but the result is contrary when DA is positive. The relationships with Size, Dnetprof, Doul, AO_lag, and audit quality are similar; there is a significant positive relationship when DA is negative, there is no significant negative relationship when DA is positive, and there is a significant positive relationship when DA is an absolute value. The relationship between Lev, ROA, Ownership_conc, and audit quality is basically similar; there is a significant negative relationship when DA is negative or an absolute value, and there is no significant positive relationship when DA is positive. The relationship between Lnage and audit quality is always significant and negative. The relationship between Big_ten and audit quality is always nonsignificant and negative. The relationship between growth and audit quality is nonsignificant and negative when DA is negative, significant and positive when DA is positive, and nonsignificant and positive when DA is an absolute value.

4.4. Robustness test

4.4.1. Replacement of dependent variables

The results of the robustness test, based on traditional measurement indices of audit quality as dependent variables, supports our research hypothesis as before. We use the traditional measure indices of audit quality, such as positive DA (DA+), negative DA (DA-), the absolute value of DA (ABSDA), the audit opinion issued by auditors (AO) and the probability of auditors issuing modified audit opinions (Maos) as the proxy variables of audit quality, to substitute in the regression model (1), respectively. Table 11 shows the regression results. In columns (1)–(3) in Table 11, when DA is negative and an absolute value, the DA of financial statements audited by male auditors is smaller than that of those audited by female auditors. This result means that the male auditors have higher audit quality. When DA is positive, there is a nonsignificant negative correlation between auditor gender (Aud_gender2) and DA+, which means that there is a nonsignificant positive correlation between auditor gender (Aud_gender2) and audit quality, but the relationship direction is consistent: DA is negative and an absolute value. Columns (4)–(5) show a significant positive correlation between auditor gender (Aud_gender2) and AO and Maos and indicate that male auditors are more likely to issue a modified audit opinion, which represents greater independence of the auditor and higher audit quality. The empirical results in Table 11 confirm our hypothesis that male auditors show higher audit quality than female auditors.

4.4.2. Replacement of independent variables

The robustness test results of replacement on independent variables from Aud_gender2 to Aud_gender1 and All_male support our research hypothesis as before. We use the gender of the first signed auditor (Aud_gender1) and the combination of two auditors (All_male), respectively, as independent variables to substitute for the gender of the second auditor in regression model (1) to test the impact of auditor gender on audit quality. The empirical results reported in Panels A and B of Table 12 show a significant positive

Table 11
Robustness test of proxy dependent variables.

VARIABLES	(1) DA-	(2) DA+	(3) ABSDA	(4) AO	(5) Maos
Aud_gender2	0.0287**	−0.00879	−0.0165**	0.343*	0.000823*
	(0.0136)	(0.00707)	(0.00838)	(0.185)	(0.000449)
Size	0.0120	−0.00759*	−0.0166***	−0.131	−0.0259***
	(0.00771)	(0.00451)	(0.00509)	(0.0969)	(0.000304)
Lev	−0.00365***	0.000483**	0.00250***	0.0248***	0.000588***
	(0.000492)	(0.000238)	(0.000293)	(0.00463)	(1.93e−05)
ROA	−0.00771***	0.00274***	0.00730***	−0.0927***	0.000460***
	(0.00190)	(0.000962)	(0.00127)	(0.0187)	(7.22e−05)
Growth	0.00147	−0.00748***	−0.00788**	0.190***	0.000679**
	(0.00558)	(0.00261)	(0.00322)	(0.0453)	(0.000266)
Lnage	−0.0394***	0.0214***	0.0429***	−0.0327	0.0173***
	(0.00924)	(0.00469)	(0.00582)	(0.143)	(0.000311)
Ownership_conc	−0.00208***	0.000334	0.00181***	−0.00924	−0.000105***
	(0.000444)	(0.000243)	(0.000289)	(0.00677)	(1.43e−05)
Dnetprof	−0.0410	0.0224	0.0389**	0.693**	0.130***
	(0.0319)	(0.0146)	(0.0186)	(0.288)	(0.00103)
Doul	0.0274*	−0.00505	−0.0139	0.325*	−0.00120**
	(0.0165)	(0.00729)	(0.00926)	(0.188)	(0.000544)
AO_lag	−0.174***	0.0639*	0.160***	3.891***	0.0117***
	(0.0610)	(0.0327)	(0.0459)	(0.222)	(0.00253)
Big_ten	−0.00200	−0.00568	8.55e−05	0.239	0.000289
	(0.0135)	(0.00688)	(0.00824)	(0.173)	(0.000441)
Constant	−0.421**	0.348***	0.508***	−2.778	0.547***
	(0.171)	(0.0980)	(0.113)	(2.075)	(0.00668)
Year	Control	Control	Control	Control	Control
Indu	Control	Control	Control	Control	Control
Observations	4674	5187	9861	9776	9861
R-squared	0.147	0.249	0.162		0.868
Pseudo R2				0.4349	

Note: Robustness standard errors in parentheses.
* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

correlation between auditor gender (Aud_gender1 and All_male) and audit quality (DA_AO3 and DA_AO5) when DA is negative. This finding indicates that the audit quality of female auditors (female auditor combination) was significantly lower than that of male auditors (male auditor combination) when the auditors faced "minor problems (i.e., client's downward adjusted earning)." When DA is positive, a nonsignificant negative correlation was seen between auditor gender (Aud_gender1 and All_male) and audit quality (DA_AO2 and DA_AO4), which indicates that there is no longer a significant gender difference on audit quality between female auditors (female auditor combination) and male auditors (male auditor combination) when the auditors faced "relatively serious problems (i.e., client's upward adjusted earning)." When DA does not distinguish positive and negative directions, a nonsignificant positive correlation is seen between Aud_gender1 and audit quality (DA_AO), but a significant positive correlation is also seen between All_male and audit quality (DA_AO). This indicates that a nonsignificant gender difference is seen in the audit quality of the first signed auditors, but a significant gender difference is seen in the audit quality of the same-sex gender signed auditor combinations, and the audit quality provided by the male auditor combinations exceeds that of the female auditor combinations. The hypothesis is thus further tested.

4.4.3. Add independent variables

The robustness test results of replacement of independent variables from Aud_gender2 to Aud_gender1 and Aud_gender2 support our research hypothesis as before. We use the genders of the first signed auditor

Table 12
Robustness test of replaced independence.

Variables	DA_AO	DA_AO2	DA_AO3	DA_AO4	DA_AO5
A: Robustness test of replacing the second signed auditor with the first signed auditor					
Aud_gender1	0.0660	−0.0676	0.209***	−0.0670	0.230***
	(0.0490)	(0.0660)	(0.0745)	(0.0670)	(0.0763)
Constant	0.696	1.244	0.105	1.358	−0.268
	(0.560)	(0.820)	(0.796)	(0.835)	(0.815)
Year	Control	Control	Control	Control	Control
Indu	Control	Control	Control	Control	Control
Observations	9861	5187	4674	5057	4445
Pseudo R2	0.0766	0.0527	0.1064	0.0573	0.1034
B: Robustness test of replacing the second signed auditor with the two same-sex signed auditor combinations					
All_male	0.200***	−0.0121	0.377***	−0.0166	0.409***
	(0.0742)	(0.101)	(0.113)	(0.102)	(0.116)
Constant	−0.330	0.0435	−0.732	0.262	−1.240
	(0.728)	(1.064)	(1.026)	(1.085)	(1.062)
Year	Control	Control	Control	Control	Control
Indu	Control	Control	Control	Control	Control
Observations	5823	3056	2763	2973	2610
Pseudo R2	0.0783	0.0565	0.1104	0.0614	0.1117
C: Robustness test of the first and second signed auditors together as independent variables					
Aud_gender1	0.0601	−0.0694	0.203***	−0.0681	0.224***
	(0.0491)	(0.0660)	(0.0746)	(0.0670)	(0.0765)
Aud_gender2	0.128***	0.0381	0.167**	0.0239	0.176***
	(0.0444)	(0.0605)	(0.0658)	(0.0614)	(0.0675)
Constant	0.589	1.207	−0.0358	1.335	−0.414
	(0.561)	(0.821)	(0.795)	(0.837)	(0.814)
Year	Control	Control	Control	Control	Control
Indu	Control	Control	Control	Control	Control
Observations	9861	5187	4674	5057	4445
Pseudo R2	0.0772	0.0528	0.1073	0.0573	0.1045

Note: Robustness standard errors in parentheses.
* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

(Aud_gender1) and the second signed auditor (Aud_gender2) as independent variables to simultaneously substitute the gender of the second signed auditor in regression model (1). Panel C of Table 12 displays the empirical results and shows a significant correlation between auditor gender (Aud_gender1 and Aud_gender2) and audit quality (DA_AO3 and DA_AO5) when DA is negative. This finding indicates that male auditors show a higher audit quality than female auditors. These empirical results further robustly confirm our research hypothesis.

4.4.4. Simultaneous replacement of dependent variable and independent variable

In a combination of the previous three methods of robustness testing, we replaced the dependent and independent variables simultaneously. Table 13 shows the empirical results. For both a separate examination of the effect of the first signed auditor on audit quality (in Panel A of Table 13) and a joint study of the effect of the first and second signed auditors on audit quality (in Panel C of Table 13), nonsignificant correlations are seen between Aud_gender1 and audit quality for each measurement method. This finding indicates that the effect of the first signed auditors' gender on the audit quality is not clear and that it was reasonable both in theory and in practice to choose the gender of the second signed auditor as an independent variable. At the same time, for both a separate examination of the effect of the second signed auditor on audit quality (Table 10) and a joint study of the effect of the first and second signed auditor on audit quality (in Panel C

Table 13
Robustness test of dependent and independent variables replaced at the same time.

Variables	(1) DA+	(2) DA−	(3) ABSDA	(4) Maos	(5) AO
A: First signed auditor and audit quality commonly used in mainstream literature					
Aud_gender1	−0.00463	0.0212	−0.0103	−3.58e−05	0.253
	(0.00773)	(0.0151)	(0.00918)	(0.000504)	(0.204)
Constant	0.343***	−0.416**	0.502***	0.548***	−2.527
	(0.0982)	(0.171)	(0.114)	(0.00670)	(2.067)
Year	Control	Control	Control	Control	Control
Indu	Control	Control	Control	Control	Control
Observations	5187	4674	9861	9861	9776
R-squared	0.249	0.146	0.162	0.868	
Pseudo R2					0.4340
B: Two same-sex signed auditor combination and audit quality commonly used in mainstream literature					
All_male	−0.0230*	0.0423*	−0.0283**	0.000985	0.579*
	(0.0120)	(0.0234)	(0.0138)	(0.000758)	(0.331)
Constant	0.403***	−0.362*	0.487***	0.548***	−2.062
	(0.124)	(0.214)	(0.141)	(0.00907)	(2.525)
Year	Control	Control	Control	Control	Control
Indu	Control	Control	Control	Control	Control
Observations	3060	2763	5823	5823	5781
R-squared	0.262	0.175	0.185	0.874	
Pseudo R2					0.4381
C: Two signed auditors and audit quality commonly used in mainstream literature					
Aud_gender1	−0.00421	0.0202	−0.00955	−7.43e−05	0.213
	(0.00773)	(0.0151)	(0.00919)	(0.000504)	(0.203)
Aud_gender2	−0.00861	0.0281**	−0.0161*	0.000826*	0.321*
	(0.00708)	(0.0137)	(0.00839)	(0.000450)	(0.186)
Constant	0.351***	−0.439**	0.516***	0.547***	−2.871
	(0.0982)	(0.172)	(0.114)	(0.00673)	(2.084)
Year	Control	Control	Control	Control	Control
Indu	Control	Control	Control	Control	Control
Observations	5187	4674	9861	9861	9776
R-squared	0.249	0.147	0.162	0.868	
Pseudo R2					0.4354

Note: Robustness standard errors in parentheses.
* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

of Table 13), significant positive correlations are seen between Aud_gender2 and audit quality for each measurement method. This finding shows that male auditors have smaller DA and a greater likelihood of issuing a modified audit opinion, which indicates that the audit quality provided by male auditors is higher than that provided by female auditors. The relationships between the two same-sex auditor combinations and the four audit quality indices, except for Maos, are significant (in Panel B of Table 13). These empirical results show that male auditor combinations have a smaller DA in client's financial statements and are more likely to issue an actual modified audit opinion; it also indicates that the audit quality of male auditor combinations is higher than that of female auditor combinations. The above empirical evidence robustly confirms our research hypothesis.

4.5. Endogenous discussion

In our regression model, we control the factors commonly used in the literature, such as the characteristics of corporate finance, corporate governance, and accounting firms, which may affect audit quality. However, some unobservable variables may distort our results. At the same time, auditor gender selection may be not

random, which may lead to self-selection bias in our empirical results. To alleviate these potential endogenous problems, based on the practice of Francis et al. (2015) and the changes in auditors' gender, we adopt the double differential (DID) method to alleviate the possible endogenous problems caused by missing variables and the propensity score matching (PSM) method to mitigate the endogenous problem in that the samples may not have a random distribution. In addition, different accounting firms have different brand reputations, different attractions for auditors of different abilities, and different audit quality objectives. These differences among accounting firms may affect the random distribution of auditors of different genders. Therefore, we control for the individual effect of the accounting firm to alleviate the possible impact of inherent differences between accounting firms on audit quality. At the same time, to alleviate this kind of endogenous problem, we examine the impact of auditor gender on audit quality according different brands of accounting firms (Big10 and Non-Big10).

4.5.1. Use the DID method to alleviate endogenous problems caused by missing variables

We use the DID method to investigate the changes in audit quality after the interchangeability of male and female auditors. **First,** we introduce an indicative variable of auditor change, DUM_aud2change, which equals 1 if the change is from female to male, otherwise 0. **Second,** with reference to Gul et al. (2013), we construct two proxy variables of audit quality that can better reflect the auditors' audit attitude and risk taking, the likelihood that auditors would issue modified audit opinions (DUM_maos),[3] and the radicalization of audit report by auditors (DUM_ARAgg),[4] which reflects the auditor's prudence. Columns 2 and 3 of Table 14 show the empirical results for the impact of auditor gender change on audit quality. A significant negative correlation was seen between DUM_aud2change and DUM_maos and DUM_ARAgg separately. This finding indicates that when a female auditor is replaced with a male auditor, the probability that a listed company should be issued modified audit opinions has been reduced obviously, and the radicalization of audit reports also has been reduced obviously. This result illustrates that when a female auditor is replaced with a male auditor, the audit quality is obviously promoted, and the audit quality provided by male auditors is higher than that provided by female auditors.

4.5.2. Use the PSM method to alleviate endogenous problems caused by sample non-random distribution

First, following the method of Francis et al. (2015), we estimate the probability of selecting male auditors in the sample of change of auditor gender. We used the indicative variable (DUMaud2change2) as the explained variable; used the main characteristics of companies, such as company size (Size), profitability (ROA), and financial leverage (Lev), as explanatory variables; performed logistic regression based on controlling the industry and year effects; and obtained a probability value of selecting a male auditor. **Second,** we use the probability value to match the 1:1 nearest neighbor sample. This process ensures that the sample of female auditors replaced with a male auditor was matched with a sample of male auditors replaced with a female auditor. **Last,** we integrate the experimental samples and paired samples and investigate the differences in audit quality between female and male auditors among the experimental and paired samples. Columns 4 and 5 of Table 14 show the empirical results. Significant negative correlations are seen between Aud_gender2 and DUM_maos and DUM_ARAgg separately. This finding shows that when the auditor changed, the probability of male auditors issuing modified audit opinions to listed companies is obviously reduced, and the radicalization of

[3] Probability model: $AO = \alpha_0 + \alpha_1 Quichratio + \alpha_2 AR + \alpha_3 Other + \alpha_4 INV + \alpha_5 ROA + \alpha_6 Loss + \alpha_7 Lev + \alpha_8 Size + \alpha_9 Listage + \alpha_{10}$-Indu。 In the model, AO is the type of audit opinion; it equals 0 if it is standard audit opinion, and equals 1 if it is modified audit opinion; Quickratio is quick ratio; AR, Other and INV are Ratio of accounts receivable, other receivables and inventory to total assets, respectively; ROA is the return on assets; Loss is the indicate variable, equals 1 if the company was loss, otherwise equals 0; Lev is asset-liability ratio; Size is the company's size; Listage is the listing years of company; Indu is the industry. Maos is the prediction estimate value of probability Model OLS regression. the mean of Maos is 0.0331, the minimum value is -0.0696, the median is 0.019, the maximal value is 0.2488.

[4] ARAgg expresses the radicalization of audit reports, it equals MAOs minus AO; the higher the value of ARAgg, the more radical, the lower the audit quality. After winsorizing the ARAgg at the 1% level, we introduce an indicate variable, DUM_ARAgg, which equals 1 if ARAgg greater than its median, expresses a lower radicalization of audit reports and a lower audit quality; which equals 0 if ARAgg smaller than its median, expresses a higher radicalization of audit reports and a higher audit quality. The mean of DUM_ARAgg is 0.4999, the standard deviation of DUM_ARAgg is 0.5, the median of DUM_ARAgg is 0.

Table 14
Regression results of DID and PSM method.

Variables	DUM_maos	DUM_ARAgg	DUM_maos	DUM_ARAgg
DUM_aud2change	−0.286*	−0.257*		
	(0.168)	(0.143)		
Aud_gender2			−0.286*	−0.257*
			(0.168)	(0.143)
Size	−2.879***	−2.154***	−2.879***	−2.154***
	(0.201)	(0.189)	(0.201)	(0.189)
Lev	0.0690***	0.0442***	0.0690***	0.0442***
	(0.00687)	(0.00683)	(0.00687)	(0.00683)
ROA	0.0468**	0.0589***	0.0468**	0.0589***
	(0.0228)	(0.0219)	(0.0228)	(0.0219)
Growth	0.0502	−0.142**	0.0502	−0.142**
	(0.0651)	(0.0723)	(0.0651)	(0.0723)
Lnage	2.171***	1.773***	2.171***	1.773***
	(0.166)	(0.156)	(0.166)	(0.156)
Ownership_conc	−0.0121*	−0.00522	−0.0121*	−0.00522
	(0.00623)	(0.00505)	(0.00623)	(0.00505)
Dnetprof	–	4.052***	–	
		(0.656)		
Doul	−0.0697	−0.140	−0.0697	−0.140
	(0.195)	(0.169)	(0.195)	(0.169)
AO_lag	−0.245	−4.866***	−0.245	−4.866***
	(0.890)	(1.763)	(0.890)	(1.763)
Big_ten	0.132	0.140	0.132	0.140
	(0.173)	(0.147)	(0.173)	(0.147)
Constant	57.19***	42.62***	57.19***	42.62***
	(4.173)	(3.961)	(4.173)	(3.961)
Year	Control	Control	Control	Control
Indu	Control	Control	Control	Control
Observations	1207	1360	1207	1360
Pseudo R2	0.4585	0.4016	0.4585	0.4016

Note: Robustness standard errors in parentheses.
* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

the audit reports of male auditors is also reduced. This illustrates that the change of auditor from female to male obviously increases the audit quality and that the audit quality provided by male auditors is higher than that provided by female auditors. This result further supports our hypothesis.

4.5.3. Endogenous problems caused by individual difference of accounting firm

We assume that accounting firms may have a certain system or customary rule of auditor distribution, and this system or customary rule may lead to the allocation of male auditors to "good companies" (i.e., those with a better financial statement) and female auditors to "bad companies" (i.e., those with a worse financial statement), thereby leading to the endogenous problems of causality. This endogenous possibility is almost impossible from the perspective of logic and practice. For the sake of conservatism, we adopt the regression method of controlling the individual effect of accounting firms to alleviate this endogenous problem. Column 2 of Table 15 shows the empirical results. The audit quality of male auditors is also better than that of female auditors.

4.5.4. Possible effects of the brand of accounting firm on auditor's gender selection

According to DeAngelo (1981b), a significant positive correlation exists between the size (brand) of the accounting firm and audit quality. From the perspective of sociology, it is considered that various brands

Table 15
Robustness test of controlled individual effect and brand of accounting firm.

Variables	Full sample DA_AO	Big10 DA_AO	Non-Big10 DA_AO
Aud_gender2	0.125***	0.134**	0.121*
	(0.0456)	(0.0593)	(0.0725)
Size	0.00121	0.0222	−0.0291
	(0.0276)	(0.0351)	(0.0453)
Lev	−0.00927***	−0.00846***	−0.0108***
	(0.00145)	(0.00195)	(0.00223)
ROA	−0.00734	−0.00765	−0.00615
	(0.00550)	(0.00713)	(0.00876)
Growth	0.0146	0.0315	−0.00653
	(0.0178)	(0.0238)	(0.0273)
Lnage	−0.0915***	−0.119***	−0.0331
	(0.0296)	(0.0389)	(0.0468)
Ownership_conc	−0.00396***	−0.00550***	−0.00134
	(0.00153)	(0.00198)	(0.00245)
Dnetprof	0.0517	0.0171	0.114
	(0.0927)	(0.120)	(0.146)
Doul	0.0578	0.125*	−0.0274
	(0.0522)	(0.0677)	(0.0833)
AO_lag	0.162	0.164	0.0462
	(0.174)	(0.222)	(0.273)
Big_ten	−0.0647		
	(0.110)		
Constant	1.089	0.773	1.713*
	(0.673)	(0.829)	(1.007)
Year	Control	Control	Control
Indu	Control	Control	Control
Individual effect	Control	Control	Control
Observations	9852	5539	4261
Pseudo R2	0.0847	0.0706	0.1064

Note: Robustness standard errors in parentheses.
* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

or sizes of accounting firm have different attraction and employment requirements for auditors. The control quality is usually better in large accounting firms with a good brand, and they may then usually select male auditors. (Could it be that male auditors have better audit quality?) To alleviate the endogenous problem caused by auditor gender selection by accounting firms of various sizes and brands, we divide the sample into two groups (Big10 and Non-Big10) according to the brand ranking of the accounting firms hired by the sample companies and investigate the impact of auditor gender on audit quality. Table 15 shows the results. The gender difference in audit quality is also significant in various subsamples (i.e., the audit quality of male auditors remains significantly higher than that of female auditors).

4.6. Further analysis

As described in the second part of the theoretical analysis, men's testosterone levels decline after 40 years of age, and women's ovaries begin to atrophy at around 45 years of age. The rapid decline in male androgen levels and female estrogen levels at a certain age will result in a decrease in the gender difference in the level of empathy (Feldman et al., 2002) and lead to a reduction of gender differences in management decisions and behavioral outcomes. Male and female sex hormone levels decline sharply at different points in time. At 40 years of age, men's male hormone levels begin to drop sharply, and their empathy levels began to rise;

women are also at a stage in which female hormone levels and empathy levels continue to increase, so the gender difference in empathy level may not change at this time. At 45 years of age, men's male hormone levels continue to decline, and their empathy levels continue to rise; however, women's female hormone levels and empathy levels begin to decline, so the gender difference in the empathy level will be significantly reduced at this time. Therefore, we can predict that the gender differences in auditors' empathy level and audit quality will be significantly reduced or even disappear after 45 years of age. To show this connection, we divided the sample into a low age group and a senior age group (divided at 45 years of age) and examined the influence of the auditor's age on gender and audit quality. Columns 2 and 3 of Table 16 show the regression results. The coefficient of the main independent variable, Aud_gender2, is significantly positive in the low age group, which indicates that the male auditors showed better audit quality than the female auditors. The relationship direction and significant level of control variables are consistent with the results of the full sample. A nonsignificant positive correlation between Aud_gender2 and audit quality is seen in the older age group; this indicates that after 45 years of age, the gender difference in audit quality narrowed or even disappeared.

To further test the corollary that the gender difference in audit quality should decrease significantly or even disappear with advancing position, we categorize the sample into two groups according to the position of the second signed auditor: a group of senior executives whose position is partner or senior executive and a group of non–senior executives whose position is below senior executive or manager. We then investigate in groups

Table 16
Regression results of gender difference of audit quality for auditors of different ages and positions.

Variables	Low age group DA_AO	Older age group DA_AO	Non–senior executive DA_AO	Senior executive DA_AO
Aud_gender2	0.136***	0.0876	0.118**	0.211
	(0.0483)	(0.116)	(0.0471)	(0.140)
Size	0.00274	0.0577	0.0304	−0.120
	(0.0276)	(0.0741)	(0.0278)	(0.0753)
Lev	−0.00720***	−0.0183***	−0.00997***	−0.00154
	(0.00156)	(0.00364)	(0.00150)	(0.00479)
ROA	−0.00666	−0.00687	−0.0115**	0.0405**
	(0.00582)	(0.0146)	(0.00567)	(0.0187)
Growth	0.00410	0.0691	0.0242	−0.0516
	(0.0189)	(0.0457)	(0.0184)	(0.0641)
Lnage	−0.100***	−0.0475	−0.0849***	−0.134
	(0.0315)	(0.0797)	(0.0313)	(0.0860)
Ownership_conc	−0.00335**	−0.00581	−0.00235	−0.0153***
	(0.00164)	(0.00390)	(0.00161)	(0.00455)
Dnetprof	0.0498	0.208	0.0494	0.234
	(0.101)	(0.232)	(0.0974)	(0.286)
Doul	0.0476	0.183	0.0434	0.209
	(0.0560)	(0.134)	(0.0546)	(0.158)
AO_lag	0.285	−0.415	0.155	0.135
	(0.196)	(0.396)	(0.181)	(0.595)
Big_ten	−0.0368	0.0160	−0.0191	−0.0771
	(0.0475)	(0.115)	(0.0460)	(0.142)
Constant	0.773	−0.0217	0.296	3.269**
	(0.602)	(1.576)	(0.601)	(1.667)
Year	Control	Control	Control	Control
Indu	Control	Control	Control	Control
Observations	8320	1528	8765	1069
Pseudo R2	0.0744	0.1058	0.0770	0.0844

Note: Robustness standard errors in parentheses.
* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

the effect of auditor position on the relationship between gender and audit quality. Columns 3 and 4 of Table 16 show the regression results. The coefficient of the main independent variable, Aud_gender2, is significant and positive in the non–senior executive group, which indicates that the audit quality of male auditors is better than that of female auditors in low positions and that the audit quality of male auditors is better than that of female auditors overall. The relationship direction and significance level of the control variables are consistent with the results of the full sample. A nonsignificant positive correlation was seen between Aud_gender2 and audit quality in the senior executive group. This indicates that the use of a position at or above manager allowed the gender difference in audit quality to narrow or even disappear. The empirical results above support our corollary about the influence of age and position on the auditor's gender difference of audit quality and further prove the main assumption of this study, that is, that the audit quality provided by male auditors is better than that provided by female auditors.

5. Discussion and conclusions

Following the framework of empathy theory and gender role socialization theory, this study investigates the influence of auditor gender on audit quality. Using large samples from Chinese A-share listed companies on both the Shanghai and Shenzhen Stock Exchanges from 2011 to 2015, we f**irst** find that the audit quality of female auditors is lower than that of male auditors. This phenomenon is related to women's higher empathy level and relationship-oriented social gender roles. **Second,** after the direction of DA is further distinguished, a positive DA indicates that the auditor may have a higher audit risk; under the circumstances, male and female auditors have the same audit attitude and quality control, which leads to a lack of a significant gender difference in their audit quality. A negative DA, however, indicates that the auditor may have a lower audit risk; under the circumstances, the audit quality shows a significant gender difference in that the audit quality of female auditors is lower than that of male auditors. This result indicates that when auditors face the problem of downward-adjusted earning and lower audit risk, female auditors are more likely to pardon and compromise with clients. **Third,** the significant gender difference in audit quality disappears with auditors older than 45 years. This is related to a convergence in the empathy level caused by the sharp reduction of male androgen levels after 40 years of age and the sharp reduction of female estrogen levels after 45 years of age; it is also related to the convergence of social gender roles between female and male auditors with age. The convergence path includes an increase in the empathy level of male auditors, which leads to a slight decline in their audit quality (0.7%); however, the empathy level of female auditors declines, which leads to a greater improvement in their audit quality (6%). These two factors lead to the reduction and disappearance of the gender difference in audit quality. **Fourth,** the gender difference in audit quality also narrows after a promotion in position, which is related to the fact that female executives tend to be more masculine (i.e., a "tough girl"). The study also finds that the audit quality shows an obvious increase when a female auditor is replaced with a male auditor and an obvious decline when a male auditor is replaced with a female auditor. This result further shows that the audit quality of male auditors is higher than that of female auditors.

The theoretical basis—logical reasoning and audit quality index construction—and conclusions of this study differ significantly from the extant research on auditors' gender differences in audit quality. We are very cautious about this, so we adopt four major categories including 35 methods for robustness tests and 4 categories including 7 methods for endogenous tests, and perform conscientious verification of our assumptions and inferences. Practice is the sole criterion for testing truth. If applied to practice, we find that our research conclusions are equally reasonable. The auditors and employees of accounting firms in the current accounting industry have higher levels of work intensity, more overtime, more legal and public opinion pressure, and greater requirements for physical strength and energy than ever before. Women may be at a disadvantage in physical strength and energy. A female auditor's performance may be affected by a lack of physical strength and energy in the actual work. Of course, it is also possible that significant gender differences in the division of labor in society and family have led to a significantly lower audit quality from female auditors than from male auditors. Therefore, our next study will consider the influence of cultural and social factors on the relationship between gender and audit quality.

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The puzzling association between inventory and auditor pricing in China☆

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ABSTRACT

The theory of audit pricing suggests that audit fees are positively associated with areas of higher inherent risk. Inventory is commonly cited as one such area, and many Western studies have reported a positive association between inventory and audit fees. However, most Chinese studies have reported a significant *negative* association. This study finds that this puzzling association is attributable to Chinese auditors charging a significant discount on the opening balance of inventory, whereas their U.S. counterparts charge a significant premium. Meanwhile, we show that opening-balance inventory is associated with higher inherent risk both in China and the U.S. On the other hand, both Chinese and U.S. auditors charge a significant discount on the net increase in inventory as of the current year end, and we show that this is associated with lower inherent risk. Therefore, Chinese auditors appear to underreact to the inherent risk associated with opening-balance inventory, which helps explain the puzzling negative association between inventory and audit fees in China.

1. Introduction

Inventory is a major critical component of current assets, and has long been assumed to be an important determinant in audit pricing due to its complexity and riskiness (Simunic, 1980). Inventory can be a risky

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balance sheet component because specific auditing procedures (e.g., observation) are recommended, and the valuation of inventory is a complex task, requiring a forecast of future events (Simunic, 1980, p. 173). Therefore, inventory divided by total assets, also known as inventory intensity, is one of the most commonly used metrics in regression models for audit pricing studies (Hay, Knechel, & Wong, 2006).

According to the meta-analysis of audit pricing research of Hay et al. (2006), 46% of their cited studies report a significant positive association between inventory and audit fees, and the overall Stouffer test on inventory is significantly positive (Hay et al., 2006, p. 165), with one exception that finds a negative association. However, studies that use similar empirical models but Chinese data reveal a different pattern. These studies generally document a significant negative association between inventory and audit fees (e.g., Cahan and Sun, 2015; Chen, Su, & Wu, 2007; Habib, Jiang, & Zhou, 2015; Huang, Chang, & Chiou, 2016; Liu and Subramaniam, 2013; Wang, Wong, & Xia, 2008).

The contrast between the pattern found in China and that documented in conventional audit pricing literature is puzzling. Addressing this puzzle is important because the audit pricing model has been widely used to explain audit pricing practices in China. By reconciling Chinese results with major empirical regularities documented in the literature, researchers may validate the theories underlying the empirical model, thus legitimizing the use of the Western-market-based empirical model in China. Otherwise, researchers may find that conventional theories cannot explain the findings in China, and thus have to identify the applicable theories for the Chinese setting.

To date, no studies have addressed the above puzzle through formal analyses of how the negative association between inventory and audit fees is shaped in China. Many Chinese studies have left this phenomenon completely unexplained. Some researchers have argued that inventory in China could be a poor proxy for audit risk or client complexity. Some have conjectured that inventory may reflect a lower level of audit risk. Alternatively, some have argued that inventory could capture a higher level of audit risk, but that Chinese auditors fail to pay sufficient attention to it.

To fill this gap in the literature, our study examines why inventory is negatively associated with audit fees in China. We decompose ending inventory into opening balance and the current-period net change. Arguably, opening inventory could be more obsolete, whereas net change in inventory is more likely to reflect private management information about opportunities in the product market. Using the U.S. auditor pricing of inventory as the benchmark, we find that U.S. auditors charge a significant premium on opening inventory and a significant discount on the net increase in ending inventory. However, Chinese auditors charge a significant discount both on opening inventory and the net increase in inventory.

We then show that in both China and the U.S., the opening balance of inventory is significantly and positively associated with inherent risk. Specifically, a larger magnitude of the opening inventory (or its components, such as raw materials and finished goods) is associated with lower sales growth for the next period, with a larger magnitude of year-end inventory write-downs.[1] We also show that in both China and the U.S., the net increase in the ending inventory is significantly and negatively associated with inherent risk. Specifically, a larger increase in the ending inventory is associated with higher revenue growth for the next period, and associated with a smaller magnitude of year-end inventory impairment.

Finally, we show that Chinese auditors spend significantly fewer audit hours when there is a larger increase in the ending inventory, but they do not exert more audit effort when there is a higher inventory opening balance.

Overall, we conclude that Chinese auditors fail to respond to the higher inherent risk in the opening balance of inventory, either by charging higher audit fees or by exerting more audit effort. However, Chinese auditors respond to the lower inherent risk in the net increase in the ending inventory by charging a fee discount and by exerting less audit effort.

First, our study is one of the first to formally address the apparent puzzle of the negative inventory–audit fee association in China. We show that various inventory components still reflect inherent risk in Chinese listed companies. However, Chinese auditors do not respond to this inherent risk in a consistent manner. Our findings are relevant to researchers who use empirical audit pricing models with Chinese data, and to reviewers and editors who find the negative association documented in Chinese submissions puzzling.

[1] The inventory write-down evidence only pertains to China, as we do not have access to inventory impairment data from the U.S.

Second, our study shows that in both a developed market, such as the U.S., and a developing market, such as China, opening inventory and the net change in ending inventory exhibit distinct risk profiles. This helps explain why the ending inventory variable shows a less consistent pattern than other inherent risk proxies (e.g., receivables, or combined receivables and inventory) in the audit pricing literature (Hay et al., 2006). By separating the opening balance from the net change in ending inventory, our findings potentially offer a refined approach to including inventory as a major proxy for inherent risk for audit pricing models (Simunic, 1980).

Third, our study hints at the possibility that audit pricing practices may not always be responsive to a client's inherent risk, particularly in emerging markets. This also likely explains why more than half of the cited studies in Hay et al. (2006) fail to report a significant positive association between inventory and audit fees, given the diversity of the audit markets examined. Therefore, our study has implications for future meta-analysis of audit pricing models. Specifically, researchers may wish to differentiate between evidence from developed markets and that from emerging markets to allow for different practices in audit pricing.

The remainder of this paper is organized as follows. Section 2 reviews the Chinese literature and develops our research questions. Section 3 replicates inventory–audit fee associations in China versus the U.S. and then reports the results of regressing audit fees on various inventory components. Section 4 provides evidence concerning risk implications among various inventory components. Section 5 examines the association between inventory components and audit hours. Section 6 concludes the paper.

2. Development of research questions

2.1. Prior Chinese literature

Although a positive association between inventory and audit fees has been well documented in jurisdictions outside China (Hay et al., 2006; Table 1), there has been no systematic review of Chinese evidence. Therefore, this section reviews prior Chinese studies, where the association between inventory and audit fees is examined and reported.

Our review covers studies published in both international and Chinese peer-reviewed journals. For international studies, we search within the publication list edited by Wu (2016, Chapter 18, Appendix), which identifies all Chinese accounting studies published in over 50 international journals up to March 2016. In addition, we search two English-language Chinese journals: *China Journal of Accounting Research* (CJAR) and *China Accounting and Finance Review* (CAFR). For Chinese-language studies, we search three major accounting journals: *Accounting Research* (*Kuaijiyanjiu* in Chinese), *Auditing Research* (*Shenjiyanjiu* in Chinese) and *China Accounting Review* (*Zhongguokuaijipinglun* in Chinese). We identify 58 archival studies on audit pricing up to March 2016. Of these studies, 23 examine and report the association between inventory and audit fees.

Panel A of Table 1 lists the distribution of the 23 relevant studies by journal: 6 studies were published in international journals, and 17 were published in Chinese journals. Panel B lists the distribution of the 23 studies by publication year. The earliest Chinese study that reports an inventory–audit fee association appears in 2004.

By reading the research design sections of the studies, we categorize the underlying rationale of including the inventory variable in each study's empirical audit pricing model. Panel C shows that 17 (73.9%) of the 23 studies state that they include the inventory variable to control for audit risk and/or audit complexity, which follows conventional audit pricing theory (Simunic, 1980).

Panel D shows that only 1 of the 23 papers reports a significant positive association between inventory and audit fees. However, 20 (86.9%) of the studies document a significant negative association. This pattern clearly contradicts evidence from outside China (Hay et al., 2006).

We are interested in how the researchers in the 20 studies that document a significant negative inventory–audit fee association interpret such an apparently puzzling finding. Panel E shows that 11 (55.0%) of the 20 studies leave this unexpected result completely unexplained. Among the nine studies that offer any interpretation, two argue that inventory may not be a sound measure of audit risk or client complexity (Liu and Subramaniam, 2013; Wang et al., 2008), while another two conjecture that inventory could be associated with lower audit risk in China (e.g., Wu, 2012). Five studies argue that greater inventory intensity may still be a

Table 1
Summary of Chinese evidence on inventory–audit fee association.

	No. of publications
Panel A: Distribution by journal	
International journals	
The Accounting Review (TAR)	1
Journal of Accounting and Economics (JAE)	1
Journal of Accounting and Public Policy (JAPP)	1
Journal of Accounting, Auditing & Finance (JAAF)	1
The International Journal of Accounting (TIJA)	1
Journal of International Accounting Research (JIAR)	1
Subtotal	6
Chinese journals	
China Journal of Accounting Research (CJAR)	2
China Accounting and Finance Review (CAFR)	3
Accounting Research (*Kuaijiyanjiu*)	1
Auditing Research (*Shenjiyanjiu*)	10
China Accounting Review (*Zhongguokuaijipinglun*)	1
Subtotal	17
Total	23
Panel B: Distribution by publication year	
2004	1
2005	1
2006	1
2007	2
2008	1
2011	2
2012	3
2013	4
2014	2
2015	5
2016	1
Total	23
Panel C: Distribution by underlying theory cited	
Audit risk	12
Audit complexity	8
Not mentioned	6
Total	23[a]
Panel D: Distribution by significance and sign of the coefficient on inventory	
Significantly positive	1
Not significantly different from zero	2
Significantly negative	20
Total	23
Panel E: Distribution by interpretation of negative inventory–audit fee association	
Unexplained	11
Inventory not a sound measure of audit risk or complexity	2
Inventory associated with lower audit risk	2
Inventory associated with higher risk, but auditors fail to pay adequate attention	5
Total	20

[a] The breakdown does not add up to 23 because 3 papers control for the inventory variable for the consideration of both audit risk and audit complexity.

proxy for higher audit risk, but auditors may fail to pay adequate attention to it. None of these conjectures have been formally tested.

Overall, Table 1 shows that it is necessary to resolve the apparent puzzle about the inventory–audit fee association in China, which has been left unsolved for over a decade.

2.2. Heterogeneity of inventory components

Audit pricing studies often regress audit fees on *total* inventory intensity, which assumes that various components of inventory share homogeneous audit risk and/or complexity. However, inventory is an aggregated account in the balance sheet, consisting of the opening balance and the net change in the ending inventory from the opening balance. Inventory also consists of various items, including raw materials, work-in-process (WIP) and finished goods. As inventory components differ in terms of the speed of turnover, production stage and purpose, they may have different implications for audit procedures and audit risk.

As inventory is a current asset, the turnover cycle is usually under a year. In our sample of Chinese (U.S.) listed companies, the median of inventory turnover is 71 (139) days. Therefore, the opening balance of inventory likely contains more obsolete items than a current-period change in inventory, which hints at greater inherent risk and greater scrutiny from auditors.

Moreover, the literature suggests that the change in inventory is likely to reflect management's private information about opportunities in the market. For example, using data from 168 U.S. manufacturing public companies, Bernard and Noel (1991) find that changes in WIP inventory tend to be a positive leading indicator of sales. Bernard and Noel (1991) posit that a knowledgeable manager would choose to expand production by adding more resources to the manufacturing process when she expects an increase in future demand and sales. She can also slow down or even choose to pause production if she forecasts a decline in demand. Therefore, the net change in ending inventory likely reflects responsive production management and lower inherent risk for the company, requiring less scrutiny from auditors.

2.3. Research questions

The key debate underlying various conjectures on the puzzling negative inventory–audit fee association surrounds whether inventory in China is associated with a higher or lower level of inherent risk for the client or has no implications for audit risk at all. Further, given the heterogeneity of different inventory components as discussed in Section 2.2, it could be worthwhile to investigate how opening inventory and the net change in ending inventory, instead of aggregate inventory intensity, is associated with inherent risk. Therefore, our first research question is as follows:

RQ1. What is the relationship between each inventory component and client's inherent risk?

Studies that document a negative association between inventory and audit fee also conjecture that the assessed low audit risk of inventory could be associated with a lower level of audit effort (Wu, 2012). By obtaining proprietary audit hours data from the Ministry of Finance (MOF), we are able to examine the inventory–audit hour association, which helps us better understand the association between inventory and audit fees. Our second research question is as follows:

RQ2. What is the association between each inventory component and audit labor effort?

A joint analysis of RQ1 and RQ2 will be useful to distinguish between the various conjectures raised in prior studies (shown in Panel E of Table 1). For example, if we find that inventory is associated with a higher level of inherent risk (RQ1) but not with more audit effort (RQ2), the conjecture of auditor failure seems to be supported. However, if we find that inventory is associated with a lower level of future client risk (RQ1) and less audit effort (RQ2), the conjecture of inventory being associated with low audit risk is more likely to be valid.

3. Association between inventory and audit fees: replication and extension

3.1. Replication

We first replicate prior studies on audit fees to corroborate the contrasting patterns concerning the inventory–audit fee association in China versus in Western audit markets, and to form a basis for further decomposing analysis.

We regress audit fees ($LNFEE_t$), measured as the natural log of audit fees of annual audit of financial statements, on total inventory intensity (INV_t), measured as year-end total inventory scaled by opening total

assets.[2] We estimate Eq. (1) using data from China and the U.S. (as the benchmark based on a major developed market), separately, for the same sample period.

$$LNFEE_t = \alpha_0 + \alpha_1 INV_t + Controls \quad (1)$$

Following Francis, Reichelt, and Wang (2005) and Su and Wu (2017), we incorporate a set of control variables including firm characteristics—firm size ($LNTA_t$), current assets (less inventory) to total assets ($CATA_t$), quick ratio ($QUICK_t$), financial leverage (LEV_t), profitability (ROA_t), prior-year audit opinion (OP_{t-1}), loss indicator ($LOSS_t$), state ownership (SOE_t), number of subsidiaries (SQ$SUBS_t$), inventory impairment ($IMPAIR_t$), foreign business indicator ($FOREIGN_t$) and 31 December fiscal year end indicator ($BUSY_t$)—and auditor-related variables, such as Big 4 indicator ($BIG4_t$), large local audit firms indicator ($BIGLOCAL_t$), industry specialist indicator ($EXPERT_t$) and auditor switch indicator ($SWITCH_t$). Industry- and year-fixed effects are also controlled for. See the Appendix for detailed variable definitions.

We aim to maintain a common set of control variables when separately estimating Eq. (1) for firms in China versus the U.S. However, given the institutional differences between China and the U.S., some control variables are included either for the Chinese sample or the U.S. sample. For example, all Chinese companies share the same fiscal year end. Thus, we do not include the $BUSY_t$ variable for Chinese firms. Although it is common to include SOE_t and $BIGLOCAL_t$ in Chinese studies, these variables are rarely used in U.S. studies because non-SOE companies and Big 4 auditors dominate the U.S. market. Thus, these two variables are not included for the U.S. sample. Further, due to the data availability issue, we do not include $FOREIGN_t$ for the Chinese sample, and we do not include SQ$SUBS_t$ and $IMPAIR_t$ for the U.S. sample, as these variables are either not readily available in major Chinese financial databases or in the Compustat database.

Our sample period spans 2004 to 2014. For Chinese firms, we retrieve inventory data from the RESSET database and all other financial data from the CSMAR database. For U.S. firms, we extract all information from Compustat. After excluding firm-year observations for financial institutions and utilities, as well as those with missing values for audit pricing model variables, we obtain a sample of 14,485 (37,197) Chinese (U.S.) firm-year observations. We winsorize continuous variables at the 1st and 99th percentiles.

Table 2 reports the descriptive statistics of the model variables. It shows that the mean (median) inventory intensity (INV_t) for Chinese sample firms is 0.20 (0.15), whereas the mean (median) for the U.S. sample is 0.10 (0.04). This suggests that Chinese listed companies are more inventory-intensive. During the sample period of 2004–2014, U.S. public companies have lower profitability (ROA_t and $LOSS_t$) and higher financial leverage (LEV_t) than Chinese listed companies. Compared with the Chinese audit market, the U.S. audit market features a much higher presence of Big 4 auditors ($BIG4_t$, 61% vs. 5%) and industry-specialist auditors ($EXPERT_t$, 38% vs. 12%). Moreover, the frequency of modified audit opinion is 6% in China, in contrast to 40% in the U.S. capital market.[3]

Table 3 reports the ordinary least squares (OLS) regression results of Eq. (1). Audit pricing models both in the U.S. and China are well explained, with adjusted R-square values of 0.859 and 0.662, respectively. For the U.S. sample, the coefficient of INV_t is significantly positive (t-stat. = 4.04), which is consistent with a positive inventory–audit fee association, as documented in Hay et al. (2006). In contrast, for the Chinese sample, the coefficient of INV_t is significantly negative (t-stat. = −3.39), which is consistent with most prior Chinese audit fee studies. Regarding control variables, our results are generally consistent with the audit pricing literature.

3.2. Inventory components and audit fees

To better understand the negative inventory–audit fee association in China, we extend Eq. (1) by decomposing the aggregate inventory into various components. In Eq. (2a), we decompose INV_t into the opening balance of inventory that is carried over from the previous period (INV_{t-1}) and the net change in ending inventory ($\triangle INV_t$), both scaled by beginning total assets. In Eq. (2b), INV_{t-1} is further decomposed into

[2] The results are qualitatively similar if using the ending total assets as the scalar. However, using the opening balance of total assets as the scalar eases subsequent decomposition analysis.

[3] Consistent with the high frequency of modified audit opinion in the U.S., Butler, Leone, and Willenborg (2004) report a frequency of 26% (34%) by Big 5 (non-Big 5) auditors during the 1988–1999 period.

Table 2
Descriptive statistics.

Variable	Chinese sample (N = 14,485)				U.S. sample (N = 37,197)			
	Mean	Med.	Min.	Max.	Mean	Med.	Min.	Max.
$LNFEE_t$	13.33	13.27	11.98	15.41	13.03	13.12	8.97	16.77
INV_t	0.20	0.15	0.00	1.05	0.10	0.04	0.00	0.75
INV_{t-1}	0.17	0.13	0.00	0.75	0.09	0.04	0.00	0.61
$\triangle INV_t$	0.03	0.01	−0.15	0.53	0.01	0.00	−0.16	0.31
RM_{t-1}	0.05	0.03	0.00	0.28	0.03	0.00	0.00	0.27
WIP_{t-1}	0.06	0.02	0.00	0.61	0.02	0.00	0.00	0.17
FG_{t-1}	0.06	0.04	0.00	0.31	0.04	0.01	0.00	0.39
$\triangle RM_t$	0.01	0.00	−0.10	0.20	0.003	0.00	−0.07	0.11
$\triangle WIP_t$	0.01	0.00	−0.17	0.35	0.002	0.00	−0.04	0.07
$\triangle FG_t$	0.01	0.00	−0.09	0.22	0.004	0.00	−0.09	0.14
$LNTA_t$	21.74	21.62	18.76	25.99	4.91	5.04	−2.94	11.95
$CATA_t$	0.38	0.37	0.05	0.87	0.46	0.42	0.02	1.00
$QUICK_t$	1.62	0.92	0.11	14.79	2.98	1.59	0.00	27.67
LEV_t	0.49	0.48	0.05	1.59	1.10	0.46	0.03	21.67
ROA_t	0.03	0.03	−0.34	0.21	−0.21	0.01	−1.71	0.17
OP_{t-1}	0.06	0	0	1	0.40	0	0	1
$LOSS_t$	0.11	0	0	1	0.47	0	0	1
$EXPERT_t$	0.12	0	0	1	0.38	0	0	1
$BIG4_t$	0.05	0	0	1	0.61	1	0	1
$SWITCH_t$	0.09	0	0	1	0.10	0	0	1
$BIGLOCAL_t$	0.40	0	0	1				
SOE_t	0.49	0	0	1				
$SQSUBS_t$	3.07	2.83	0	8.83				
$IMPAIR_t$	0.22	0.01	0	39.86				
$FOREIGN_t$					0.42	0	0	1
$BUSY_t$					0.70	1	0	1

See the Appendix for the definition of variables.

the opening balance of specific items including raw materials (RM_{t-1}), work-in-process (WIP_{t-1}) and finished goods (FG_{t-1}), and $\triangle INV_t$ is decomposed into $\triangle RM_t$, $\triangle WIP_t$ and $\triangle FG_t$, which facilitates a more detailed understanding of the inventory–audit fee association.

$$LNFEE_t = \beta_0 + \beta_1 INV_{t-1} + \beta_2 \Delta INV_t + Controls \tag{2a}$$

$$LNFEE_t = \beta_0 + \beta_1 RM_{t-1} + \beta_2 WIP_{t-1} + \beta_3 FG_{t-1} + \beta_4 \Delta RM_t + \beta_5 \Delta WIP_t + \beta_6 \Delta FG_t + Controls \tag{2b}$$

We use the same Chinese and U.S. samples as in Eq. (1). Concerning the inventory components, Table 2 shows that in China (the U.S.), the mean opening inventory intensity is 0.17 (0.09), whereas the mean net change in ending inventory is 0.03 (0.01).

Panel A of Table 4 reports the OLS regression results of Eq. (2a). It shows that $\triangle INV_t$ is significantly and negatively associated with audit fees both in the U.S. and China (t-stats. = −6.07 and −3.56, respectively). However, INV_{t-1} is significantly and positively associated with audit fees in the U.S. (t-stat. = 7.34), but significantly and negatively associated with audit fees in China (t-stat. = −2.53).[4] Panel A reveals that the major difference in the auditor pricing of inventory between China and the U.S. lies in the pricing of opening inventory, rather than the net change in ending inventory.

Panel B of Table 4 further shows that U.S. auditors charge a significant fee discount for net increase in all three inventory items (i.e., $\triangle RM_t$, $\triangle WIP_t$ and $\triangle FG_t$). Similarly, Chinese auditors charge a significant fee

[4] The net change in ending inventory is only one-ninth of the opening inventory (= 0.1/0.9) for U.S. public companies, which justifies the significantly positive coefficient on INV_t (as shown in Table 3) being dominated by the significantly positive coefficient on INV_{t-1} (rather than the significantly negative coefficient on $\triangle INV_t$).

Table 3
Total year-end inventory and audit fees: OLS regression results.

Dep. Var: $LNFEE_t$	Chinese sample		U.S. sample	
	Coef.	t-stat.	Coef.	t-stat.
Variable of interest				
INV_t	−0.123	−3.39***	0.218	4.04***
Control variables				
$LNTA_t$	0.258	31.63***	0.517	109.20***
$CATA_t$	0.048	1.20	0.422	14.34***
$QUICK_t$	−0.009	−3.04***	−0.033	−21.14***
LEV_t	0.025	0.78	0.041	18.68***
ROA_t	0.108	1.12	−0.278	−16.64***
OP_{t-1}	0.167	7.69***	0.121	12.49***
$LOSS_t$	0.053	3.50***	0.074	6.05***
$EXPERT_t$	0.113	6.70***	0.000	0.02
$BIG4_t$	0.667	16.74***	0.365	17.74***
$SWITCH_t$	−0.051	−4.80***	−0.074	−6.41***
$BIGLOCAL_t$	0.072	6.05***		
SOE_t	−0.075	−5.54***		
$SQSUBS_t$	0.088	17.59***		
$IMPAIR_t$	0.031	5.72***		
$FOREIGN_t$			0.271	16.84***
$BUSY_t$			0.078	5.11***
Industry fixed effects	Yes		Yes	
Year fixed effects	Yes		Yes	
N	14,485		37,197	
Adj. R^2	0.662		0.859	

*** Denotes significance at the 1% level (two-tailed).
Standard errors are clustered at the company level.
See the Appendix for the definition of variables.

discount for the net increase in raw materials ($\triangle RM_t$) and WIP inventory ($\triangle WIP_t$).[5] These patterns corroborate the negative association between $\triangle INV_t$ and audit fees shown in Panel A of Table 4.

Moreover, Panel B shows that U.S. auditors charge a significant premium for the opening balance of all three inventory items (i.e., RM_{t-1}, WIP_{t-1} and FG_{t-1}). However, Chinese auditors do not charge a premium for the opening balances of raw materials (RM_{t-1}) or finished goods (FG_{t-1}), and charge a significant fee discount for the opening balance of WIP inventory (WIP_{t-1}). These findings help us understand how the significant and negative association between INV_{t-1} and audit fees in China is shaped.

4. Inventory components and corporate inherent risk

As Table 4 shows that the net increase in ending inventory is associated with lower audit fees, in this section, we examine whether it is also associated with lower inherent risk. More interestingly, we investigate whether the opening balance of inventory is associated with higher or lower inherent risk in the Chinese and U.S. samples, respectively, as Table 4 shows an inconsistent (and contrasting) pattern of audit pricing of opening inventory between Chinese and U.S. auditors.

4.1. Sales growth

Sales are the fundamental driver of earnings and cash flows (Dechow, Kothari, & Watts, 1998), through which the value of inventory becomes realized. Bernard and Noel (1991) argue that some inventory

[5] In the Chinese sample, the coefficient of $\triangle FG_t$ is also negative (t-stat. = −1.02).

Table 4
Decomposed inventory and audit fees: OLS regression results.

Dep. Var: $LNFEE_t$	Chinese sample		U.S. sample	
	Coef.	t-stat.	Coef.	t-stat.
Panel A: Opening balance of and net change in total inventory				
INV_{t-1}	−0.122	−2.53**	0.491	7.34***
$\triangle INV_t$	−0.152	−3.56***	−0.442	−6.07***
Controls	Yes		Yes	
N	14,485		37,197	
Adj. R^2	0.662		0.861	
Panel B: Opening balance of and net change in three inventory items				
RM_{t-1}	−0.026	−0.20	0.318	2.25**
WIP_{t-1}	−0.211	−3.25***	0.525	2.33**
FG_{t-1}	0.059	0.59	0.747	7.30***
$\triangle RM_t$	−0.189	−2.30**	−0.710	−4.22***
$\triangle WIP_t$	−0.201	−3.44***	−0.777	−3.21***
$\triangle FG_t$	−0.087	−1.02	−0.344	−2.66***
Controls	Yes		Yes	
N	14,485		37,197	
Adj. R^2	0.662		0.861	

** and *** denote significance at the 5% and 1% levels (two-tailed), respectively.
Standard errors are clustered at the company level.
For the sake of brevity, we do not tabulate the control variables (including year and industry fixed effects) used in the estimation, which are the same as those used in Table 3.
See the Appendix for the definition of variables.

components reflect private management information about market opportunities. Therefore, we use next-period sales growth as our first proxy for inherent risk. We estimate the following models:

$$SALESGROW_{t+1} = \gamma_0 + \gamma_1 INV_{t-1} + \gamma_2 \Delta INV_t + Controls \quad (3a)$$

$$SALESGROW_{t+1} = \gamma_0 + \gamma_1 RM_{t-1} + \gamma_2 WIP_{t-1} + \gamma_3 FG_{t-1} + \gamma_4 \Delta RM_t + \gamma_5 \Delta WIP_t + \gamma_6 \Delta FG_t + Controls \quad (3b)$$

In Eqs. (3a) and (3b), the dependent variable $SALESGROW_{t+1}$ is the percentage change in revenue from year t to year t+1. Following Cooper, Gulen, and Schill (2008), we control for firm size ($LNTA_t$), financial leverage (LEV_t), profitability (ROA_t), operating cash flow ratio ($CASHFLOW_t$) and book-to-market ratio (BTM_t). In addition, we include annual stock return (RET_t) to control for factors that may not be reflected in accounting information. Due to missing values for some model variables, the Chinese and U.S. samples for estimating Eqs. (3a) and (3b) are reduced to 14,247 and 28,777, respectively.

Table 5 presents the OLS regression results for Eqs. (3a) and (3b). Panel A shows that both in China and the U.S., $\triangle INV_t$ is significantly and positively associated with $SALESGROW_{t+1}$, with t-statistics of 8.01 and 11.36, respectively. Panel B further shows that the net increase in all three inventory items ($\triangle RM_t$, $\triangle WIP_t$ and $\triangle FG_t$) is associated with higher future revenue growth. These results indicate that the net increase in ending inventory strongly predicts higher future revenue growth, which is consistent with management having private information about future opportunities in the product market (Bernard and Noel, 1991). It is also consistent with the evidence in Table 4 that both Chinese and U.S. auditors charge a significant fee discount for $\triangle INV_t$ in response to its lower inherent risk.

Panel A also shows that in the U.S. sample, INV_{t-1} is strongly and negatively associated with $SALESGROW_{t+1}$ (t-stat. = −9.40). Moreover, Panel B shows that the opening balance of all three inventory items (RM_{t-1}, WIP_{t-1} and FG_{t-1}) is associated with poorer future revenue growth. These results are consistent with U.S. auditors charging a significant fee premium for INV_{t-1} (as evidenced in Table 4) in response to its higher inherent risk.

Finally, we come to the coefficient of INV_{t-1} in the Chinese sample. If Chinese auditors charge a significant fee discount for opening inventory due to its lower inherent risk, we would expect a significant and positive

Table 5
Decomposed inventory and next-period sales growth: OLS regression results.

Dep. Var: $SALESGROW_{t+1}$	Chinese sample		U.S. sample	
	Coef.	t-stat.	Coef.	t-stat.
Panel A: Opening balance of and net change in total inventory				
Variables of interest				
INV_{t-1}	−0.050	−0.84	−0.489	−9.40***
$\triangle INV_t$	0.666	8.01***	1.387	11.36***
Control variables				
$LNTA_t$	−0.035	−5.28***	−3.46***	−3.46***
LEV_t	−0.004	−0.10	−7.19***	−7.19***
ROA_t	−0.124	−0.85	−7.73***	−7.73***
$CASHFLOW_t$	−0.224	−2.44**	−2.13**	−2.13**
BTM_t	−0.126	−5.29***	−12.72***	−12.72***
RET_t	0.109	7.68***	7.77***	7.77***
Industry fixed effects	Yes		Yes	
Year fixed effects	Yes		Yes	
N	14,247		28,777	
Adj. R^2	0.051		0.077	
Panel B: Opening balance of and net change in three inventory items				
RM_{t-1}	−0.367	−2.86***	−0.604	−6.11***
WIP_{t-1}	0.056	0.79	−0.608	−5.61***
FG_{t-1}	−0.250	−2.67***	−0.561	−7.86***
$\triangle RM_t$	0.547	3.00***	1.673	6.36***
$\triangle WIP_t$	0.646	5.21***	2.421	6.93***
$\triangle FG_t$	1.065	6.12***	1.111	6.34***
Controls	Yes		Yes	
N	14,247		28,777	
Adj. R^2	0.051		0.077	

** and *** denote significance at the 5% and 1% levels (two-tailed), respectively.
Standard errors are clustered at the company level.
For the sake of brevity, we do not tabulate the control variables (including year and industry fixed effects) in Panel B, which are the same as those used in Panel A.
See the Appendix for the definition of variables.

coefficient of INV_{t-1}. However, this is not the case. As shown in Panel A, the coefficient of INV_{t-1} in the Chinese sample has a negative sign, rather than a significant positive one. Panel B further shows that the coefficients of RM_{t-1} and FG_{t-1} are significantly negative (t-stats. = −2.86 and −2.67, respectively), which suggests higher inherent risk for the opening balances of raw materials and finished goods in China. However, recall that Panel B of Table 4 shows that Chinese auditors do not charge a higher fee premium for the opening balances of these two inventory items.

Overall, the evidence in Table 5 suggests that the audit pricing of opening inventory by Chinese auditors is not consistent with its inherent risk when measured by future sales growth.

4.2. Inventory impairment

Our second proxy for inherent risk is inventory impairment for the current year, which incorporates management's evaluation of the economic value of the ending inventory (Feng, Li, McVay, & Skaife, 2015). To examine how inventory components are associated with inventory impairment, we specify the following models:

$$IMPAIR_t = \delta_0 + \delta_1 INV_{t-1} + \delta_2 \Delta INV_t + Controls \tag{4a}$$

$$IMPAIR_t = \delta_0 + \delta_1 RM_{t-1} + \delta_2 WIP_{t-1} + \delta_3 FG_{t-1} + \delta_4 \Delta RM_t + \delta_5 \Delta WIP_t + \delta_6 \Delta FG_t + Controls \tag{4b}$$

Table 6
Decomposed inventory and year-end inventory impairment: Tobit regression results.

Dep. Var: $IMPAIR_t$	Coef.		t-stat.
Panel A: Opening balance of and net change in total inventory			
Variables of interest			
INV_{t-1}	1.095		4.70***
$\triangle INV_t$	−1.100		−5.58***
Control variables			
$MARGIN_t$	−0.709		−3.78***
$CAPINTENSITY_t$	0.115		4.26***
$SALESVOL_t$	0.505		4.30***
$SALESGROW_t$	0.013		0.63
$SQSUBS_t$	0.043		4.23***
AGE_t	0.054		2.60***
$BIG4_t$	0.177		3.60***
$BIGLOCAL_t$	0.063		1.99**
$LOSS_t$	0.493		8.04***
$LNTA_t$	−0.128		−4.32***
Industry fixed effects		Yes	
Year fixed effects		Yes	
N		13,570	
Pseudo R^2		0.088	
Panel B: Opening balance of and net change in three inventory items			
RM_{t-1}	2.086		4.16***
WIP_{t-1}	0.285		1.08
FG_{t-1}	3.280		8.82***
$\triangle RM_t$	−1.261		−2.66***
$\triangle WIP_t$	−1.469		−4.87***
$\triangle FG_t$	−0.686		−2.01**
Controls		Yes	
N		13,570	
Pseudo R^2		0.088	

** and *** denote significance at the 5% and 1% levels (two-tailed), respectively.
Standard errors are clustered at the company level.
For the sake of brevity, we do not tabulate the control variables (including year and industry fixed effects) in Panel B, which are the same as those used in Panel A.
See the Appendix for the definition of variables.

In Eqs. (4a) and (4b), the dependent variable $IMPAIR_t$ is measured as the absolute magnitude of year-end inventory impairment (scaled by the ending total assets). Following Feng et al. (2015), we control for gross margin ($MARGIN_t$), capital intensity ($CAPINTENSITY_t$), sales volatility ($SALESVOL_t$) and sales growth ($SALESGROW_t$). We also include a number of firm and auditor characteristics, such as the number of subsidiaries ($SQSUBS_t$), listing age (AGE_t), Big 4 auditor indicator ($BIG4$), large local auditor indicator ($BIGLOCAL_t$), profitability (ROA_t), reporting loss indicator ($LOSS_t$) and firm size ($LNTA_t$). Because inventory impairment data are not readily available in Compustat for U.S. public companies, we estimate Eqs. (4a) and (4b) only for the Chinese sample.

We use Tobit regression to estimate Eqs. (4a) and (4b) because the absolute magnitude of inventory impairment is always positive (i.e., left censored).[6] The regression results are shown in Table 6.

As shown in Panel A of Table 6, the coefficient of INV_{t-1} is 1.095 (t-stat. = 4.70), whereas the coefficient of $\triangle INV_t$ is −1.100 (t-stat. = −5.58). These findings suggest that in China, the net increase in ending inventory is associated with significantly lower impairment risk, whereas opening inventory is associated with a significantly higher impairment risk.

[6] The results remain robust when using OLS regression.

Panel B of Table 6 further shows that the net increase in all three inventory items ($\triangle RM_t$, $\triangle WIP_t$ and $\triangle FG_t$) is associated with significantly lower impairment risk. In contrast, the coefficients of all three inventory items (RM_{t-1}, WIP_{t-1} and FG_{t-1}) are positive, and those of raw materials and finished goods are significant (t-stats. = 4.16 and 8.82, respectively).

Overall, the evidence in Table 6 suggests that although Chinese auditors charge a significant fee discount for the net increase in ending inventory in response to its lower impairment risk, they fail to charge higher audit fees for opening inventory despite its greater impairment risk.

5. Inventory components and audit labor effort

Our second research question asks how inventory components are associated with audit labor effort. The MOF required audit firms to file audit labor effort information (including the size of the audit team and the number of field days) for audits of listed companies during the 2006–2011 period. We obtain this proprietary data to measure auditors' labor inputs, and specify Eqs. (5a) and (5b) as follows:

$$LAL_t = \eta_0 + \eta_1 INV_{t-1} + \eta_2 \Delta INV_{t-1} + Controls \tag{5a}$$

$$LAL_t = \eta_0 + \eta_1 RM_{t-1} + \eta_2 WIP_{t-1} + \eta_3 FG_{t-1} + \eta_4 \Delta RM_t + \eta_5 \Delta WIP_t + \eta_6 \Delta FG_t + Controls \tag{5b}$$

The dependent variable LAL_t is the natural log of audit labor effort. We measure LAL_t as the natural log of the size of the audit team ($LNTEAM_t$), the natural log of the number of field days ($LNDAY_t$), or the natural log of the size of the audit team multiplied by the number of field days ($LN(TEAM\times DAY)_t$). We use the same set of explanatory variables as in Eqs. (2) and (3). As the audit labor input data are not available for U.S. public companies, we estimate Eqs. (5a) and (5b) for the Chinese sample only. The sample size is reduced to 6412 because the audit labor data in China are only available for the 2006–2011 period.

Panel A of Table 7 reports the OLS regression results of Eq. (5a). Across three specifications of audit labor effort, our model shows sound explanatory power, with an adjusted R-square of 0.385. This is comparable to the adjusted R-square of 0.365 reported in a prior Chinese study (Gong, Li, Lin, & Wu, 2016, Table 3, Column 3). The results for the control variables are generally consistent with the literature on audit labor effort (Caramanis and Lennox, 2008; Gong et al., 2016).

Panel A shows that the coefficients of $\triangle INV_t$ are significant and negative across all three specifications for audit labor input. Therefore, Chinese auditors spend considerably fewer audit hours when there is a larger net increase in ending inventory, which is consistent with the expected response to its lower inherent risk (as manifested in sales growth and inventory impairment). Panel B of Table 7 further shows that less audit effort is made particularly when there is a larger increase in the ending balance of WIP inventory (t-stats. = −2.57 and −2.62 in the $LNDAY_t$ and $LN(TEAM\times DAY)_t$ models, respectively) and, to a lesser extent, raw materials (t-stat. = −1.82 in the $LN(TEAM\times DAY)_t$ model).

In contrast, the coefficients of INV_{t-1} are not significantly different from zero in any of the three audit labor effort models. Panel B of Table 7 further shows that Chinese auditors do not devote significantly greater effort to the opening balance of raw materials or finished goods, despite their higher inherent risk in terms of sales growth and inventory impairment.[7] Moreover, Chinese auditors spend significantly fewer audit hours on the opening balance of WIP inventory, with t-statistics of −2.41, −1.95 and −3.02 in the three specifications of Eq. (5b). This pattern is consistent with Chinese auditors charging a significant fee discount for the opening balance of WIP as shown in Panel B of Table 4 (t-stat. = −3.25). However, no evidence in Tables 5 and 6 suggests that the opening balance of WIP is associated with higher sales growth (t-stat. = 0.79) or lower impairment risk (t-stat. = 1.08).

Overall, Table 7 shows that the pattern of Chinese auditor labor effort is consistent with the audit pricing pattern, and is also consistent with expected effort for the net change in ending inventory. However, the pattern is inconsistent with expected audit effort for the opening balance of inventory.

[7] There is only one exception: the marginally significant and positive coefficient of FG_{t-1} in the $LN(TEAM\times DAY)_t$ model (t-stat. = 1.71).

Table 7
Decomposed inventory and audit labor effort: OLS regression results.

Dep. Var:	$= LNTEAM_t$		$= LNDAY_t$		$= LN(TEAM \times DAY)_t$	
	Coef.	t-stat.	Coef.	t-stat.	Coef.	t-stat.
Panel A: Opening balance of and net change in total inventory						
Variables of interest						
INV_{t-1}	−0.059	−0.98	−0.036	−0.35	−0.095	−0.80
$\triangle INV_t$	−0.115	−1.81*	−0.300	−2.91***	−0.415	−3.34***
Control variables						
$LNTA_t$	0.154	15.03***	0.101	7.22***	0.256	14.42***
$CATA_t$	0.184	3.42***	0.037	0.44	0.221	2.18**
$QUICK_t$	−0.017	−3.91***	−0.027	−3.92***	−0.044	−5.09***
LEV_t	0.011	0.3	−0.081	−1.34	−0.070	−0.99
ROA_t	0.261	1.96*	−0.089	−0.44	0.172	0.7
OP_{t-1}	−0.002	−0.08	0.122	2.50**	0.120	2.02**
$LOSS_t$	0.028	1.05	0.001	0.02	0.029	0.6
$EXPERT_t$	0.111	3.44***	−0.246	−6.56***	−0.134	−2.64***
$BIG4_t$	0.531	9.60***	0.082	1.52	0.613	7.61***
$SWITCH_t$	0.084	3.96***	0.145	4.86***	0.229	5.71***
$BIGLOCAL_t$	0.060	3.50***	0.125	4.34***	0.186	5.37***
SOE_t	0.015	0.89	0.117	4.06***	0.132	3.93***
$SQSUB_t$	0.106	15.87***	0.130	12.41***	0.236	19.21***
$IMPAIR_t$	0.010	1.57	0.051	6.97***	0.061	6.72***
Industry fixed effects	Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes	
N	6412		6412		6412	
Adj. R^2	0.385		0.385		0.385	
Panel B: Opening balance of and net change in three inventory items						
RM_{t-1}	0.082	0.47	0.169	0.64	0.251	0.80
WIP_{t-1}	−0.183	−2.41**	−0.245	−1.95*	−0.428	−3.02***
FG_{t-1}	0.183	1.28	0.300	1.33	0.483	1.71*
$\triangle RM_t$	−0.232	−1.54	−0.296	−1.29	−0.528	−1.82*
$\triangle WIP_t$	−0.087	−0.93	−0.373	−2.57**	−0.460	−2.62***
$\triangle FG_t$	0.014	0.09	−0.251	−1.06	−0.237	−0.76
Controls	Yes		Yes		Yes	
N	6412		6412		6412	
Adj. R^2	0.386		0.386		0.386	

*, ** and * denote significance at the 10%, 5% and 1% levels (two-tailed), respectively.
Standard errors are clustered at the company level.
For the sake of brevity, we do not tabulate the control variables (including year and industry fixed effects) in Panel B, which are the same as those used in Panel A.
See the Appendix for the definition of variables.

6. Summary and conclusions

Table 8 summarizes our main findings in the analyses of audit pricing (Table 4), inherent risk in terms of sales growth (Table 5), inventory impairment (Table 6) and audit labor effort (Table 7). We organize the evidence with the inherent risk assessment presented first, followed by auditor response. This fits the idea of risk-based audits advocating a reasonable response to a given level of inherent risk (Bell, Peecher, & Solomon, 2005; Knechel, 2007), which has been accepted worldwide in the past several decades. In the last column of Table 8, we evaluate the consistency between the assessed inherent risk level for each inventory component (INV_{t-1} or $\triangle INV_t$) and the assessed auditor response level. Panels A and B of Table 8 present the U.S. and Chinese evidence, respectively.

Table 8
Summary of main evidence.

	Inherent Risk			Auditor response			Consistency
	Sales growth	Impairment	Risk level	Fees	Labor effort	Response level	
Panel A: U.S. Sample							
INV_{t-1}	$-^{***}$	na.	High	$+^{***}$	na.	High	Yes
RM_{t-1}	$-^{***}$	na.	High	$+^{**}$	na.	High	Yes
WIP_{t-1}	$-^{***}$	na.	High	$+^{**}$	na.	High	Yes
FG_{t-1}	$-^{***}$	na.	High	$+^{***}$	na.	High	Yes
$\triangle INV_t$	$+^{***}$	na.	Low	$-^{***}$	na.	Low	Yes
$\triangle RM_t$	$+^{***}$	na.	Low	$-^{***}$	na.	Low	Yes
$\triangle WIP_t$	$+^{***}$	na.	Low	$-^{***}$	na.	Low	Yes
$\triangle FG_t$	$+^{***}$	na.	Low	$-^{***}$	na.	Low	Yes
Panel B: Chinese Sample							
INV_{t-1}	ns.	$+^{***}$	High	$-^{**}$	ns.	Low	No
RM_{t-1}	$-^{***}$	$+^{***}$	High	ns.	ns.	Medium	No
WIP_{t-1}	ns.	ns.	Medium	$-^{***}$	$-^{***}$	Low	No
FG_{t-1}	$-^{***}$	$+^{***}$	High	ns.	$+^{*}$	Medium#	No
$\triangle INV_t$	$+^{***}$	$-^{***}$	Low	$-^{***}$	$-^{***}$	Low	Yes
$\triangle RM_t$	$+^{***}$	$-^{***}$	Low	$-^{**}$	$-^{*}$	Low	Yes
$\triangle WIP_t$	$+^{***}$	$-^{***}$	Low	$-^{***}$	$-^{***}$	Low	Yes
$\triangle FG_t$	$+^{***}$	$-^{**}$	Low	ns.	ns.	Medium	No

"+" ("−") denotes a significant and positive (negative) sign of coefficient.
*, ** and *** denote significance at the 10%, 5% and 1% levels (two-tailed), respectively.
na.: data not available.
ns.: not significant.
The medium level is assessed given an insignificant fee response and a weakly positive labor effort response.
Consistency: Evaluated as "Yes" ("No") if the auditor response level is consistent (inconsistent) with the inherent risk level.
Labor effort results are based on Eqs. (5a) and (5b) using $LN(TEAM*DAY)_t$ as the dependent variable.
See the Appendix for the definition of variables.

As shown in Panel A of Table 8, our study documents that U.S. auditors respond to inventory components ($\triangle INV_t$) with significantly lower inherent risk by charging a significant fee discount, and to inventory components (INV_{t-1}) with significantly higher inherent risk by charging a significant fee premium. Therefore, we conclude that in the U.S. market, audit pricing is consistent with the idea of business risk audits.[8]

As shown in Panel B of Table 8, Chinese auditors respond to inventory components ($\triangle INV_t$) with significantly lower inherent risk by charging a significant fee discount, and this is particularly responsive to the net change in raw materials and WIP. However, Chinese auditors fail to charge a significant fee premium for inventory components (INV_{t-1}) with significantly higher inherent risk. They even charge a significant fee discount for opening inventory, which is mainly driven by the underpricing of the opening balance of WIP. We therefore conclude that in the Chinese market, audit pricing practices only partially implement the idea of risk-based audits.

Our study provides useful insight into the puzzling negative association between inventory and audit fees in China. The evidence points to imperfect risk-based auditing practices in China. Our study also highlights a risky audit area (i.e., the opening balance of inventory) for future improvement toward more responsive pricing and audit labor resource allocation. Finally, our findings offer a refinement to the audit pricing model by separating the opening balance from the net change in ending inventory when using inventory as a major proxy for inherent risk.

[8] We were unable to assess the U.S. evidence from inventory impairment or audit labor effort due to data unavailability.

Appendix A

Variable List

Variable	Definition and Measurement
$LNFEE_t$	Natural log of annual audit fees for year t
INV_t	Total net inventory at the end of year t/total assets at the end of year t−1
INV_{t-1}	Total net inventory at the end of year t−1/total assets at the end of year t−1
$\triangle INV_t$	Change in total net inventory from year t−1 to year t/total assets at the end of year t−1
RM_{t-1}	Net raw materials at the end of year t−1/total assets at the end of year t−1
WIP_{t-1}	Net work-in-process inventory at the end of year t−1/total assets at the end of year t−1
FG_{t-1}	Net finished goods at the end of year t−1/total assets at the end of year t−1
$\triangle RM_t$	Change in net raw materials from year t−1 to year t/total assets at the end of year t−1
$\triangle WIP_t$	Change in net work-in-process inventory from year t−1 to year t/total assets at the end of year t−1
$\triangle FG_t$	Change in net finished goods from year t−1 to year t/total assets at the end of year t−1
$LNTA_t$	Natural log of total assets at the end of year t
$CATA_t$	Current assets (less inventory) at the end of year t/total assets at the end of year t
$QUICK_t$	Current assets (less inventory) at the end of year t/current liabilities at the end of year t
LEV_t	Total liabilities at the end of year t/total assets at the end of year t
ROA_t	Net income for year t/total assets at the end of year t
OP_{t-1}	Coded 1 for a prior-year modified audit opinion, and 0 otherwise
$LOSS_t$	Coded 1 if the current-year net income is negative, and 0 otherwise
$EXPERT_t$	Coded 1 for the first- or second-ranked audit firm as a nation-wide industry leader for year t, and 0 otherwise
$BIG4_t$	Coded 1 if the auditor is a Big 4 audit firm, and 0 otherwise
$SWITCH_t$	Coded 1 for an initial audit engagement, and 0 otherwise
$BIGLOCAL_t$	Coded 1 if the auditor is a local non-Big 4 audit firm and ranks top 10 based on the sum of total assets audited by an audit firm for year t, and 0 otherwise
SOE_t	Coded 1 if the controlling shareholder of the company is the government or a state-owned enterprise for year t, and 0 otherwise
$SQSUBS_t$	Square root of consolidated subsidiaries at the end of year t
$IMPAIR_t$	(The absolute magnitude of inventory impairment provided for year t/total assets at the end of year t) × 100
$FOREIGN_t$	Coded 1 for companies reporting pretax income from foreign operations for year t, and 0 otherwise
$BUSY_t$	Coded 1 for companies with December 31st fiscal year end, and 0 otherwise
$SALESGROW_t$	(Sales for year t/total assets at the end of year t) – (sales for year t−1/total assets at the end of year t−1)
$CASHFLOW_t$	Net cash flow from operations for year t/total assets at the end of year t
BTM_t	Book-to-market value of equity at the end of year t
RET_t	Annual return in the stock market for year t
$MARGIN_t$	(Sales for year t – cost of goods sold for year t)/sales for year t
$CAPINTENSITY_t$	The natural log of gross property, plant, and equipment at the end of year t
$SALESVOL_t$	The standard deviation of annual sales divided by total assets over the prior seven years (requiring at least three observations)
AGE_t	Number of years (by the end of year t) since a company was listed
$LNTEAM_t$	Natural log of the size of the audit team for the audit of year t
$LNDAY_t$	Natural log of the number of field days for the audit of year t
$LN(TEAM\times DAY)_t$	Natural log of the size of the audit team multiplied by the number of field days for the audit of year t

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The effects and economic consequences of cutting R&D tax incentives

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ABSTRACT

Research has documented the stimulating effect of R&D tax credits on R&D expenditure when enacting an R&D tax credit or raising the credit rate. However, the potential adverse effects and consequences of reducing R&D tax incentives remain unexamined. Using a cut in R&D tax incentives in Taiwan, we document the adverse effect of reducing the R&D credit rate on corporate R&D expenditure. The reduced R&D credit rate has a negative impact on the relation between corporate R&D expenditure and firm value. Our results highlight the adverse effects and economic consequences of reducing R&D tax incentives in an emerging economy.

1. Introduction

This paper investigates the effects and economic consequences of cutting research and development (R&D) tax credit rates. Prior research documents the positive effect of enacting R&D tax credits or increasing credit rates in spurring additional corporate investment in R&D (Gupta et al., 2011; Finley et al., 2015). The research, however, has not examined the effects of reducing R&D tax incentives on corporate R&D expenditure. Corporate R&D expenditure may be less responsive to a decrease than to an increase in credit rates, as competition within industries and commitment to long-term R&D plans may constrain firms from substantially reducing their R&D investment. Hence, whether reducing R&D tax incentives will result in firms decreasing their R&D investment remains an unanswered empirical question. Even less is known about the relationship between R&D spending and firm value after a reduction in R&D credit rates.

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The purpose of this paper is to fill this gap by assessing the impact of Taiwan's tax policy on R&D investment. R&D investment is important for both technological innovation and the competitiveness of economy. On account of the external benefits of R&D investment, many countries provide R&D credits to stimulate R&D expenditure in the private sector. Even developed countries such as the United States, Canada and France continue to provide R&D tax credits for corporate R&D expenditure. Over the past three decades, Taiwan has implemented favorable tax measures to stimulate firms to invest in R&D. The statutory R&D credit rate was gradually increased to 35% and could be further raised to 50% if the firm's current-year R&D expenditure exceeded its average R&D expenditure for the two previous years. However, the generous R&D tax incentives were long criticized for causing enormous revenue loss and a deterioration in the fiscal budget. In response to this criticism, Taiwan enacted the Statute for Industrial Innovation (SII) in 2010 to replace the previous tax incentives and reduce the R&D credit to a flat rate of 15%. This marked the first time Taiwanese policymakers greatly reduced the tax incentive for firm R&D expenditure, in contrast to most tax incentives of emerging countries aiming to stimulate incremental corporate R&D spending. It is unclear whether this reduction adversely affected corporate R&D expenditure and the overall economy.

The focus of this paper is to assess the effects and economic consequences of reducing R&D tax incentives in emerging economies. Using a sample of Taiwanese listed and over-the-counter firms for the period 2006–2014, we find that firms significantly reduced their R&D spending in response to the decrease in R&D credit rate by the SII. Furthermore, the credit rate reduction shows a negative effect on the relation between corporate R&D spending and firm value, as measured by Tobin's Q. We also find that the negative effect is more salient in the high-tech sample. Taken together, the results provide evidence of adverse effects and economic consequences of cutting R&D tax incentives.

We perform various sensitivity tests and robustness checks that include constructing alternative samples, model specifications and proxies for the economic consequences in our sample. We find that our contrast sample of biologics companies did not exhibit adverse effects or economic consequences after implementation of the SII. Using market-adjusted stock returns as an alternative proxy for economic consequences, we find that implementation of the SII had a negative impact on the relation between corporate R&D spending and stock returns. Our results are robust to different model specifications using both panel data estimations and a difference-in-differences design. Furthermore, we hand-collect the actual R&D tax credit amount from financial statement footnotes as a proxy variable to examine the effect of reducing R&D credit on firm innovation output. Our results show reduced innovation output by companies after implementation of the SII. Finally, we find that implementation of the SII significantly reduced both firm R&D credits and government tax revenue loss.

Our study makes several contributions to the literature. First, we extend the previous research on the link between R&D tax credit incentives and firm R&D spending. While the literature documents a positive effect of R&D tax credits in stimulating additional R&D spending (Berger, 1993; Gupta et al., 2011; Finley et al., 2015), little is known about the adverse impact of reducing R&D tax credits on firm R&D expenditure. Our study fills this gap by using the unique setting of the Taiwanese tax reform to address this issue. Companies may not reduce their R&D spending after the credit rate is decreased because of the constraints of nontax factors such as industry competition and commitment to long-term R&D projects. Our results, however, show a significant decrease in corporate R&D spending after a reduction in the credit rate, suggesting that the adverse tax effects outweigh the nontax factors in firm R&D investment decisions. Furthermore, the results of this paper provide tax policy implications for emerging economies. Developing countries often use tax incentives to stimulate investment. R&D investment is critical for technological advancement in developing countries. The SII, however, marks the first time Taiwan cut the tax incentives for firm R&D spending. The adverse effect we document arising from this cut suggests that developing countries should carefully consider the economic consequences of tax policies for firm R&D investment. Our paper also adds to the literature on the economic consequences of reducing the R&D credit rate, as there is limited empirical evidence on the relation between R&D spending and firm value after a reduction in R&D credit rate. We show that reducing the credit rate has a negative effect on the relation between corporate R&D spending and firm value.

The remainder of the paper is organized as follows. Section 2 discusses the background and related literature and develops our testable hypotheses. Section 3 develops the research design. Section 4 presents and analyzes the empirical results. Section 5 discusses the sensitivity tests, and Section 6 concludes the paper.

2. Background, related literature and hypothesis development

2.1. Background on R&D tax credits in Taiwan

Like many developing countries or regions, Taiwan has long provided substantial tax incentives to promote industrial upgrading and stimulate firm R&D investment. The Statute for Upgrading Industries (SUI) was enacted on 1 January 1991, and was one of the most important tax incentives to promote investment in Taiwan. One of the SUI's most favorable tax incentives was its statutory base credit rate of 35%[1] for firm R&D expenditure and an incremental credit rate of 50% if the current year's R&D expenditure exceeded the average for the previous two years. This generous tax incentive raised considerable concern in Taiwan about its effectiveness in stimulating firm R&D investment. The government also cautioned about the growing loss of revenue from these tax incentives and urged that their effectiveness in stimulating the economy be evaluated using empirical evidence (Chen and Gupta, 2017). The SUI expired at the end of 2009, and the Taiwanese government replaced it with the Statute for Industrial Innovation (SII). The SII essentially abolished all tax incentives except for the R&D tax credit, which it reduced to a flat rate of 15% without any increments. This marked the first policy change for R&D tax incentives in Taiwan. Whether the reduced R&D tax incentive resulted in adverse effects on firm R&D spending has implications for developing countries when changing their tax incentive policy.

2.2. R&D investment

Although it is straightforward to predict that an R&D tax credit should result in increased R&D spending because the credit lowers the marginal cost of R&D investment, the research finds mixed evidence for the effectiveness of R&D credits in stimulating R&D spending (Berger, 1993; Bloom et al., 2002; Klassen et al., 2004).

Berger (1993) investigates the effects of R&D tax credits in the Economic Recovery Tax Act of 1981 (ERTA). Using a sample of 263 U.S. firms with data from 1975 to 1989, he finds that a tax incentive increases R&D spending. On average, R&D tax credits increased R&D intensity (measured as the ratio of R&D spending to sales) by 2.9% during 1981–1989. He also finds that R&D credit induced $1.74 in additional spending per dollar of forgone revenue during the period 1982–1985. These results suggest that the credit-induced R&D spending is higher than the loss of tax revenue. Swenson (1992) also examines the effectiveness of the tax credit for research and experimentation (R&E) expenditure using data from 1975 to 1988. The results indicate that while credit increased additional research spending, the effect of the credit was substantially mitigated by the impact of net operating loss carryforwards and low growth opportunity. Bloom et al. (2002) examine the impact of fiscal incentives on the level of R&D investment. Using a sample of nine OECD countries over a 19-year period (1979–1997), they find that tax incentives are effective in increasing R&D intensity. They find that a 10% fall in the cost of R&D stimulates an R&D rise of just over 1% in the short run and almost 10% in the long run.

Klassen et al. (2004) examine the effectiveness of R&D tax incentives by comparing the R&D decisions of firms from Canada and the United States. These two countries have different R&D tax policies. In Canada, all R&D expenditure qualifies for a tax credit, while the U.S. tax credit applies only to incremental R&D expenditure. Using a matched sample of Canadian and U.S. firms reporting an R&D expense of at least 0.5% of sales between 1991 and 1997, they find that the Canadian incentive produced on average $1.30 per dollar of tax revenue forgone compared with $2.96 in the U.S. The results indicate that applying a credit only to incremental R&D expenditure provides a larger incentive for firms. In our study, the SUI provides a statutory base credit rate of 35% for firm R&D expenditure and an incremental credit rate of 50% for the excess of

[1] The effective base credit rate was 30% in 2008.

current year's R&D expenditure over the average for the previous two years. Hence, Taiwan's R&D credit is structured to combine the strict incremental credit in the U.S. and the straight credit in Canada, offering a unique setting to examine firm responses to the policy of cutting R&D tax incentives.

Prior research documents the stimulating effects of R&D credit stemming from the Omnibus Budget Reconciliation Act of 1989 (OBRA89). In the U.S., R&D credits have been incremental in nature, implying that companies must spend more in the current year than a given base amount to get the credit. OBRA89 replaced the moving average base for the computation with a fixed percentage base. Gupta et al. (2011) examine this change in the computation of the credit enacted in OBRA89 using a sample of 2540 firms for the period 1981–1994, and find that while overall firm eligibility declined after OBRA89, eligibility increased for firms in high-tech industries. They also find that the median R&D spending of high-tech (other) companies that qualified for the credit increased by approximately 15.9% (9.4%) between 1986 and 1989 and 1990–1994, and the R&D tax credit induced approximately $2.08 of additional spending per dollar of forgone Treasury revenue in the post-OBRA89 period.

After enactment of the OBRA, an important design change was the enactment of the Alternative Simplified Credit (ASC) in 2007. This did not replace the OBRA credit regime, but provided firms with a choice between two credit-calculation methods. Beginning in 2007, companies had the option each year of choosing between the OBRA89 and ASC methods, depending on which would generate the larger tax benefit.[2] Finley et al. (2015) find that the ASC design dramatically increased firm eligibility for R&D tax credits, inducing approximately $2.26 additional R&D spending per dollar of forgone tax revenue.

Rao (2016) investigates the U.S. federal R&D tax credit data from 1981 to 1991 and finds that a 10% reduction in the user cost of R&D led the average firm to increase its R&D intensity by 19.8% in the short run. In the long run, the average company faced the adjustment costs and further increased its spending over time.

Using data from Taiwan, Wang and Chen (2000) examine the effectiveness of the SUI's R&D investment tax credits, personnel training and the establishment of international brand names. Using linear structural relations (LISREL) to analyze 161 questionnaire samples, they find that tax credits positively impacted firm R&D expenditure and established international brand names. Yang et al. (2012) use a sample of manufacturing firms listed on the Taiwan Stock Exchange (TSE) during 2001–2005, and find that R&D tax credits positively influenced R&D spending and growth, especially for electronics companies.

Chen and Li (2017) find the reduced credit rate by the SII have an adverse effect on the R&D spending of growth companies, financially-constrained companies and electronics companies.[3] Further, the disallowing R&D credits of carrying forward into next four years results in less volatility in changes in firms' R&D spending.

Bloom et al. (2002) find that a 10% decrease in the cost of R&D investment stimulated an additional 1% of R&D investment in the short run and 10% in the long run. Intuitively, a reduction in the R&D credit rate should lead firms to undertake R&D spending. However, there may be restrictions on the scaling back of R&D spending. First, R&D projects are carried out on a long-run basis. Second, competition within industries drives the need for innovation. Under the SUI, if a firm invested $100 in R&D it could receive a tax credit of $35; under the SII, it could receive a credit of only $15, increasing the net R&D investment cost from $65 to $85, a net RD investment increase of $20.[4] Thus, *ceteris paribus*, we expect the increase in the marginal investment cost of R&D to reduce the optimal R&D expenditure level. A reduction in firm R&D after SII would suggest that the negative effect arising from cutting the R&D incentive exceeds the cost of scaling down a firm's R&D investment, and therefore that the firm reduces its R&D spending. Thus, we state our first hypothesis as follows.

H1: *Ceteris paribus*, corporate R&D expenditure decreases after implementation of the Statute for Industrial Innovation.

[2] Under OBRA89, the base amount is a fixed function of the firm's historical R&D intensity, and the increased R&D intensity in the current period determines the credit amount. Under the ASC, the base amount is a rolling average of the firm's prior three years of R&D expenditure, irrespective of sales, where R&D expenditure in the current year relative to the prior three years determines the credit amount. The statutory rates are 20% under OBRA and 14% under ASC.

[3] They, however, did not examine the overall effect of the SII on the structural change in firms' R&D expenditures.

[4] Still, there is a $15 difference in net R&D costs under the SUI and the SII, given the effective credit rate of 30% in 2008 under the SUI.

2.3. The economic consequences of cutting R&D tax incentives

R&D is a major source of competitive advantage for most companies. Although a high level of R&D intensity does not guarantee the generation of successful innovation and enhanced firm performance, companies that invest heavily in R&D are more likely trying to compete on the basis of innovativeness (O'Brien, 2003; Lin et al., 2006). Czarnitzki et al. (2011) investigate the impact of R&D tax credits on the innovation activities of Canadian manufacturing firms, and conclude that tax credits lead to additional innovation. Capon et al. (1990) find a positive association between research and development expenditure and performance. Research also finds that the frequency of patent citations and R&D spillovers are positively and significantly related to firm value (Chin et al., 2006).

As prior studies suggest a positive relation between R&D and firm value, we expect this positive relation to be weakened by the SII cut in R&D tax incentives due to the resulting structural change in R&D costs. Before implementation of the SII, the SUI provided substantial R&D tax incentives to subsidize firm R&D expenditure, effectively reducing after-tax R&D costs. The R&D tax incentives of the SUI included (1) a statutory base credit rate of 35% for all qualifying R&D expenditure, and (2) an additional credit rate of 15% for a firm's current-year R&D spending over its prior two-year R&D average expenditure.[5] The SII, however, reduced the R&D credit rate to a flat rate of 15% without any incremental credit. This reduction in R&D tax incentives might have resulted in an upward structural shift in after-tax R&D costs for firms, as the reduced base credit rate proportionately increased after-tax R&D costs and the elimination of incremental credit further increased after-tax R&D costs for firms with greater R&D expenditure, potentially reducing the value of innovative R&D output. Hence, we expect the reduction in the R&D credit rate by the SII to adversely affect the relation between corporate R&D expenditure and firm value. Therefore, we propose our second hypothesis as follows.

H2: *Ceteris paribus*, the implementation of the Statute for Industrial Innovation has a negative effect on the relation between corporate R&D expenditure and firm value.

3. Data and research design

3.1. Data and sample selection

Our sample companies consist of the non-financial companies listed on the Taiwan Stock Exchange (TSE) and Over-the-Counter Market (OTC). We exclude biologics firms from our test sample because they are not affected by the implementation of the SII.[6] We use biologics firms as a contrast sample for additional analysis. Prior research finds that high-tech firms are more likely to qualify for the R&D tax credit than non-high-tech firms (Gupta et al., 2011). We thus separately conduct the test on a subsample of high-tech firms, including those in the semiconductor, computer and peripheral equipment, optoelectronic, and communications and Internet industries.

Our sample period consists of the four years before implementation of the SII (2006–2009) and five years afterwards (2010–2014). For the initial sample, we exclude firm-years with missing data on variables included in the regression model. The final sample consists of 10,523 firm-year observations. Table 1 reports the industry distribution of the sample firms: electronics firms (industry codes 24–31) account for about 54.78% of the sample, reflecting the importance of Taiwanese electronics industry in the global electronics supply chain, and high-tech firms (industry codes 24–27) account for about 29.6% of the sample.

[5] Under the SUI, the R&D credit rate increased to 50% from the statutory base credit rate of 35% for the excess of a firm's current-year R&D spending over its previous two-year R&D average expenditure.

[6] Biologics companies continued to enjoy the R&D tax incentives as before through the Act for the Development of Biotech and New Pharmaceuticals Industry.

Table 1
Industry distribution.

Industry name	TSE industry code[a]	Sample observations	Percentage of observations
Cement	01	61	0.58%
Food	02	209	1.99%
Plastic	03	242	2.30%
Textile & Fiber	04	473	4.49%
Electrical Engineering & Machinery	05	551	5.24%
Appliance & Cable	06	128	1.22%
Glass & Ceramics	08	37	0.35%
Papermaking	09	62	0.59%
Steel & Iron	10	330	3.14%
Rubber	11	98	0.93%
Auto	12	45	0.43%
Construction	14	564	5.36%
Sea Transport	15	182	1.73%
Tourism	16	106	1.01%
Wholesale & Retailing	18	169	1.61%
Other	20	553	5.26%
Chemical	21	314	2.98%
Biotechnology & Medical Care	22	412	3.92%
Oil, Gas & Electricity	23	104	0.99%
Semiconductor	24	916	8.70%
Computer & Peripheral Equipment	25	841	7.99%
Optoelectronic	26	805	7.65%
Communications & Internet	27	554	5.26%
Electronic Components	28	1501	14.26%
Electronic Products Distribution	29	331	3.15%
Information Service	30	268	2.55%
Electronic-Other	31	549	5.22%
Cultural and Creative Industry	32	118	1.12%
Total		**10,523**	**100%**

[a] We define industries according to the TSE industry codes.

3.2. Econometric methods

To test our two hypotheses, we construct the following two regression models.

3.2.1. Empirical model of H1

Following prior studies (Gupta et al., 2011; Finley et al., 2015), we construct regression model (1) to test H1 as follows:

$$RDI_{it} = \alpha_0 + \alpha_1 DYEAR_t + \alpha_2 TobinQ_{it} + \alpha_3 CFShort_{it} + \alpha_4 mRDI_{jt} + \alpha_5 LagRDI_{it} + \alpha_6 ETR_{it} + \alpha_7 SIZE_{it} + \alpha_8 ROA_{it} + \alpha_9 DEBT_{it} + \alpha_{10} FIRMAGE_{it} + \alpha_{11} GDP_t + \sum_j Industry\ effects + \varepsilon_{it} \quad (1)$$

where
subscript: i = firm index, j = industry index, and t = year index;

RDI = R&D expenditure ÷ net sales;
DYEAR = a dummy variable equal to 1 if the firm-observation is in the period 2010–2014, and 0 otherwise;
TobinQ = Tobin's Q, measured as (market value of common shares outstanding + book value of preferred stock + long-term debt + short-term debt) ÷ total assets;

CFShort	=	cash flow constraints before R&D expenditure, measured as (dividends + cash flow from investing – cash flow from operations – R&D expenses) ÷ beginning-of-year total assets;
mRDI	=	the average *RDI* of the industry, measured as the mean *RDI* of all firms in firm i's industry;
LagRDI	=	the one-year lagged *RDI*;
ETR	=	effective tax rate before R&D, measured as (current expenses + R&D expenses × statutory corporate income tax rate) ÷ (pre-tax income + R&D expenses);
SIZE	=	the natural logarithm of total assets;
ROA	=	net income before R&D expenses ÷ total assets;
DEBT	=	total liabilities ÷ total assets;
FIRMAGE	=	the natural logarithm of firm age in years;
GDP	=	gross domestic product;
Industry effects	=	the industry dummies;
ε	=	residual term.

3.2.1.1. Dependent variable. The dependent variable *RDI* is R&D intensity defined as R&D expenditure divided by net sales. Following prior research (Berger, 1993; Gupta et al., 2011), we scale *RDI* by net sales to provide a comparable basis.

3.2.1.2. Independent variable. Our test variable *DYEAR* is equal to 1 for the years after enactment of the SII (i.e., 2010–2014), and 0 otherwise. As H1 hypothesizes that firm R&D expenditure decreased after the implementation of the SII, we expect the coefficient on *DYEAR*, $\alpha 1$, to be negative. As the SII essentially abolished all tax incentives but for the R&D tax credit and reduced the credit rate to a flat 15%, there may be a concern that the coefficient of *DYEAR* captures the SII effect rather than R&D credit change alone. We address this concern as follows. First, the SII also abolishes other investment tax credits, such as for investment in automatic-production and for pollution-prevention capital assets. However, there may be no direct correlation between firm R&D expenditure and capital asset investment, as firms usually determine their R&D and capital asset budgets as separate projects.[7] To the extent that R&D expenditure is not directly correlated with capital asset expenditure, the coefficient on *DYEAR* in the R&D regression model may not be severely confounded by the effect of capital asset investment. Second, under the SUI, the effective base credit rate for R&D investment was 30% in 2008 while the effective credit rate for capital asset investment was only a flat 5%. The effect of abolishing capital asset investment credit is thus likely to be much smaller than the reduction in the R&D credit rate under the SII.

3.2.1.3. Control variables. Control variables in our model generally follow prior studies for the determinants of *RDI* (Gupta et al., 2011; Chen, 2014; Finley et al., 2015). *TobinQ*, defined as the market value of equity plus the book value of debt divided by the book value of total assets, captures growth opportunities. Companies with greater growth opportunities may have more innovation projects and undertake more R&D spending. Swenson (1992) finds that the positive impact of R&D credit exists only for firms with high growth opportunities. Berger (1993) documents that companies with greater market-to-book ratios have higher R&D expenditure. Thus, the predicted coefficient on *TobinQ* ($\alpha 2$) is positive. *CFShort* is the measure of the cash flow constraint before R&D spending. Myers and Majluf (1984) propose a financing hierarchy suggesting that because of information asymmetry, companies prefer to finance R&D with funds generated internally rather than externally. Firms with higher financial constraints have fewer internally generated funds to invest in R&D spending. Thus, the predicted coefficient on *CFShort* ($\alpha 3$) is negative. We measure the availability of internal funds by including an estimate of a firm's cash flow shortfall before R&D spending, following Brown and Krull (2008). *CFShort* is used to test whether firms have enough cash flow from operations before

[7] For our sample, we find that the correlation coefficient between R&D expenditure and changes in fixed assets, both scaled by total assets, is only 0.02543, suggesting that firm R&D expenditure and capital asset investment are not strongly correlated.

R&D to pay for investments and dividends. R&D spending is an autoregressive process instead of a random walk process (Klassen et al., 2004); therefore, we include lagged R&D intensity (*LagRDI*). We also include *mRDI* to capture industry-specific factors that drive R&D expenditure. The effective tax rate before R&D spending (*ETR*) is used to control for the tax rate effect on the cost of R&D spending. *ETR* is defined as the sum of current tax expenses and R&D expenses multiplied by the corporate tax rate and divided by the sum of pre-tax income and R&D expenses. Firms with a higher *ETR* are likely to have higher R&D expenditure because of the reduced after-tax cost of R&D investment. Thus, we expect the coefficient on *ETR* to be positive. *SIZE*, defined as the natural logarithm of total assets, is used to control for the scale effect on R&D expenditure. Following prior studies, we have no predicted sign for *SIZE* (Gupta et al., 2011; Finley et al., 2015). *ROA* is defined as net income before R&D divided by total assets. As prior studies argue that unprofitable companies are more likely to experiment with innovative activity (Hitt et al., 1991), whereas another study argues that less profitable firms may reduce their R&D spending (Daellenbace et al., 1999), we make no prediction for firm *ROA*. *DEBT*, defined as debt to total assets, is a proxy for firm financial leverage. Companies with higher debt ratios may face higher costs of financial distress and thus limit risky expenditure such as R&D spending (Chen and Hsu, 2009). Thus, we expect the coefficient on *DEBT* to have a negative sign. *FIRMAGE* is defined as the number of years a company has been established. As prior research suggests that older companies have less incentive to invest in innovation (Lin et al., 2011), we expect the coefficient on *FIRMAGE* to be significantly negative. Finally, we incorporate gross domestic product, *GDP*, to control for changes in macroeconomic conditions that may influence the results of our analysis. We winsorize the dependent variable, *RDI*, and each of the continuous variables except for *ETR*[8] and *GDP*, at 1% and 99% to prevent outliers from unduly influencing the results. We also control for industry fixed effects in model (1).

3.2.2. Empirical model for H2

To test our H2, we construct regression model (2) to analyze the effect of SII implementation on firm value as follows:

$$TobinQ_{it} = \gamma_0 + \gamma_1 DYEAR_t + \gamma_2 RDI_{it} + \gamma_3 DYEAR_t \times RDI_{it} + \gamma_4 SIZE_{it} + \gamma_5 FIRMAGE_{it} + \gamma_6 DEBT_{it} + \gamma_7 PPE_{it} + \gamma_8 HHI_{ij} + \sum_j Industry\ effects + \varepsilon_{it} \quad (2)$$

where
subscript i = firm index, j = industry index, t = year index;

TobinQ	=	Tobin's Q, measured as (market value of common shares outstanding + book value of preferred stock + long-term debt + short-term debt) ÷ total assets;
DYEAR	=	a dummy variable that equals 1 if the firm observation is in the period 2010–2014, and 0 otherwise;
RDI	=	R&D expenditure ÷ net sales;
SIZE	=	the natural logarithm of total assets;
FIRMAGE	=	the natural logarithm of firm age in years;
DEBT	=	total liabilities ÷ total assets;
PPE	=	gross property, plant and equipment ÷ total assets;
HHI	=	the Herfindahl–Hirschman Index, computed as the sum of squared market share based on firm sales at the TSE industry code level;
Industry effects	=	industry dummies;
ε	=	residual term.

[8] Following McGuire et al. (2012), we winsorize *ETR* to the range between 0 and 1.

3.2.2.1. Dependent variable. As a proxy for firm value, we use Tobin's Q (*TobinQ*), measured as the sum of the market value of common shares outstanding, book value of preferred stock and long- and short-term debt divided by total assets, as used extensively in prior research (e.g., Shane and Klock, 1997; Bharadwaj et al., 1999; Chin et al., 2006).

3.2.2.2. Independent variables. We include *RDI* and $DYEAR \times RDI$ in Eq. (2). As we expect the reduction in R&D credit rate by the SII to have an adverse effect on the relation between corporate R&D expenditure and firm value, the predicted coefficient on $DYEAR \times RDI$ (γ_3) is negative.

3.2.2.3. Control variables. The control variables in our model generally follow prior studies of the determinants of firm value (Chin et al., 2006; Bharadwaj et al., 1999; Renders and Gaeremynck, 2012). We control for firm and industry characteristics in prior research that are correlated with firm value. We include firm size (*SIZE*), firm age (*FIRMAGE*) and leverage (*DEBT*). We also include capital intensity (*PPE*) and industry concentration (*HHI*). *PPE* is defined as the ratio of gross property, plant and equipment to total assets. As Renders and Gaeremynck (2012) find that the relationship between capital intensity and firm value is negative, we expect *PPE* to be negatively associated with *TobinQ*. The Herfindahl–Hirschman Index (*HHI*) is a measure of industry concentration, defined as the sum of squared market share based on firm sales in the TSE industry code level. Prior research suggests that industry concentration provides market power, which positively influences firm value (Domowitz et al., 1986). Therefore, we expect *HHI* to be positively associated with *TobinQ*. We winsorize the dependent variable, *TobinQ*, and each of the continuous variables at 1% and 99% to prevent outliers from unduly influencing the results. We also include dummies to control for industry fixed effects.

4. Results

4.1. Descriptive statistics and univariate analysis

Table 2 profiles the descriptive statistics of our sample firms for the selected variables. The means of *RDI* and *TobinQ* are about 0.034 and 1.247 for all firms and 0.066 and 1.407 for high-tech firms, respectively, indicating that high-tech firms have greater R&D expenditure and a higher market premium. Table 3 reports the Pearson and Spearman correlations between the selected variables included in the regression models. The correlations across the control variables are generally in line with economic intuition and with those found in prior studies. The correlation matrix, however, indicates a positive univariate relation between the dependent variables and our test variables, inconsistent with our prediction. As the univariate relations do not control for the effects of other factors, we conduct further multivariate regression tests.

4.2. Multivariate regression results

4.2.1. Test of the SII's effect on firm R&D intensity

Table 4 presents the regression results of model (1) separated into all firms and high-tech firms. The results for all firms show that the coefficient on *DYEAR* is negative and significant at the 1% level, supporting H1 that after implementation of the SII, Taiwanese companies reduced their R&D spending in response to the reduced R&D credit rate. The coefficients on *CFShort* and *Debt* are significantly negative, suggesting that firms with greater financial constraints and leverage tended to invest less in R&D spending, consistent with our prediction that firms tend to rely on internal funding for R&D spending because of the information asymmetry for R&D investment projects. The coefficients on *ETR* are significantly positive, consistent with the notion that firms with higher tax rates are more likely to invest in R&D to utilize greater R&D tax shields.

The results for high-tech firms show that the coefficient on *DYEAR* is also negative and significant at the 1% level, supporting H1. The magnitude of the coefficient on *DYEAR* for high-tech firms (−0.0139) is much larger than for all firms (−0.0055), suggesting that the adverse effect is more salient for high-tech firms, consistent with our conjecture. The coefficients on the control variables for high-tech firms are, in general, similar to those for all firms, consistent with our expectations. Overall, the results in Table 4 lend support to H1 that companies reduced their R&D expenditure after implementation of the SII.

Table 2
Descriptive statistics.

Variable	All firms N = 10,111			High-tech firms N = 3116		
	Mean	Std.	Median	Mean	Std.	Median
RDI	0.034	0.061	0.013	0.066	0.084	0.037
ΔRDI	0.001	0.016	0.000	0.003	0.029	0.000
TobinQ	1.247	0.874	0.998	1.407	0.961	1.122
CFShort	−0.006	0.126	−0.012	−0.031	0.128	−0.037
mRDI	0.036	0.035	0.024	0.069	0.033	0.058
LagRDI	0.033	0.057	0.013	0.063	0.078	0.036
ETR	0.133	0.157	0.114	0.140	0.160	0.123
SIZE	15.211	1.339	15.022	15.281	1.506	15.009
ROA	0.066	0.108	0.064	0.078	0.135	0.084
DEBT	0.360	0.171	0.347	0.329	0.167	0.311
FIRMAGE	3.176	0.495	3.219	2.869	0.471	2.890
HHI	0.003	0.013	0.000	0.001	0.007	0.000
GDP	16.444	0.074	16.445	16.447	0.074	16.445
RETURN	0.1270	0.557	0.001	0.107	0.616	−0.043
BE/ME	−0.147	0.710	−0.068	−0.309	0.706	−0.250
ME	14.897	1.408	14.724	15.144	1.525	14.959
PPE	0.199	0.174	0.150	0.186	0.169	0.131

Notes: We define the variables as follows: *RDI* is R&D expenditure scaled by net sales; *ΔRDI* is the change in the *RDI*; *TobinQ* is measured as (stock price × common shares outstanding + book value of preferred stock + long-term debt + short-term debt) ÷ book value of total assets; *CFShort* is cash flow constraints before R&D expenditure, measured as (dividends + cash flow from investing – cash flow from operations – R&D expenses) ÷ beginning of-year total assets; *mRDI* is the average *RDI* of the industry measured as the mean *RDI* of all firms in firm i's industry; *LagRDI* is the one-year lagged R&D intensity; *ETR* is the effective tax rate before R&D, measured as (current expenses + R&D expenses × statutory corporate income tax rate) ÷ (pre-tax income + R&D expenses); *SIZE* is the natural logarithm of total assets; *ROA* is net income before R&D expenses scaled by total assets; *DEBT* is total debt scaled by total assets; *FIRMAGE* is the natural logarithm of firm age in years; *HHI* is the Herfindahl–Hirschman index; *GDP* is the log of year t real gross domestic product; *PPE* is the ratio of gross property, plant and equipment to total assets; *RETURN* is the firm's market adjusted stock return from December of year t − 1 to December of year t; *BE/ME* is the natural log of the ratio of book equity to market equity for the fiscal year ending in year t − 1; *ME* is the natural log of the market capitalization at the end of year t.

4.2.2. The economic consequence of cutting R&D tax incentives: Firm value

Table 5 shows the regression results for model (2), with all firms and high-tech firms in columns 1 and 2, respectively. The results for all firms show that the coefficient on *RDI* is significantly positive, consistent with the notion that firms with a higher value tend to invest more in R&D. However, the coefficient on $DYEAR \times RDI$ is negative and significant (−2.1945, t = −4.37), lending support to H2, that implementation of the SII negatively impacted the relation between corporate R&D spending and firm value. The result for high-tech firms is also negative and significant at the 1% level, supporting H2. The signs of the coefficients of the control variables in Table 5 are, in general, consistent with our predictions. Overall, the results in Table 5 indicate that the reduced R&D credit rate had a negative impact on the relation between corporate R&D expenditure and firm value.

5. Sensitivity analyses

5.1. Balanced sample

A potential concern with our findings is that the sample composition in the pre- and post-SII periods might have changed. To address this concern, we form a balanced panel including only those firms present in our sample for the entire 9-year period. The results remain consistent with those in Tables 4 and 5.

Table 3
Correlation table (N = 10,111).

	RDI	*DYEAR*	*TobinQ*	*CFShort*	*mRDI*	*LagRDI*	*ETR*	*SIZE*	*ROA*	*DEBT*	*FIRMAGE*	*GDP*
Panel A: Model (1)												
RDI	1.000	0.041***	0.221***	−0.224***	0.543***	0.929***	0.136***	−0.206***	0.142***	−0.253***	−0.288***	0.044***
DYEAR	0.041***	1.000	0.013	0.080***	0.072***	0.057***	−0.077***	0.028***	0.001	−0.040***	0.112***	0.898***
TobinQ	0.221***	0.013	1.000	−0.012	0.187***	0.238***	−0.053***	−0.152***	0.015	0.034***	−0.204***	−0.029***
CFShort	−0.224***	0.080***	−0.012	1.000	−0.189***	−0.221***	−0.073***	0.063***	−0.229***	0.198***	0.056***	0.058***
mRDI	0.543***	0.072***	0.187***	−0.189***	1.000	0.536***	0.082***	−0.098***	0.151***	−0.203***	−0.403***	0.079***
LagRDI	0.929***	0.057***	0.238***	−0.221***	0.536***	1.000	0.130***	−0.212***	0.169***	−0.241***	−0.294***	0.049***
ETR	0.136***	−0.077***	−0.053***	−0.073***	0.082***	0.130***	1.000	−0.060***	0.169***	−0.101***	−0.068***	−0.067***
SIZE	−0.206***	0.028***	−0.152***	0.063***	−0.098***	−0.212***	−0.060***	1.000	0.136***	0.144***	0.206***	0.025**
ROA	0.142***	0.001	0.015	−0.229***	0.151***	0.169***	0.169***	0.136***	1.000	−0.307***	−0.122***	−0.026***
DEBT	−0.253***	−0.040***	0.034***	0.198***	−0.203***	−0.241***	−0.101***	0.144***	−0.307***	1.000	0.053***	−0.041***
FIRMAGE	−0.288***	0.112***	−0.204***	0.056***	−0.403***	−0.294***	−0.068***	0.206***	−0.122***	0.053***	1.000	0.104***
GDP	0.044***	0.898***	−0.029***	0.058***	0.079***	0.049***	−0.067***	0.025**	−0.026***	−0.041***	0.104***	1.000

	TobinQ	*DYEAR*	*RDI*	*DYEAR×RDI*	*SIZE*	*DEBT*	*PPE*	*FIRMAGE*	*HHI*
Panel B: Model (2)									
TobinQ	1.000	0.013***	0.221***	0.131***	−0.152***	0.034***	−0.039***	−0.204***	0.030***
DYEAR	0.013	1.000	0.041***	0.343***	0.028***	−0.040***	−0.059***	0.112***	−0.017*
RDI	0.221***	0.041***	1.000	0.776***	−0.206***	−0.253***	−0.077***	−0.288***	−0.078***
DYEAR×RDI	0.131***	0.343***	0.776***	1.000	−0.139***	−0.187***	−0.063***	−0.159***	−0.059***
SIZE	−0.152***	0.028***	−0.206***	−0.139***	1.000	0.144***	0.029***	0.206***	0.432***
DEBT	0.034***	−0.040***	−0.253***	−0.187***	0.144***	1.000	0.072***	0.053***	0.043***
PPE	−0.039***	−0.059***	−0.077***	−0.063***	0.029***	0.072***	1.000	0.088***	0.059***
FIRMAGE	−0.204***	0.112***	−0.288***	−0.159***	0.206***	0.053***	0.088***	1.000	0.121***
HHI	0.030***	−0.017*	−0.078***	−0.059***	0.432***	0.043***	0.059***	0.121***	1.000

*, ** and *** stand for significance at the 10%, 5% and 1% levels, respectively.

Table 4
Test of the SII effect on R&D expenditure.
$RDI_{it} = \alpha_0 + \alpha_1 DYEAR_t + \alpha_2 TobinQ_{it} + \alpha_3 CFShort_{it} + \alpha_4 mRDI_{jt} + \alpha_5 LagRDI_{it} + \alpha_6 ETR_{it} + \alpha_7 SIZE_{it} + \alpha_8 ROA_{it} + \alpha_9 DEBT_{it} + \alpha_{10} FIRMAGE_{it} + \alpha_{11} GDP_t + \Sigma_j Industry\ effects + \varepsilon_{it}$ (1)

	All Firms	High-Tech Firms
Constant	−0.4427*** (−3.79)	−0.7648** (−2.53)
DYEAR	−0.0055*** (−4.89)	−0.0139*** (−4.65)
TobinQ	0.0003 (0.58)	0.0012 (0.90)
CFShort	−0.0070** (−2.21)	−0.0112 (−1.39)
mRDI	0.2384*** (5.74)	0.3692*** (4.56)
LagRDI	0.9407*** (64.46)	0.9294*** (37.31)
ETR	0.0060*** (3.26)	0.0174*** (2.66)
SIZE	0.0001 (0.58)	−0.0002 (−0.48)
ROA	−0.0186*** (−4.44)	−0.0435*** (−3.94)
DEBT	−0.0131*** (−6.89)	−0.0305*** (−5.82)
FIRMAGE	−0.0006 (−1.36)	−0.0021** (1.98)
GDP	0.0265*** (3.70)	0.0472** (2.55)
N	10,111	3116
Industry effects	YES	YES
Adjusted R^2	0.8687	0.8321

This table presents the regression results of the SII effect on R&D expenditure. The *t*-statistics in parentheses are based on robust standard errors clustered at the firm level.
*, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.
See Table 2 for variable definitions.

Table 5
Test of the SII effect on the relation between corporate R&D expenditure and firm value.
$TobinQ_{it} = \gamma_0 + \gamma_1 DYEAR_t + \gamma_2 RDI_{it} + \gamma_3 DYEAR_t \times nRDI_{it} + \gamma_4 SIZE_{it} + \gamma_5 FIRMAGE_{it} + \gamma_6 DEBT_{it} + \gamma_7 PPE_{it} + \gamma_8 HHI_{ij} + \Sigma_j Industry\ effects + \varepsilon_{it}$ (2)

	All firms	High-tech firms
Constant	3.6661*** (9.85)	2.8265*** (4.93)
DYEAR	0.1191*** (5.20)	−0.1019* (−1.87)
RDI	3.4606*** (5.92)	3.4848*** (4.32)
DYEAR×RDI	−2.1945*** (−4.37)	−1.9678*** (−2.74)
SIZE	−0.1081*** (−4.93)	−0.0923** (−2.58)
FIRMAGE	−0.2071*** (−5.66)	−0.1604*** (−3.09)
DEBT	0.6614*** (5.04)	0.8749*** (3.33)
PPE	−0.3206*** (−3.10)	−0.2335 (−1.09)
HHI	7.9331*** (5.20)	11.8990** (1.98)
N	10,111	3116
Industry effects	YES	YES
Adjusted R^2	0.1376	0.1241

This table presents the regression results of the SII effect on the relation between corporate R&D expenditure and firm value. The *t*-statistics in parentheses are based on robust standard errors clustered at the firm level.
*, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.
See Table 2 for variable definitions.

5.2. Biologics firm sample

Biologics companies continued to enjoy the R&D tax incentives provided by the Act for the Development of Biotech and New Pharmaceuticals Industry, and were thus not affected by the reduced R&D credit rate under the SII, as the Act provides the same tax credit benefit as the SUI. We therefore use biologics firms as a contrast sample to conduct the sensitivity analysis.

Panels A and B of Table 6 present the regression results for models (1) and (2), respectively, using the biologics sample. In panel A of Table 6 the coefficient on $DYEAR$ is negative but insignificant (0.1423, $t = -0.68$), and in panel B the coefficient on $DYEAR \times RDI$ is positive and insignificant (0.0403, $t = 0.15$). The results suggest that biologics companies, as a contrast sample, do not exhibit the adverse effects on R&D spending and firm value as do other firms after implementation of the SII.

5.3. The economic consequence of cutting R&D tax incentives: Stock returns

In addition to *TobinQ*, we use the market-adjusted stock returns as an alternative proxy for testing the effect of cutting R&D spending on firm value. Prior studies find that R&D intensity is positively associated with corporate stock returns (Chan et al., 2001; Eberhart et al., 2004). R&D activity represents an important corporate resource for enhancing firm value. We use the market-adjusted stock returns as the dependent variable and construct model (3) as follows:

$$RETURN_{it} = \beta_0 + \beta_1 DYEAR_t + \beta_2 RDI_{it} + \beta_3 DYEAR_t \times RDI_{it} + \beta_4 BE/ME_{i,t-1} + \beta_5 ME_{it} + \beta_6 ROA_{it} + \beta_7 DEB_{it} + \beta_8 SIZE_{it} + \sum_j Industry\ effects + \varepsilon_{it} \quad (3)$$

Our test variable is DYEAR×RDI in model (3). As we expect the reduction in the R&D credit rate under the SII to negatively affect the relation between corporate R&D expenditure and stock returns, the predicted coefficient on DYEAR×RDI (β_3) is negative. Following Li (2011), we also include BE/ME, ME and ROA in model (3). BE/ME is the natural log of the ratio of book equity to market equity for the fiscal year ending in year t − 1. ME is the natural log of the market capitalization at the end of year t. ROA is defined as net income before R&D divided by total assets.

Table 6
Results of biologics sample.

	Biologics firms
Panel A: Test of the SII effect on R&D expenditure (model 1)	
Constant	−16.9464 (−1.05)
DYEAR	−0.1423 (−0.68)
TobinQ	0.0233 (0.57)
CFShort	0.1616 (0.74)
mRDI	0.2009 (1.38)
LagRDI	0.9694*** (10.32)
ETR	0.6394* (0.09)
SIZE	0.0715** (2.03)
ROA	−0.3727 (−1.07)
DEBT	−0.5823** (−2.57)
FIRMAGE	−0.0208 (−0.63)
GDP	0.9755 (0.99)
N	412
Adjusted R^2	0.7543
	Biologics firms
Panel B: Test of the SII effect on the relation between corporate R&D expenditure and firm value (model 2)	
Constant	4.7419* (1.95)
DYEAR	0.5176*** (3.66)
RDI	0.4081*** (2.90)
DYEAR×RDI	0.0403 (0.15)
SIZE	−0.1375 (−0.82)
FIRMAGE	−0.2711 (−1.59)
DEBT	−1.4182 (−1.41)
PPE	−0.1946 (−0.25)
HHI	13.4291 (0.30)
N	412
Adjusted R^2	0.2294

*, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.
See Table 2 for variable definitions.

Table 7 presents the results of model (3) separately for all firms and biologics firms. The results show that the coefficient on $DYEAR \times RDI$ for all firms is negative and significant (−0.2851, $t = -1.65$); however, the coefficient on $DYEAR \times RDI$ for biologics firms is negative but significant (−0.0445, $t = -0.830$). The results suggest that implementation of the SII negatively impacted the relation between corporate R&D spending and stock returns. However, biologics firms continued to enjoy the special tax incentive, and hence did not exhibit this adverse effect.

5.4. Test of the SII effect on firm innovation output

R&D is uncertain and consumes both money and time. However, R&D investment is essential for firms where innovation is pivotal. Because of the externality benefit of R&D investment, many countries provide R&D tax credits to stimulate R&D expenditure in the private sector. However, many countries grant tax credits only for *qualified* R&D expenditure that can lead to innovative output, and the expenditure must be reviewed by the tax authorities to qualify for the credit. Hence, R&D tax credits may, to some extent, reflect a firm's qualified innovative investment in R&D. Czarnitzki et al. (2011) conclude that tax credits lead to additional innovation output. Cappelen et al. (2012) also find that projects receiving tax credits result in the development of new production processes and to some extent new company products. These results imply that R&D tax credits may be positively related to firm innovation activity. We thus use the tax credit value as a

Table 7
Test of the SII effect on the relation between corporate R&D expenditure and stock returns.
$RETURN_{it} = \beta_0 + \beta_1 DYEAR_t + \beta_2 RDI_{it} + \beta_3 DYEAR_t \times RDI_{it} + \beta_4 BE/ME_{i,t-1} + \beta_5 ME_{it} + \beta_6 ROA_{it} + \beta_7 DEB_{it} + \beta_8 SIZE_{it} + \Sigma_j Industry\ effects + \varepsilon_{it}$ (3)

	All Firms	Biologics firms
Constant	0.3230*** (4.49)	0.3756 (1.39)
DYEAR	−0.0599*** (−5.83)	0.0197 (0.46)
RDI	−0.1672 (−1.00)	0.0659 (1.12)
DYEAR×RDI	−0.2851* (−1.65)	−0.0445 (−0.83)
BE/ME	0.6150*** (37.15)	0.6185*** (11.73)
ME	0.6205*** (36.70)	0.6140*** (10.61)
ROA	1.0447*** (18.22)	0.9910*** (4.24)
DEBT	1.2446*** (29.17)	1.0470*** (6.09)
SIZE	−0.6455*** (−38.15)	−0.6467*** (−10.42)
N	10,111	412
Industry effects	YES	NO
Adjusted R^2	0.4370	0.3963

This table presents the regression results of the SII effect on the relation between corporate R&D expenditure and stock returns. The *t*-statistics in parentheses are based on robust standard errors clustered at the firm level.
*, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.
See Table 2 for variable definitions.

proxy for innovation output. We hand-collect tax credit data from the income tax footnotes in financial statements, and define a firm with greater innovation output as one that qualifies for a tax credit. We then construct model (4) to test the impact of the SII on firm innovation output as follows:

$$CREDIT_{it} = \beta_0 + \beta_1 DYEAR_t + \beta_2 RDI_{it} + \beta_3 DYEAR_t \times RDI_{it} + \beta_4 SIZE_{it} + \beta_5 ROA_{it} + \beta_6 PPE_{it} + \beta_7 FIRMAGE_{it} + \beta_8 GDP_{it} + \sum_j Industry\ effects + \varepsilon_{it} \quad (4)$$

where CREDIT = 1 for firms with non-zero credit values. Other variables are defined as previously.

Consistent with our expectation, the untabulated results show that the coefficient on *DYEAR* is negative and significant at the 1% level, suggesting that implementation of the SII had a negative effect on firm innovation output.

5.5. The effect on government revenue

To examine the effect of the SII on government revenue, we provide the following two statistics: (1) the value of firm tax credits for the SUI and SII periods and (2) the amount of government tax revenue lost due to the SUI and SII.

We hand-collect the actual R&D tax credit value from the income tax footnotes in firm financial statements during our sample period. Panel A of Table 8 indicates that the mean R&D credit value for each firm-year observation for the SUI and SII periods is about NT$6,736,000 and NT$1,280,000, respectively. The statistically significant difference in the means of the credit value between the two periods (*t*-statistic = 8.36, *p*-value = 0.01) suggests that the actual R&D tax credits obtained by our sample firms were much lower in the SII period than in the SUI period.

Panel B of Table 8 outlines the yearly tax revenue loss from the SUI and SII based on the income statistics of Taiwan's Ministry of Finance. The statistics show a gradual increase in annual tax revenue loss during the SUI period from 2006 to 2009 from about NT$119.46 billion to NT$196.68 billion. In contrast, the SII period from 2010 to 2014 shows a gradual decrease from about NT$192.56 billion to NT$89.28 billion. Taken

Table 8
The SII effect on firm R&D credit and government tax revenue loss.

	SUI Period	SII period	*t*-test
Panel A: Firm R&D credit in the SUI and SII periods (in NT$ thousands)			
Mean R&D credit value	67,364	12,803	8.36***
	SUI period	SII period	
Panel B: Annual tax revenue loss from the SUI and SII (in NT$ thousands)			
		2010	192,556,095
2006	119,462,825	2011	160,659,273
2007	180,501,472	2012	114,537,979
2008	151,261,020	2013	100,815,504
2009	196,681,848	2014	89,282,026

*, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

together, the results show a significant reduction after implementation of the SII in both firm R&D credits and government tax revenue loss.

5.6. Control of firm-fixed effects and difference-in-differences test

Models (1) and (2) use panel data estimation to control for unobserved industry-fixed effects because while inter-industry differences in market structure, demand conditions and technological opportunity have critical effects on firm investment in R&D innovation, unobservable firm-specific characteristics such as corporate vision and strategy may also be important influences. Therefore, we conduct the following robustness tests.

5.6.1. Controlling for firm-fixed and year effects

We use the whole sample for the regression tests, including the biotechnology companies, a total of 10,523 firm-year observations.[9] Panels A and B of Table 9 present the results of the regression models for H1 and H2. The coefficients on $DYEAR$ and $DYEAR\times RDI$ remain negative and significant in both panels A and B, consistent with H1 and H2 that corporate R&D expenditure decreases under the SII and that the SII negatively affects the relation between corporate R&D expenditure and firm value. The coefficients on other independent variables are qualitatively similar to the results in Tables 4 and 5.

5.6.2. A generalized difference-in-differences design

We conduct a difference-in-differences regression model (5) to analyze the different effects of the SII on firm value for biotechnology versus non-biotechnology firms. Biotechnology firms continued to enjoy a special tax incentive status and were unaffected by the SII's reduced R&D credit rate. Model (5) is stated as follows:

$$TobinQ_{it} = \alpha_0 + \alpha_1 DYEAR_t \times IND_j + \alpha_2 RDI_{it} + \alpha_3 SIZE_{it} + \alpha_4 FIRMAGE_{it} + \alpha_5 DEBT_{it} + \alpha_6 PPE_{it} + \alpha_7 HHI_{jt} + \sum_j firm\ effects + \sum_t Year\ effects + \varepsilon_{it} \quad (5)$$

where

subscripts i = firm index, j = industry index and t = year index. $DYEAR$ is a dummy variable for years after the enactment of the SII, IND is a dummy variable for non-biotechnology firms and $DYEAR\times IND$ is the interaction term of $DYEAR$ and IND. Because biotechnology firms are not affected by the enactment of the SII, we expect the coefficient on $DYEAR\times IND$, α_1, to be negative.

Panel C of Table 9 presents the results of model (5). Consistent with our expectation, the coefficient on $DYEAR\times IND$ is negative and significant (-0.2806, $t = -2.02$), suggesting that non-biotechnology firms are more adversely affected by the SII than biotechnology firms.

[9] The sample has a total of 10,523 firm-year observations.

Table 9
Robustness tests.

Panel A: Test of the SII effect on R&D expenditure—Control for firm-fixed effects and year effects	
Constant	−0.1015 (−0.79)
DYEAR	−0.0040*** (−2.83)
TobinQ	−0.0018** (−2.17)
CFShort	0.0024 (0.71)
mRDI	0.0179 (1.62)
LagRDI	0.4930*** (11.3)
ETR	0.0049** (2.21)
SIZE	−0.0049** (−2.48)
ROA	−0.0602*** (−6.87)
DEBT	−0.0165*** (−3.07)
FIRMAGE	0.0120** (2.51)
GDP	0.0095 (1.22)
N	10,523
Firm effects	YES
Year effects	YES
Adjusted R^2	0.9095

Panel B: Test of the SII effect on the relation between corporate R&D expenditure and firm value—Control for firm-fixed and year effects	
Constant	−2.2754** (−2.22)
DYEAR	−0.1038*** (−4.65)
RDI	0.4363 (0.81)
DYEAR×RDI	−1.4349*** (−3.97)
SIZE	0.3623*** (5.34)
FIRMAGE	−0.5012*** (−3.86)
DEBT	−0.3317** (−2.24)
PPE	−0.2496 (−1.28)
HHI	4.9690 (1.22)
N	10,523
Firm effects	YES
Year effects	YES
Adjusted R^2	0.6780

Panel C: Difference-in-differences (Model 5)	
Constant	0.0354 (0.07)
DYEAR×IND	−0.2806** (−2.02)
RDI	−0.5680 (−1.07)
SIZE	0.3499*** (5.08)
FIRMAGE	−1.1750*** (−6.41)
DEBT	−0.3331** (−2.23)
PPE	−0.1824 (−0.94)
HHI	5.9085 (1.38)
N	10,523
Firm effects	YES
Year effects	YES
Adjusted R^2	0.6886

This table presents the regression results of the SII effect on R&D expenditure. The *t*-statistics in parentheses are based on robust standard errors clustered at the firm level. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. See Table 2 for variable definitions.

This table presents the regression results of the SII effect on the relation between corporate R&D expenditure and firm value. The *t*-statistics in parentheses are based on robust standard errors clustered at the firm level.

This table presents the regression results of the different effects of SII on firm value for biotechnology and non-biotechnology firms. The *t*-statistics in parentheses are based on robust standard errors clustered at the firm level.

6. Conclusion

This study examines the effect of reducing the R&D tax credit rate in Taiwan on corporate R&D expenditure and the economic consequences arising from cutting the R&D tax incentive. Using Taiwanese firms listed on the TSE and OTC from 2006 to 2014, we find a significant reduction in firm R&D spending after implementation of the SII in response to the reduced R&D credit rate. Furthermore, we find an adverse impact of the increased after-tax R&D costs on the relation between corporate R&D spending and firm value. Moreover, we find reduced innovation output from companies after implementation of the SII, but not among biologics companies, which were unaffected by the reduced R&D credit rate. Finally, the income statistics show significantly reduced firm R&D credits and government tax revenue loss after implementation of the SII.

The results of this paper contribute to the tax policy debate about the pros and cons of R&D tax incentives. Developing countries or regions often use extensive tax incentives to attract foreign investment and stimulate innovation. However, concerns are often raised about the loss of tax revenue. Taiwan enacted the SII in 2010 to replace the previously abundant tax incentives, marking the first time policymakers in Taiwan greatly reduced tax incentives for firm R&D expenditure. Our paper provides evidence that the negative effect of cutting R&D incentives exceeds the cost to firms of scaling down their R&D investment. Our results have important implications for developing countries or regions evaluating the potential impact of changing their tax incentive policy.

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Are state ownership and auditors' locality determinants of asset write-downs? Evidence from China

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ABSTRACT

After issuing the *1998 Accounting Standards*, Chinese regulators implemented additional regulations in 2001 governing write-downs of impaired assets and required assessment of recoverable amounts for four additional asset categories. As the recoverable value cannot be obtained objectively, management can discretionally assess the magnitude of write-downs to affect bottom-line profit. This study used 7258 firm-year observations in China from 1998 to 2005 to examine whether the percentage of asset write-downs by state-controlled firms differs from non-state-controlled firms, conditional upon more conservative financial reporting rules, and investigate whether local auditors support managerial decisions on asset write-downs. The empirical findings support the tendency of state-controlled ownerships to have lower asset write-downs. Local auditors also support managerial decisions on asset write-downs, especially when the companies are controlled by local governments.

1. Introduction

Recent studies emphasize that accounting standards only partially influence accounting properties, and it is the preparer's incentives that determine the quality of accounting information (Ball et al., 2003; Ball and

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Shivakumar, 2005). In fact, institutional features of a country influence the ownership and governance of enterprises, which shape the preparer's incentives to report accounting information. Market forces and government involvement play important roles in determining the institutional features. In other words, the demand for financial reporting by the public and the government's participation in setting and enforcing the rules and standards affect the ownership structure of enterprises and in turn their incentives for reporting.

This study investigates whether different ownership structures of A-share listed companies in China will differ in the policy of impairment provision and have different levels of earnings management. I choose China to examine the write-down provisions because it provides a unique institutional setting. First, the Chinese government retains significant ownership and control of listed enterprises. Before the introduction of the shareholding system by the State Council in July 1992, China is a centrally planned economy and all enterprises are state-owned. Therefore, there is little demand for public financial information as the dominating shareholder is the state or its agents. Following the establishment of the Shanghai and Shenzhen stock exchanges in the early 1990s, the Ministry of Finance (MOF) is responsible for releasing accounting standards, and the China Securities Regulatory Commission (CSRC) is established to monitor and regulate the Chinese stock market. However, the government is still exercising significant control over listed companies by holding state shares and state-owned legal person shares. The dual roles played by the government as both investor and regulator provide a unique setting for this study. Second, with China's accession to the World Trade Organization (WTO), the MOF issued accounting standards in 1998, 1999 and 2001 and specified rules for asset write-downs. This is a unique opportunity to investigate whether ownership structure will affect the incentives of preparers of accounting information and in turn influence the write-down magnitude in response to the change in accounting standards. Third, the CSRC is monitoring the listing status of companies on the two exchanges according to the reported Return on Equity (ROE) levels. Companies continuing to report losses over a three-year period will be delisted. However, the CSRC also assesses the applications for raising additional capital with reference to the ROE levels. If an enterprise can maintain the required ROE levels over three consecutive years, it can apply for rights issues. Therefore, the reported profit levels of companies in China play extra roles as compared with other institutional settings.

To improve the quality of accounting information to attract more investors in local enterprises, Chinese authorities issue accounting regulations and accounting standards with reference to international standards. By introducing asset write-down regulations in 1998 and 2001, the Chinese government aims at enhancing the usefulness of the information reported on financial statements. However, the decision to write down the value of assets and the magnitude of the write-downs allow management of listed companies to exercise discretion in determining the recoverable value of relevant assets and provide a good chance for management to opportunistically manage the reported earnings. Li (2001) shows that when the policy of asset write-downs is compulsory, listed companies with loss aversion, rights issues and threshold motivations tend to increase (or, not to decrease) the current earnings. In China, there are three categories of ownership of A-shares, namely, state shares, legal person shares, and tradable shares.[1] Provincial governments are managing listed companies, whether controlled by state shares or state-owned legal person shares (China Industrial and Commercial Times, 2003) and are unwilling to have companies under their provincial supervision be delisted. If these companies suffer from continuous loss, local governments will try to adopt all administrative measures to protect their listing status (Legaldaily.com.cn., 2001). As asset write-downs will affect the reported profits and thus the listing status, the *Accounting System for Shareholding Companies* of 1998 ("*1998 Accounting Standards*") and the *Accounting System for Business Enterprises* of 2001 ("*2001 Accounting Standards*") provide opportunities

[1] State shares are held by the central government, provincial governments or wholly owned government enterprises. Legal person shares are held by domestic institutions, including securities firms and non-bank financial institutions. Most of the legal person shares are partially owned by the central or provincial governments (Jia et al., 2005). Neither state shares nor legal person shares are allowed to trade via the Shanghai and Shenzhen stock exchanges in China, and they are only transferable to domestic institutions within the same category upon the CSRC's approval (Cooper, 2003; Jiang, 2004).

to the management of listed companies to manage earnings. The objective of this study is to examine whether the companies controlled by local governments, through state shares and state-owned legal person shares, will affect the magnitude of asset write-downs.

Prior studies suggest that high-quality auditors act as one of the effective deterrents to earnings management by detecting and revealing misreporting by management (Becker et al., 1998) and that the Big Six audit clients use more conservative accounting methods (Basu et al., 2002; Chung et al., 2003). In China, the audit market is still dominated by small-scale domestic certified public accounting (CPA) firms and is not fully opened to international accounting firms. Chan et al. (2006) find that local auditors have greater economic dependence on local clients and tend to issue clean auditor opinions to companies owned by local government. Hence, I further examine whether audit firms with operations in the same provincial region as their clients will tend to follow the management decision on asset impairment to keep their listed clients.

In this study, I examine all companies listed on the Shanghai and Shenzhen stock exchanges from 1998 to 2005. From a sample of 7258 observations, I find that local government-controlled companies tend to write down fewer assets, even though more conservative financial reporting regulations are introduced. I also find that audit firms with operations in the same provincial region as their clients tend to follow management's decision on asset impairment when the clients are controlled by local governments.

The results of this study contribute to the literature in several aspects. First, this study contributes to understanding the unique characteristics of the Chinese capital market. One of the most important objectives of the management of listed firms is to maintain the required ROE level and thus to safeguard their listing status and meet the rights issue requirements. With the intention to achieve the target, companies are likely to adopt an aggressive asset write-downs policy to report the required ROE level. Second, this paper shows the impacts of ownership structures on earnings management. The Chinese government is not only the majority shareholder but also the regulator of companies listed in China. Unlike that in market-oriented economies, management of listed companies in China is not appointed by shareholders but by the central or local governments. Managers of local government-controlled companies in China are more likely to have political connections with the government (Fan et al., 2007). These managers are seldom rewarded in line with their performance as incentive-based compensation schemes are not widely launched in China. Managers do not worry about financing because the banking industry in China is not well developed, and funding is mainly provided by the government through financing from other State-Owned Enterprises (SOEs) and the raising of capital. In other words, listed companies in China are seldom monitored by financial institutions or lenders. They have fewer stakeholders than their companions in the western market. To strive for political promotion and to indicate their superior performance in the competition with managers of non-listed SOEs, managers of local government-controlled companies have strong incentives to be aggressive in reporting. Third, Chan et al. (2006) find that local auditors have greater economic dependence on local clients and tend to issue clean auditor opinions to companies owned by local governments. The present study provides further evidence that the locality of audit firms and their clients can impact the impairment decision. To build a credible independent auditing profession and to compete with international audit firms after China's accession to the WTO, Chinese regulatory bodies should evaluate the effectiveness of the policies relating to the improvement of auditor quality and independence. Fourth, Chen and Wu (2007) find that accounting standards are a necessary ingredient but are not sufficient in conservative financial reporting. The present results further show that companies controlled by local governments have fewer incentives to recognize asset impairments despite the availability of conservative rules.

The remainder of the paper is organized as follows. The next section provides an analysis of the institutional background of the study. The third section reviews previous literature and develops the hypothesis. The fourth section presents the research methodology. The fifth section discusses the empirical results. The sixth section summarizes the robustness checks, and the final section concludes the paper.

2. Institutional background

2.1. Accounting regulations on asset write-downs

In 1998, the MOF issued the *1998 Accounting Standards* and allowed companies to provide for bad and doubtful debts[2] according to management's judgment (Chen et al., 2004). Under the new standards, all listed companies with shares issued to investors outside China (B-shares) and shares issued on the Hong Kong Exchange (H-shares), New York Stock Exchange (N-shares) and London Stock Exchange (L-shares) were required to adopt the rules and to write down values of inventories and short- and long-term investments. However, except for the provision for bad debts, the rules on asset write-downs were not mandatory for A-share listed enterprises. In other words, A-share listed companies were only encouraged to voluntarily write down the asset value on their inventories and short- and long-term investments. Moreover, the *1998 Accounting Standards* did not specify how to take up the impairment losses and therefore, firms could have accounting choices. First, management could choose whether to adopt the write-down policy. Second, if firms adopted the policy, they could charge the impairment expenses wholly to the income statement and reduce the current year's reported income level, or they could discretionally charge the portion relating to the current reporting year to the income statement and the remainder to retained earnings if it related to operations in previous years. However, it is hard to assess, and also difficult for auditors to verify, the amount related to the current year and previous years.

As the *1998 Accounting Standards* were only optional for A-shares listed companies, these companies seldom adopted the new approach (Chen et al., 2004). The MOF then amended the regulations in 1999 by introducing *Supplementary Provisions on Accounting Treatment in the Accounting System for Shareholding Companies* ("*1999 Supplementary Provisions*") to compulsorily require all listed and non-listed companies to set up provisions for the write-downs of four types of their assets, namely accounts receivable, inventories, short-term investments and long-term investments. In addition, the new provisions incorporated other receivables into accounts receivable and required a corresponding provision for bad debts to be made, as the situation required. The *1999 Supplementary Provisions* also required companies to charge the unrealized loss incurred in 1999 to the income statement and record the portion related to prior years to equity (Li, 2001; Chen et al., 2004). Therefore, the impact of adopting the accounting standards would not fall wholly on net income in 1999. All asset impairment provisions made after 1999 will be reflected in the income statement of the relevant year.

In 2000, the Chinese authority issued the *2001 Accounting Standards* to enforce all listed companies to provide for impairment in value of an additional four types of assets, effective from 2001. These additional assets include intangible assets, fixed assets, construction in progress and commission loans.[3] Unlike the four asset categories specified in the *1998 Accounting Standards*, the market values of the four new assets are more difficult to assess objectively. Hence, the *2001 Accounting Standards* required that such assets be written down to their recoverable amounts, i.e., the higher of net selling price and the value in use. However, recoverable amounts are not easily available from the market. Furthermore, commission loans are always treated by companies as off-balance-sheet items, and it is even more difficult to provide for any impairment of an asset that is not recognized on the books (see Table 1).

[2] Before 1998, listed companies could only provide for bad debt allowances according to approved percentages of 0.3–0.5% on the outstanding accounts receivable balances. There were several reasons for prohibiting write-downs on other assets. First, assets in Chinese SOEs were not likely to be impaired during the central planning economy era. Second, China adopted tax-based accounting until the early 1990s, and accounting income differed little from taxable income (Chan et al., 2007). Therefore, write-downs of assets would reduce the reported income and might affect the income tax revenues of the state. Third, assessing assets for write-downs required market values. However, certain SOEs were monopolies in their industries (e.g., national defense, power generation and coal mining or oil and gas extraction), and market values of their assets were not always available in China.

[3] Commission loans are loans made to investment companies in return for compromised returns. This was a common practice during the period of the booming security market. However, when a bear market was experienced, the principal, together with the promised returns, might not be recoverable. Before the release of the *2001 Accounting Standards*, listed companies were not required to disclose commission loans separately. Instead, the commission loans were sometimes incorporated into short- or long-term investments.

Table 1
Accounting treatment on asset impairment. (Source: Yang et al. (2005))

Category of Assets	Governed by Accounting Standard		Specification of Fair Value	Impairment Loss Charged to Income Statement Under
	1998	2001		
Accounts Receivable (incl. Other Accounts Receivable)	✓	✓	Recoverable Amount	Administration Expenses
Inventories	✓	✓	Net Selling Price	Administration Expenses
Short-Term Investments	✓	✓	Market Value	Gain or Loss on Investments
Long-Term Investments	✓	✓	Recoverable Amount	Gain or Loss on Investments
Intangible Assets	–	✓	Recoverable Amount	Non-Operating Expenses
Fixed Assets	–	✓	Recoverable Amount	Non-Operating Expenses
Construction in Progress	–	✓	Recoverable Amount	Non-Operating Expenses
Commission Loans	–	✓	Recoverable Amount	Gain or Loss on Investments

2.2. Profitability requirement for listed companies

The establishment of the Shanghai and the Shenzhen stock exchanges in 1990 and 1991, respectively, provided platforms for companies to raise capital. Initially, the People's Bank of China supervised the local governments of Shanghai and Shenzhen and other governmental bodies to monitor the capital market in China. The CSRC was established pursuant to the State Council Directive in July 1992 to monitor and regulate the Chinese stock market. In 1998, the CSRC set up the Special Treatment (ST) and Particular Treatment (PT) system to improve the quality of listed companies and to protect the rights of investors. Companies continuously suffering losses will be labeled to remind investors of the additional risks incurred when investing in their shares. When a listed company suffers losses for two consecutive years, the shares will be labeled as ST, and the CSRC will impose reporting and trading restrictions on its shares.[4] If the ST firm has a turnaround in the following year, the ST label will be lifted. However, if the ST company continues to incur losses in the third year, its shares will be classified as PT and can only be traded on Fridays.[5] If the PT company suffers further losses, its shares will be suspended from trading, and the company will be delisted from the stock exchange. By labeling the firms with ST or PT, companies with poor management can be easily identified by investors.

Local governments are unwilling to have companies under their provincial supervision be delisted. Hence, speculators push the share prices upwards as they expect the local governments to step into bail the PT companies out (Wall Street Journal, 2001). To convey correct information to the public, the CSRC strengthened the regulatory procedure and effective 1 January 2002, it abolished the PT category. According to the new rules, all companies suffering losses for three consecutive years are suspended from trading. If an ST company, after incurring losses for three consecutive years, continues to report losses in the following quarter, the CSRC will label it with an asterisk before ST. If an *ST company again reports losses in the following quarter, it will be delisted from the exchange (Hong Kong Commercial News, 2003).

Raising equity in China, including initial public offerings (IPOs) and re-issuance of securities, also requires the CSRC's approval. According to the "Relevant Questions Concerning Rights Issue by Listed Companies" issued by the CSRC in March 1999, to qualify for rights issues for years 1999 and 2000, listed companies have to attain a minimum annual ROE of 6% for each of the previous three years and maintain an average ROE of 10% for the three years.[6]

[4] Apart from providing an audited interim report to the CSRC, the daily fluctuation of the stock price of an ST company should not exceed 5%. As the daily stock price variation for normal listed companies is restricted at 10%, the reduction in price variation on ST firms has further reduced the attractiveness to investors of trading their shares.

[5] The share price of a PT company can continue to fall but is not allowed to rise over 5% for any trading day to avoid any manipulation from related parties.

[6] "Notice about Doing Well in the Issuance of New Shares by Listed Companies" released by the CSRC on 15 March 2001 amended the requirement by allowing listed companies, from 2001 onwards, to apply for rights issues if they attained a minimum level of 6% of the weighted average yield rates of net assets, being the lower of the net income before extraordinary items and the net income, for the latest 3 years.

2.3. Earnings management incentives

The central regulators set up a quota system for listing Chinese companies, and each province was given a number of SOEs to be listed (Leung et al., 2002). Provincial governments can determine which firms could list. However, the best SOEs may not be able to be listed because the provincial governments would use the scarce quotas for those firms that needed money the most (Leung et al., 2002). Local governments are managing the listed companies, no matter whether they are controlled by state shares or state-owned legal person shares (China Industrial and Commercial Times, 2003). Hence, local governments are unwilling to have companies under their provincial supervision be delisted.[7] For those companies suffering continuous losses, local governments will adopt all available administrative measures to maintain their listing status (Legaldaily.com.cn., 2001). Therefore, as long as the companies are controlled by state shares or state-owned legal person shares, local governments can exercise control over them.

According to Becker et al. (1998), managers may be motivated to "manage" earnings by incentives such as management compensation plans, debt covenants, import relief negotiations, management buyouts and proxy contests. In China, reported earnings play an additional role of retaining listing status. As loss-producing companies will immediately attract the attention of the CSRC, one of the most important targets for management is to avoid reporting losses on the financial statements. To save from being labeled as ST, *ST or PT, a listed company must avoid losses for two to three consecutive years. The CSRC identifies loss-producing companies irrespective of the magnitude of their loss. Thus, a company incurring a loss of RMB1 will be treated by the CSRC in the same way as those suffering a loss of RMB100 million. Hence, management may intend to adopt the "big bath" approach, i.e., making adjustments to shift losses for two consecutive years into one, or to reduce losses for three consecutive years into two. Li (2001) shows that to minimize any further negative impact, management will incorporate future expenses by writing off assets in the current period so that they can increase future earnings.

Similarly, management may intend to shift profits from one period to another to fulfill the requirement to raise additional share capital. The listing rules of both exchanges require the firm applying for rights issue to attain a minimum ROE level of 6% for each of the three years prior to offering additional capital and to maintain an average ROE level of 10% for the three years. To secure the right to raise further capital, a firm with an ROE level above 6% in the previous year will tend to want to attain an ROE level of 6% in the current year. A firm with ROE levels above 6% in each of the two previous years may be more eager to achieve a higher ROE level in the current year to maintain the average ROE level for the three years at 10% and to utilize the right to raise additional capital.

In addition, unlike the case in market-oriented economies, management of local government-controlled listed companies in China is not appointed by shareholders but by the central or local governments. Thus, it is common that senior executives of listed enterprises are seconded from local government and will return to the government after the secondment period. Hence, managers of these firms are more likely to have political connections with the government (Fan et al., 2007) and are therefore more likely to be promoted as government officers. With the higher earnings of the listed companies indicating superior performance and better administrative abilities of the management, managers of state-controlled firms have stronger incentives to be aggressive in financial reporting to secure their future political career. However, managers of listed state-controlled firms are also competing with managers of non-listed SOEs for political promotion. Non-listed SOEs are not required to adopt the accounting standards.[8] They are less visible to the public, and thus their accounting information is less exposed to public scrutiny. Hence, managers of listed state-controlled firms will have greater incentive to manage earnings to enhance their performance relative to managers of non-listed SOEs.

[7] In the context of China's quota system, delisting means the retroactive reduction of an allotted quota, and no other company can use the quota of the delisted firm to issue its shares (Pistor and Xu, 2005).

[8] The *1998 Accounting Standards* do not apply to non-listed SOEs. The *2001 Accounting Standards* are also not mandatory for non-listed SOEs. If they decide to adopt the new standards, they are required to apply to the local Bureau of Finance for permission.

2.4. Ownership structure of listed companies in China

Economic reforms have transformed China from a centrally planned economy and have brought out restructuring of the ownership structure in enterprises from contractual leasing and collectively owned Township-Village Enterprises to investor-owned public enterprises (Zhang, 2001). In July 1992, the State Council issued the *Regulations on Transforming the Management Mechanism of State-Owned Industrial Enterprises* and introduced the shareholding system. Currently, China's listed companies are classified into A-shares, B-shares, H-shares, N-shares and L-shares according to the holders' residency. A-shares are listed on the Shanghai or the Shenzhen stock exchanges, are held by domestic shareholders and are denominated in RMB.[9] B-shares are also listed on the two exchanges in China, but only to foreign shareholders, and are denominated in Hong Kong or US dollars.[10] H-shares, N-shares and L-shares are Chinese enterprises listing on the Hong Kong Exchange, New York Stock Exchange and London Stock Exchange, respectively. A-shares, B-shares and the overseas-listed shares carry the same ownership rights.

The ownership of A-shares is mainly divided into three different categories: state shares, legal person shares and tradable shares. State shares are issued to the central government, local governments or wholly owned government enterprises. Legal person shares are further divided into two categories: state-owned legal shares and ordinary legal shares. Ordinary legal shares are issued to domestic institutions such as securities companies and non-bank financial institutions.[11] Tradable shares, which amount to only 35% of the total shares of the enterprises, are issued to the public, and most of them are held in the hands of small individual investors (Wang, 2004).

Non-tradable shareholders control the enterprises. As shown in Panel C of Table 2, the portion of non-tradable shares was reduced from 71.9% in 1993 to 64.5% in 1995 and remained at a very steady level after that. State shares represent the largest portion within the non-tradable shares. In 1992, the total number of state shares was 2.9 billion, representing 42.0% of the total issued number of shares and 60.3% of the number of non-tradable shares. After the 15th National Congress of the China Communist Party held in September 1997, more state-owned enterprises were allowed to be listed on the exchanges. During 1998–2001, 327.5 billion additional shares were raised, a number 1.69 times that of the total number of shares listed on the exchanges at the end of 1997. With the total non-tradable shares remaining at 65% of the total issued share capital, the portion of state shares has increased from 31.5% in 1997 to 45.0% in 2005, indicating that the controlling power of state shareholders over the market is increasing.

2.5. Audit quality in China

Prior studies have noted that conservatism is one of the most important characteristics of financial statements (Pope and Walker, 1999; Ball et al., 2000; Chung et al., 2003) and that the Big Six audit clients adopt more conservative accounting methods (Basu et al., 2002; Chung et al., 2003). DeAngelo (1981) finds that Big Six auditors are of higher quality than non-Big Six auditors, and Chung et al. (2002) find that when management has preferences for income-increasing accounting choices, Big Six auditors are more effective than non-Big Six auditors in monitoring and deterring opportunistic accounting choices. The audit market in China is still dominated by small-scale domestic CPA firms and is not yet fully opened to international accounting

[9] In 2002, Qualified Foreign Institutional Investors (QFIIs) were allowed to participate in the A-share market with the approval of the CSRC.

[10] Starting from June 2001 onwards, the restriction on B-shares to be traded by foreign investors using foreign currencies was lifted.

[11] Before 2005, both state shares and legal person shares could not be traded on the Shanghai and the Shenzhen stock exchanges but could be transferred to domestic institutions within the same category, subject to CSRC approval (Cooper, 2003; Jiang, 2004). State shares can only be transferred to another state shareholder and legal person shares are restricted to transfer to another legal person shareholder. The transfer price is set at the net assets value per share plus a margin through negotiation and is also subject to CSRC approval (Wei and Xiao, 2005). This restriction is imposed to retain significant ownership and control of the enterprises and the industries by the state and to eliminate any chance of diluting the state control over listed companies without prior approval (Walter and Howie, 2001). Under the "Administrative Measures on the Share Segregation Reform of Listed Companies" and the "Guidelines on Practice and Operation of Share Segregation Reform of Listed Companies," state and legal person shares can now be traded after the proposal for disposal of these shares are approved by the state-owned assets regulatory authorities.

Table 2
Stock market in China. (Source: CSRC, China Securities and Futures Statistical Yearbook (2006))

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Panel A: Summary Statistics of the Shanghai and Shenzhen Stock Exchanges														
No. of Listed Companies	53	183	291	323	530	745	851	949	1088	1160	1224	1287	1377	1381
Only A-shares[a]	–	–	227	242	431	627	727	822	955	1025	1085	1146	1236	1240
Amount of Capital Raised from A-shares (RMB, billion)	5.0	19.5	5.0	2.3	22.4	65.5	40.9	49.8	81.2	53.4	51.7	45.4	35.3	5.7
Market Capitalization (RMB, billion)	105	353	369	347	984	1753	1952	2647	4809	4352	3833	4246	3706	3243
No. of Investors (million)	2.2	8.4	11.1	12.9	24.2	34.8	42.60	48.1	61.2	69.0	68.4	69.8	72.2	73.4
Panel B: Share Structure of China's Listed Companies (No. of Total Shares, in billions)														
Non-tradable Shares														
State Shares	2.9	19.0	29.7	32.9	43.2	61.2	86.6	111.6	147.5	241.1	277.3	304.7	334.4	343.3
Domestic Legal Person's Shares	1.5	7.6	14.7	19.7	31.6	57.0	68.0	78.1	85.7	90.8	96.4	101.0	110.2	79.5
Foreign Legal Person's Shares	0.3	0.4	0.8	1.2	1.5	2.6	3.6	4.1	4.6	4.6	5.3	5.9	7.0	22.6
Employee Shares	0.1	0.9	0.5	0.3	1.5	4.0	5.2	3.7	2.4	2.4	1.6	1.1	0.9	0.4
Others	0.0	0.0	0.1	0.6	1.2	2.3	3.1	3.4	3.5	1.6	3.2	3.4	4.6	25.7
Total Non-tradable Shares	4.8	27.9	45.8	54.7	79.0	127.1	166.5	200.9	243.7	340.5	383.8	416.1	457.1	471.5
Tradable Shares														
A-shares	1.1	6.2	14.4	18.0	26.7	44.3	60.8	81.3	107.8	131.8	150.9	171.5	199.3	228.1
B-shares	1.0	2.5	4.2	5.6	7.9	11.7	13.4	14.2	15.2	16.3	16.8	17.5	19.7	21.8
H-/N-/L-shares	0.0	2.2	4.1	6.5	8.4	11.2	12.0	12.5	12.5	33.2	36.0	37.7	38.8	41.6
Total Tradable Shares	2.1	10.9	22.7	30.1	43.0	67.2	86.2	108.0	135.5	181.3	203.7	226.7	257.8	291.5
Total No. of Shares issued	6.9	38.8	68.5	84.8	122.0	194.3	252.7	308.9	379.2	521.8	587.5	642.8	714.9	763.0
Panel C: Share Structure of China's Listed Companies (% of Total Shares)														
Non-tradable Shares														
State Shares	42.0	49.0	43.4	38.8	35.4	31.5	34.3	36.1	38.9	46.2	47.2	47.4	46.8	45.0
Domestic Legal Person's Shares	21.7	19.6	21.5	23.2	25.9	29.3	26.9	25.3	22.6	17.4	16.4	15.7	15.4	10.4
Foreign Legal Person Shares	4.4	1.0	1.2	1.4	1.2	1.3	1.4	1.3	1.2	0.9	0.9	0.9	1.0	2.9
Employee Shares	1.5	2.4	0.7	0.4	1.2	2.1	2.1	1.2	0.6	0.5	0.3	0.2	0.1	0.1
Others	0.0	0.0	0.2	0.7	1.0	1.2	1.2	1.1	0.9	0.3	0.5	0.5	0.6	3.4
Total Non-tradable Shares	69.6	71.9	66.9	64.5	64.8	65.4	65.9	65.0	64.3	65.3	65.3	64.7	63.9	61.8
Tradable Shares														
A-shares	15.9	16.0	21.0	21.2	21.9	22.8	24.1	26.3	28.4	25.3	25.7	26.7	27.9	29.9
B-shares	14.5	6.4	6.1	6.6	6.5	6.0	5.3	4.6	4.0	3.1	2.9	2.7	2.8	2.9
H-/N-/L-shares	0.0	5.7	6.0	7.7	6.9	5.8	4.8	4.1	3.3	6.4	6.1	5.9	5.4	5.4
Total Tradable Shares	30.4	28.1	33.1	35.5	35.3	34.6	34.1	35.0	35.7	34.7	34.7	35.3	36.1	38.2
Total Shares	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Notes:
[a] Information is only available from 1994 onwards.

firms. Chan et al. (2006) find that political and economic influences from local government will outweigh the effect of high-quality auditors, and local auditors have greater economic dependence on local clients and thus are more likely to issue clean auditor opinions compared to companies owned by local governments.

The CPA profession was established in China in the 1910s along with the development of shareholding enterprises. International CPA firms began to practice in China, and by 1947, there were 3356 registered CPAs in China. The revolution in 1949 diminished the role of auditing in China. In 1962, the economy was

completely nationalized, and the majority of enterprises in China were owned and managed by the State or respective industrial ministries. SOEs operated strictly according to the State or ministerial plans. Hence, the demand for independent audits by public accountants no longer existed (Gensler and Yang, 1996). The economic reform in 1979 brought about structural changes to the economy. Restructuring of SOEs into joint stock companies and the inflows of foreign direct investment created a demand for independent external audits in China. The first Chinese CPA firm was established in Shanghai, and thereafter, thousands of new CPA firms were set up throughout the country (Tang, 2000). However, as the audit profession was being newly developed, audit firms lacked the expertise and resources to provide services to their clients. During the 1980s and early 1990s, local government agencies, universities and research institutions transferred qualified personnel to work in the audit firms and thus controlled the business operations of the firms. This affiliation of audit firms with governmental agencies resulted in a lack of independence (Chan et al., 2006). Sponsoring local government agencies often demanded that companies located within their administrative territory appoint audit firms that they sponsored (Yang et al., 2001). In return, the auditors' judgments and audit opinions were often influenced by local governments (Zhong, 1998; Tang, 1999). To prepare for China's accession to the WTO and to build a credible independent auditing profession, the Chinese regulatory authorities restructured CPA firms in 1997 and 1998 by delinking the financial ties with their sponsoring government units (Chan et al., 2006).

However, such delinking of CPA firms may not be an effective means to create an independent auditing profession. First, by retaining formerly government-affiliated auditors as their personnel, local CPA firms can maintain *guanxi*, i.e., a close relationship, with local governments and thus are able to benefit from this relationship to provide service to new clients and to retain existing clients in the same region (Chan et al., 2006). As local governments remain important in securing clientele for local audit firms, they continue to exercise strong political influence over auditor independence. Second, audit firms in China are generally small and lack the technical expertise and resources[12] to provide needed services to listed companies. Therefore, clients of CPA firms are mostly located within the same provincial region. According to Chan et al. (2006), the lack of mobility of audit firms reduces their ability to resist pressure from local clients.

3. Literature review and hypotheses

Previous studies on managerial earnings management mainly focus on income-increasing accounting choices whereas studies on the accounting treatment of asset write-downs do not provide consistent evidence on the incentives for and results of this income-decreasing accounting method (Chen et al., 2004). Aharony et al. (2000) find that Chinese SOEs manage earnings upwards before IPOs. Li (2001) examines the 1998 asset write-downs policy in China and finds that companies voluntarily writing down assets in 1998 are underestimating the asset impairments. Chen et al. (2004) show that voluntary asset write-downs in 1998 have a positive valuation effect, especially for companies with CEO changes and/or big losses. Chen and Wu (2007) find that conservative accounting rules alone are insufficient to improve the quality of financial reporting. The *1998* and the *2001 Accounting Standards* introduced a provision for asset write-downs and provided an opportunity to study whether earnings management exists in financial reporting by way of impairment provision.

Tian (2000) shows that firms under the control of state shareholders are generally valued lower than others controlled by non-government shareholders. Chen et al. (2003) find that the local governments in China collude with SOEs in conducting earnings management to circumvent central government regulation. Local governments supervising the SOEs intend to generate target (or above target) performances, including meeting the planned ROE or maintaining listing status, by conducting earnings management transactions. As no objective guideline is released for assessing the recoverable amount of writing down impaired assets, the accounting standards launched in 1998 and 2001 provide an opportunity for controlling parties to manage the earnings of the enterprise. The present study expects A-share listed companies dominated by holders of state shares

[12] To qualify to audit listed companies, CPAs and CPA firms must obtain licenses from the CSRC and the MOF. Effective from July 2000, the MOF required all licensed CPA firms auditing listed companies to employ at least 60 CPAs, including 20 licensed CPAs, and to generate annual revenue of at least RMB15 million in the previous year. At the end of year 2006, 70 CPA firms were licensed to audit listed companies in China.

(including state-owned legal person's shares), as compared to those dominated by holders of non-state shares, to have higher motivation for earnings management through the policy of writing down assets impairment. Because asset write-downs will adversely affect reported profits, I expect companies controlled by local governments to manage earnings by reducing the level of asset write-downs. The first hypothesis is thus formulated as follows:

H1. Companies dominated by local governments (including state shares and state-owned legal person's shares) have a lower level of asset write-downs as compared with companies dominated by holders of non-state shares.

Chung et al. (2003) and Basu et al. (2002) find that the Big Six audit clients use more conservative accounting. Accounting conservatism means recognizing bad news immediately and charging all expenditures whenever there is any doubt. In other words, assets impairment should be written down immediately. Generally, high-quality auditors are assumed to be able to limit their clients' earning management activities. However, recent studies find that auditors located in the same provincial region as their clients are less independent. Chan et al. (2006) find that, based on data collected for the period from 1996 to 2002, local auditors have greater economic dependence on local clients and are subject to more political influence from local governments. If local clients are providing for a lower level of asset impairment, I expect that the auditors within the same province will be less independent and more likely to support the accounting treatment. Hence, if clients are providing for a lower level of asset impairment, auditors with the same locality will tend to support the decision. Therefore, I expect local auditors are more likely to report a lower level of asset write-downs as compared to Big-4 auditors, and amongst the local auditors, companies controlled by local governments tend to report a lower level of asset write-downs. The following hypotheses are proposed.

H2a. Compared to the Big-4 auditors, local auditors are more likely to report a lower level of asset write-downs.

H2b. Compared to companies not controlled by local governments, companies dominated by local governments and audited by local auditors tend to report a lower level of asset write-downs.

4. Statistical model

Similar to Riedl (2004) and Chen et al. (2004), I estimate the following model to test the hypotheses:

$$
\begin{aligned}
WD_t = {} & \alpha_0 + \alpha_{01}POST_{99} + \alpha_{02}POST_{01} + \alpha_{11}SS_t + \alpha_{12}SS_t \times POST_{99} + \alpha_{13}SS_t \times POST_{01} \\
& + \alpha_{21}RET_t + \alpha_{22}RET_t \times POST_{99} + \alpha_{23}RET_t \times POST_{01} \\
& + \alpha_{31}SS_t \times RET_t + \alpha_{32}SS_t \times RET_t \times POST_{99} + \alpha_{33}SS_t \times RET_t \times POST_{01} \\
& + \alpha_{41}Neg\_RET_t + \alpha_{42}Neg\_RET_t \times POST_{99} + \alpha_{43}Neg\_RET_t \times POST_{01} \\
& + \alpha_{51}SS_t \times Neg\_RET_t + \alpha_{52}SS_t \times Neg\_RET_t \times POST_{99} + \alpha_{53}SS_t \times Neg\_RET_t \times POST_{01} \\
& + \alpha_{61}RET_t \times Neg\_RET_t + \alpha_{62}RET_t \times Neg\_RET_t \times POST_{99} + \alpha_{63}RET_t \times Neg\_RET_t \times POST_{01} \\
& + \alpha_{71}SS_t \times RET_t \times Neg\_RET_t + \alpha_{72}SS_t \times RET_t \times Neg\_RET_t \times POST_{99} + \alpha_{73}SS_t \times RET_t \times Neg\_RET_t \times POST_{01} \\
& + \beta_{01}Locality_t + \beta_{02}SS_t \times Locality_t + \beta_{03}Big\_4_t + \beta_{04}SS_t \times Big\_4_t + \beta_{05}SIZE_{t-1} + \beta_{06}DR_{t-1} \\
& + \beta_{07}\Delta Sales_t + \beta_{08}\Delta ACC_t + \beta_{09}\Delta OCF_t + \beta_{10}LOSS_t + \beta_{11}SS_t \times LOSS_t + \beta_{12}LOSS_{t-1} + \beta_{13}SS_t \times LOSS_{t-1} \\
& + \beta_{14}LOSS_t \times LOSS_{t-1} + \beta_{15}SS_t \times LOSS_t \times LOSS_{t-1} + \beta_{16}ROE00\_01_t + \beta_{17}SS_t \times ROE00\_01_t \\
& + \beta_{18}ROE00\_01_t \times LOSS_{t-1} + \beta_{19}SS_t \times ROE00\_01_t \times LOSS_{t-1} + \beta_{20}ROE06\_07_t + \beta_{21}SS_t \times ROE06\_07_t \\
& + \beta_{22}ROE06\_07_{t-1} + \beta_{23}SS_t \times ROE06\_07_{t-1} + \beta_{24}ROE06\_07_t \times ROE06\_07_{t-1} \\
& + \beta_{25}SS_t \times ROE06\_07_t \times ROE06\_07_{t-1} + Industry\ Dummies + \varepsilon_t
\end{aligned}
$$

where

WD_t = write-downs on asset impairment (reflected as a positive amount) in period t, divided by corresponding assets at the end of period t − 1; and

$POST_{99}$ = dummy variable, 1 if the observation is from the post-1999 period, 0 otherwise; and

$POST_{01}$ = dummy variable, 1 if the observation is from the post-2001 period, 0 otherwise; and
SS_t = dummy variable, 1 if the largest shareholder holds ≥20% of the shares in the listed company, either in the form of state shares or state-owned legal person shares, and the holding percentage is greater than the sum of the holding percentage of the next four largest shareholders, 0 otherwise; and
RET_t = 12-month buy-and-hold annual stock returns from May in year t to April in year $t+1$; and
Neg_RET_t = dummy variable, 1 if the company generated negative annual stock returns, 0 otherwise; and
$Locality_t$ = dummy variable, 1 if the company is audited by a local auditor, 0 otherwise; and
Big_4_t = dummy variable, 1 if the company is audited by a Big 4 auditor, 0 otherwise; and
$SIZE_{t-1}$ = natural logarithm of the beginning total assets value; and
DR_{t-1} = beginning debt-to-asset ratio; and
$\Delta Sales_t$ = percentage change in sales from period t − 1 to period t; and
ΔACC_t = change in total accruals between period t and t − 1, divided by total assets at period t − 1; and
ΔOCF_t = change in operating cash flows between period t and t − 1, divided by total assets at period t − 1; and
$LOSS_t$ = dummy variable, 1 for a company reporting loss after write-downs in period t, 0 otherwise; and
$LOSS_{t-1}$ = dummy variable, 1 for a company reporting loss after write-downs in period t − 1, 0 otherwise; and
$LOSS_t \times LOSS_{t-1}$ = interaction variable, 1 if the company reported loss after write-downs in period t − 1 and in period t, 0 otherwise; and
$ROE00\_01_t$ = dummy variable, 1 for $0.00 \leq ROE \leq 0.01$ after write-downs, 0 otherwise; and
$ROE00\_01_t \times LOSS_{t-1}$ = interaction variable, 1 if the company reported loss after write-downs in period t − 1 and is generating $0.00 \leq ROE \leq 0.01$ after write-downs in period t, 0 otherwise; and
$ROE06\_07_t$ = dummy variable, 1 for $0.06 \leq ROE \leq 0.07$ after write-downs in period t, 0 otherwise; and
$ROE06\_07_{t-1}$ = dummy variable, 1 for $0.06 \leq ROE \leq 0.07$ after write-downs in period t − 1, 0 otherwise; and
$ROE06\_07_t \times ROE06\_07_{t-1}$ = interaction variable, 1 if the company reported ROE ≥ 0.06 and ≤0.07 after write-downs in periods t − 1 and t, 0 otherwise.

The dependent variable, WD_t, is measured as the dollar amount of the write-downs on assets impairment and reflected as a positive number, for period t in accordance with the *1998 Accounting Standards*, *1999 Supplementary Provisions* and *2001 Accounting Standards*, divided by the beginning value of the assets impaired. Similar to Chen and Wu (2007), I divide the sample period into three sub-periods and include $POST_{99}$ and $POST_{01}$ to measure the impact on asset write-downs according to changes in the increasingly conservative reporting requirements.[13]

SS_t is a dummy variable classifying ownership of listed companies and is coded 1 for companies under local government influence, and 0 if otherwise. A listed company is controlled by local government if the largest shareholder is holding state shares or state-owned legal person shares and holds at least 20% of the shares, and its holding percentage is greater than the summation of the holding percentage of the next four largest shareholders. According to prior studies, the 20% cutoff is considered large enough to exercise effective control of a listed company (La Porta et al., 1999; Chan et al., 2006). To counter the potential union formed by other large shareholders, the ownership percentage of the largest shareholder should be greater than the sum of the next four largest shareholders (Tai et al., 2007).

To estimate the extent of conservatism, I include RET_t and Neg_RET_t into the model. Economic factors may have impacts on the magnitude of the write-downs. I introduce RET_t to capture the 12-month buy-and-hold annual stock returns from May in year t to April in year $t+1$, adjusted by the value-weighted annual market returns. When the stock return is negative, a lower value of net assets of the company is reflected in the stock price, and I should observe a larger amount of write-down. In this case, the association

[13] As the *1998 Accounting Standards* were only optional for A-shares listed companies, most of these companies have not adopted the new approach, except for accounts receivable. The *1999 Supplementary Provisions* compulsorily require all listed and non-listed companies to set up provisions for the write-downs of four types of their assets, and therefore the hypothesized relationship between write-downs and the test variables is estimated to be more significant for the period from 1999 onwards.

between return and the write-down magnitude should be negative. When the stock return is positive, the company should not reverse the write-down provisions as accounting earnings reflect "bad news" more quickly than "good news" (Basu, 1997). In such circumstances, the association between return and the write-down magnitude should be small. Therefore, I expected RET_t to be around zero. Neg_RET_t is a dummy variable, and is 1 if the company generated negative annual stock returns. According to Chen and Wu (2007), if companies adopt conservative accounting, economic losses proxied by negative stock returns should be mapped into accounting net income at a higher rate, and the coefficients of α_{61}, α_{62} and α_{63} will be positive. $RET_t \times Neg\_RET_t$ is included in the model as an interaction variable to test if the negative annual returns are negatively associated with the write-down magnitude. I expect the impacts of economic factors on write-downs to be asymmetric and estimate $RET_t \times Neg\_RET_t$ to be negative. $SS_t \times RET_t$, $SS_t \times Neg\_RET_t$ and $SS_t \times RET_t \times Neg\_RET_t$ are interaction variables introduced to examine whether the company controlled by local government will behave differently in its write-down decision in response to the annual return. If local government-controlled companies are less conservative in reporting, that is, if they write down a lower asset value when the stock returns are negative, $SS_t \times Neg\_RET_t$ will be negative.

DeAngelo (1981) finds that the Big Six auditors are of higher quality than non-Big Six auditors, and Chan et al. (2006) find that local auditors have greater economic dependence on and are subject to more political influence from the local clients than non-local auditors are. Big_4_t measures whether the Big Four auditors are more effective than non-Big Four auditors in deterring opportunistic accounting choices. Amongst the non-Big Four auditors, $Locality_t$ is coded as 1 if the auditor and its client are located in the same province or municipality. I expect that due to the political influence from firms controlled by local governments, local audit firms will be more likely to support management's decision on asset write-down, and the coefficient on β_{02} will be negative.

$SIZE_{t-1}$ is a control variable and is measured as the natural logarithm of the total assets at the beginning of the period. Francis et al. (1996) find that larger companies are more likely to write down asset value, and thus the coefficient of this variable is expected to be positive. DR_{t-1} is another control variable and is the beginning debt-to-asset ratio. Already tied up with high borrowing cost on bank loans, high-leverage firms will be interested in raising lower-cost financing and will tend to discretionally write down asset value to increase the possibility of meeting the targets for raising additional capital in later years. Hence, DR_{t-1} is expected to be positive. Similar to Riedl (2004), $\Delta Sales_t$ and ΔOCF_t are included in the model as proxies for economic factors related to changes in asset value. $\Delta Sales_t$ represents the percentage change in sales, and ΔOCF_t represents the change in operating cash flows, scaled by total assets at the end of period $t-1$. $\Delta Sales_t$ relates to accrual-related performance attributes, whereas ΔOCF_t captures cash-related attributes. As in previous studies, $\Delta Sales_t$ and ΔOCF_t are expected to be negative (Riedl, 2004). I include ΔOCF_t, representing the percentage change in total accruals between period t and $t-1$, scaled by the beginning total asset value, to measure whether a change in working capital would result in more allowance made for the working capital assets, and I expect the coefficient on β_{08} to be positive.

$LOSS_t$, $LOSS_{t-1}$, $LOSS_t \times LOSS_{t-1}$, $ROE00\_01_t$, $ROE00\_01_t \times LOSS_{t-1}$, $ROE06\_07_t$, $ROE06\_07_{t-1}$ and $ROE06\_07_t \times ROE06\_07_{t-1}$ are included to test whether profitability and regulations governing profitability level will have any impact on the asset write-downs decisions. $LOSS_t$ is a dummy variable equal to 1 when the firm reports a loss in period t. The CSRC's labeling system only identifies firms with losses, without taking into account the amount of loss they report. Therefore, I expect firms reporting losses will take a "big bath" charge to take up impairment cost of future periods in the current year, and $LOSS_t$ will be positively related to the write-down magnitude. $LOSS_{t-1}$ is also a dummy variable and is coded 1 for firms with negative ROE after asset write-downs in period $t-1$. If the firm has already suffered from loss in period $t-1$, it will be more likely to take the write-down in the current year to reduce expenses in future periods. $LOSS_t \times LOSS_{t-1}$ is an interaction dummy variable and is coded 1 if loss is incurred in both period t and period $t-1$. Because the firm has suffered losses for two consecutive years, it is at high risk of being delisted. Hence, it may make more effort to minimize future expenses and to write down asset value in the current period. I expect $LOSS_t \times LOSS_{t-1}$ to be positively related to the magnitude of write-downs in the current year.

$ROE00\_01_t$ is a dummy variable and is coded 1 for firms with non-negative ROE less than 1% ($0 \leq \text{ROE} \leq 0.01$) after writing down asset value. The CSRC introduced the Special Treatment and Particular Treatment system to identify poor-quality listed companies to investors and issued rules to delist companies

reporting losses for two consecutive quarters, after suffering losses for three consecutive years. If the firm turns around in the current year, the loss reported in the previous year will not be taken into account by the CSRC in its labeling system. Hence, firms reporting loss in year t − 1 will tend not to take asset write-downs in the current year to report a marginally non-negative ROE. I expect the coefficient on $ROE00\_01_t \times LOSS_{t-1}$ to be negative. $ROE06\_07_t$ is another dummy variable and is coded 1 for firms with ROE reported, after asset write-downs, of not less than 6%. A company preparing to issue further shares in the near future needs to maintain its ROE at a minimum level of 6%. $ROE06\_07_t \times ROE06\_07_{t-1}$ is an interaction variable and is coded 1 when the firm reports an ROE, after asset write-downs, of not less than 6% in two consecutive years. The variable is expected to be negatively related to the write-down magnitude as the firm surviving a 6% ROE level for two years is less likely to further write down its assets in the current year and to increase the chance of meeting the target in the third year to raise additional capital.

5. Sample selection and empirical results

5.1. Source of data

The sample used in this study comprises all listed companies in the Shenzhen Stock Exchange and the Shanghai Stock Exchange in China for the years from 1998 to 2005. The 1998–2005 period was chosen because most firms in China did not make allowances before 1998, except that for accounts receivable. To prevent listed companies from opportunistically managing earnings, the MOF in China released new accounting standards in February 2006 (2006 *Accounting Standards*) to forbid any reversals of impairment provision on fixed assets and intangible assets, effective from 2007. In other words, net impairment for the year may not reflect the change in fair value of the assets. Thus, to exclude the impact from the 2006 *Accounting Standards*, the sample used in this paper covers the period up to 2005. Financial, impairment and stock return data were collected from the *CSMAR database* (2007) developed by the Shenzhen GTA Information Technology Company. The information of listed companies, including the residencies and the details of ownership—names, numbers and percentages of shares held by the top ten shareholders together with the names and residencies of auditors used in this study—were extracted manually from the annual reports of individual companies for 1998 to 2005. A listed company is classified as local government controlled if the largest shareholder is holding state shares or state-owned legal person shares and owns at least 20% of the shares, with the holding percentage being greater than the next four largest shareholders combined. Consistent with previous studies, the 20% cutoff is considered large enough to exercise effective control of a listed company (La Porta et al., 1999; Chan et al., 2006). The largest shareholder can control the company and counter the union potentially formed by other large shareholders if its ownership percentage is greater than the sum of the next four largest shareholders (Tai et al., 2007). Alternative cutoffs are used in the robustness tests.

This study only includes financial information of companies with A-shares listed on the Shanghai and Shenzhen stock exchanges. As illustrated in Panel A of Table 3, from a total of 9317 firm-year observations for the period from 1998 to 2005, I exclude 1081 firm-year observations for firms with B-shares or H-shares as they are subject to a higher level of disclosure requirement. Of the total of 8236 firm-year observations for A-share listed companies for the study period, I exclude 613 newly listed firm-year observations as no comparative data is available. I further exclude 365 firm-year observations with incomplete financial and audit information. The final sample retained in the analysis is 7258 firm-year observations, representing over 88% of the total companies with A-shares listed on the two exchanges in China during the study period.

5.2. Descriptive statistics

Table 4 presents the descriptive statistics of the sample firms in the analysis. I report *t*-test results on the mean difference and Wilcoxon signed-rank test results on the median difference for the sub-samples divided according to whether the firms are controlled by local government.

The return variable of local government-controlled companies, $SS_t \times \mathrm{RET}_t$, is greater than the RET_t variable, indicating that local government-controlled enterprises generally report better results. Similar results are found for $SS_t \times Neg\_RET_t$ and $SS_t \times RET_t \times Neg\_RET_t$. Over 68% of the A-share listed companies have

Table 3
Descriptive information on sample selection. (Source: CSRC, China Securities and Futures Statistical Yearbook (2006))

	1998	1999	2000	2001	2002	2003	2004	2005	1998–2005
Panel A: Sample Selection									
Total Number of Listed Companies	851	949	1088	1160	1224	1287	1377	1381	9317
Companies with B-shares and/or H-shares Listed	(124)	(127)	(133)	(135)	(139)	(141)	(141)	(141)	(1081)
Total Number of A-share Listed Companies	727	822	955	1025	1085	1146	1236	1240	8236
IPOs During the Year[a]	(100)	(95)	(133)	(70)	(60)	(61)	(90)	(4)	(613)
Selected Sample Companies	627	727	822	955	1025	1085	1146	1236	7623
Missing Data	(36)	(33)	(35)	(40)	(51)	(43)	(41)	(86)	(365)
Selected Sample Companies	591	694	787	915	974	1042	1105	1150	7258
Industry[b]:	1998	1999	2000	2001	2002	2003	2004	2005	1998–2005
Panel B: Industrial Distribution of Listed Companies									
Agriculture, Forestry, Animal Husbandry & Fishery	10	14	16	24	25	26	27	33	175
Mining and Quarrying and Oil and Gas Extraction	3	5	8	10	12	13	16	18	85
Manufacturing	291	365	426	503	547	591	631	664	4018
Electricity, Gas and Water Supply	27	32	34	39	42	46	48	53	321
Construction	9	11	14	15	16	17	22	24	128
Transportation and Warehousing	17	21	25	32	35	39	42	43	254
Information Technology	43	46	51	58	58	64	72	74	466
Wholesale and Retail Trade	68	70	70	79	82	85	85	83	622
Estate Development and Operation	35	35	37	39	41	43	43	42	315
Public Facilities Services and Tourism	17	19	24	31	30	33	33	34	221
Communications and Cultural Industries	8	8	9	9	10	10	9	9	72
Conglomerates	63	68	73	76	76	75	77	73	581
Selected Sample Companies	591	694	787	915	974	1042	1105	1150	7258

Notes:
[a] The study excludes firms with an IPO during the year as they do not provide comparative figures for the tests.
[b] CSRC released the "Industry Classification Guideline for Listed Companies" on 4 April 2001 and divided the listed companies into the 12 industries listed above.

their accounts audited by local audit firms, and only 3% of the listed enterprises are audited by the Big Four auditors. Therefore, the audit market is still dominated by small-scale domestic CPA firms and is not fully opened to international accounting firms. All regulatory incentives variables for companies controlled by local governments are less than the pooled observations.

5.3. Regression results

To reduce the effect of extreme outliers on the regression results, I truncate continuous variables of *RET*, *SIZE*, *DR*, ΔS*ales*, ΔA*CC* and Δ*OCF* at the bottom and top percentiles. I present the regression results based on the truncated sample in Table 5. With the introduction of the improved quality of accounting standards, the relationship between negative returns and write-down magnitude should be positive. However, the recoverable value of the four new asset categories introduced in the *2001 Accounting Standards* requires management to exercise judgment in their assessment. Consistent with Hypothesis 1, the coefficient on $SS_t \times Neg\_RET_t \times POST01$ is significantly negative. In other words, as even more conservative financial reporting is stipulated by the *2001 Accounting Standards*, companies controlled by local governments are less conservative in reporting asset write-down.

To test the second hypothesis, I examine the monitoring role of the auditors by including the variables of *Big_4* and *Locality* in the regression. Consistent with Hypothesis H2a, the positive coefficients on Big_4_t and $SS\_Big\_4_t$ show that companies audited by Big Four audit firms tend to write down more asset value, although the results are not significant. This is consistent with prior studies showing that large international audit firms are more independent, and their clients use more conservative accounting methods (Basu et al., 2002; Chung et al., 2003), even though they are controlled by local governments. The difference in coefficients

Table 4
Descriptive statistics on client firm characteristics and auditor locality.

	Mean	Min.	Median	Max.	Std. Dev.	Skewness
WD_t	0.0311	−0.5566	0.0130	0.6049	0.0743	7.0580
Conservatism Variables						
SS_t	0.8328	0.0000	1.0000	1.0000	0.3732	−1.7841
RET_t	−0.0059	−0.6512	−0.1165	1.9244	0.4081	1.3998
$SS_t \times RET_t$	0.0012	−0.6512	−0.0024	1.9244	0.3706	1.5234
Neg_RET_t	0.6098	0.0000	1.0000	1.0000	0.4878	−0.4501
$SS_t \times Neg\_RET_t$	0.5013	0.0000	1.0000	1.0000	0.5000	−0.0052
$RET_t \times Neg\_RET_t$	−0.1559	−0.6512	−0.1165	0.1251	0.1739	−0.7161
$SS_t \times RET_t \times Neg\_RET_t$	−0.1255	−0.6512	0.0000	0.1251	0.1660	−1.0284
Auditor Locality Variables						
$Locality_t$	0.6863	0.0000	1.0000	1.0000	0.4640	−0.8034
$SS_t \times Locality_t$	0.5779	0.0000	1.0000	1.0000	0.4939	−0.3154
Big_4_t	0.0304	0.0000	0.0000	1.0000	0.1716	5.4758
$SS_t \times Big\_4_t$	0.0261	0.0000	0.0000	1.0000	0.1594	5.9478
Regulatory Incentives Variables						
$LOSS_t$	0.1138	0.0000	0.0000	1.0000	0.3176	2.4327
$SS_t \times LOSS_t$	0.0876	0.0000	0.0000	1.0000	0.2827	2.9189
$LOSS_{t-1}$	0.0816	0.0000	0.0000	1.0000	0.2738	3.0570
$SS_t \times LOSS_{t-1}$	0.0607	0.0000	0.0000	1.0000	0.2388	3.6798
$LOSS_t \times LOSS_{t-1}$	0.0334	0.0000	0.0000	1.0000	0.1797	5.1941
$SS_t \times LOSS_t \times LOSS_{t-1}$	0.0244	0.0000	0.0000	1.0000	0.1543	6.1653
$ROE00\_01_t$	0.0676	0.0000	0.0000	1.0000	0.2510	3.4460
$SS_t \times ROE00\_01_t$	0.0557	0.0000	0.0000	1.0000	0.2293	3.8762
$ROE00\_01_t \times LOSS_{t-1}$	0.0124	0.0000	0.0000	1.0000	0.1105	8.8303
$SS_t \times ROE00\_01_t \times LOSS_{t-1}$	0.0093	0.0000	0.0000	1.0000	0.0960	10.2233
$ROE06\_07_t$	0.1014	0.0000	0.0000	1.0000	0.3019	2.6407
$SS_t \times ROE06\_07_t$	0.0857	0.0000	0.0000	1.0000	0.2800	2.9600
$ROE06\_07_{t-1}$	0.1042	0.0000	0.0000	1.0000	0.3055	2.5917
$SS_t \times ROE06\_07_{t-1}$	0.0882	0.0000	0.0000	1.0000	0.2836	2.9054
$ROE06\_07_t \times ROE06\_07_{t-1}$	0.0270	0.0000	0.0000	1.0000	0.1621	5.8376
$SS_t \times ROE06\_07_t \times ROE06\_07_{t-1}$	0.0235	0.0000	0.0000	1.0000	0.1515	6.2934
Other Control Variables						
$SIZE_{t-1}$	20.8748	19.0263	20.8276	23.0173	0.7811	0.2401
DR_{t-1}	0.4405	0.0741	0.4360	1.0095	0.1714	0.1865
$\Delta Sales_t$	0.1889	−0.8066	0.1352	3.4441	0.4216	2.1587
ΔACC_t	0.0996	−0.3177	0.0922	0.6276	0.1291	0.3486
ΔOCF_t	0.0057	−0.3905	0.0076	0.3570	0.1003	−0.2026

Notes:
a. WD_t = write-downs on asset impairment (reflected as a positive amount) in period t, divided by total assets at the end of period t − 1; $SS_t = 1$ if the largest shareholder holds ≥20% of the shares in the listed company, either in the form of state shares or state-owned legal person shares, and the holding percentage is greater than the sum of the holding percentage of the next four largest shareholders, 0 otherwise; and
RET_t = 12-month buy-and-hold annual stock returns from May in year t to April in year $t + 1$; and
$Neg\_RET_t = 1$ if the company generated negative annual stock returns, 0 otherwise; and
$Locality_t = 1$ if the company is audited by a local auditor, 0 otherwise; and
$Big\_4_t = 1$ if the company is audited by a Big 4 auditor, 0 otherwise; and
$SIZE_{t-1}$ = natural logarithm of beginning total assets value; and
DR_{t-1} = beginning debt-to-asset ratio; and
$\Delta Sales_t$ = percentage change in sales from period t − 1 to period t; and
ΔACC_t = change in total accruals between period t and t − 1, divided by total assets at period t − 1; and
ΔOCF_t = change in operating cash flows between period t and t − 1, divided by total assets at period t − 1; and
$LOSS_t = 1$ for company reporting loss after write-downs in period t, 0 otherwise; and
$LOSS_{t-1} = 1$ for company reporting loss after write-downs in period t − 1, 0 otherwise; and
$LOSS_t \times LOSS_{t-1}$ = interaction variable, 1 if the company reported loss after write-downs in period t − 1 and in period t, 0 otherwise; and
$ROE00\_01_t = 1$ for $0.00 \leq \text{ROE} \leq 0.01$ after write-downs, 0 otherwise; and

$ROE00\_01_t \times LOSS_{t-1}$ = interaction variable, 1 if the company reported loss after write-downs in period t − 1 and is generating 0.00 ≤ ROE ≤ 0.01 after write-downs in period t, 0 otherwise; and
$ROE06\_07_t = 1$ for 0.06 ≤ ROE ≤ 0.07 after write-downs in period t, 0 otherwise; and
$ROE06\_07_{t-1} = 1$ for 0.06 ≤ ROE ≤ 0.07 after write-downs in period t − 1, 0 otherwise; and
ROE06_07t × ROE06_07t − 1 = interaction variable, 1 if the company reported ROE ≥ 0.06 and ≤0.07 after write-downs in periods t − 1 and t, 0 otherwise.
b. The top and bottom 1% of the continuous variables of WD_t, RET_t, $SIZE_{t-1}$, DR_{t-1}, $\Delta Sales_t$, ΔACC_t and ΔOCF_t, are truncated according to annual distributions of the respective variables.

on $Locality_t$ and $SS\_Locality_t$ support Hypothesis 2b. The negative significant coefficient on $SS\_Locality_t$ shows that local auditors tend to support a lower level of asset write-downs of A-share listed companies controlled by local governments.

To control for the firm size effect on the write-downs, the logarithm of total assets at the beginning of the period ($SIZE_{t-1}$) is included in the model. Although previous studies find that larger companies are more likely to write down asset values (Francis et al., 1996), the results in the present analysis present a different finding. The write-down on asset impairment in China is significantly negatively associated with the size of the enterprises (t = −9.06) at the 1% level. This may be due to the reason that larger firms in China can afford higher-quality fixed assets, and thus the values of those assets are not impaired as much as those possessed by smaller firms. I expect high-leverage firms will be more interested in raising financing with lower cost and are more likely to discretionarily write down asset values to increase the possibility of meeting the targets for raising further capital. The debt ratio (DR_{t-1}, t = 9.59) is significantly positive, as predicted. In addition, the asset impairment decision is significantly associated with $\Delta Sales_t$ (t = −5.30), which means when its income level is high, a listed company is more willing to write down asset values. The write-down magnitude is negatively associated with $\Delta Sales_t$, as expected, and is statistically significant. The signs of coefficients ΔACC_t and ΔOCF_t are inconsistent with the expectation but are not significant.

$LOSS_t$, $LOSS_{t-1}$, $LOSS_t \times LOSS_{t-1}$, $ROE00\_01_t$ and $ROE00\_01_t \times LOSS_{t-1}$ are introduced into the model to test the impact of the CSRC's regulations on the write-down magnitude (Li, 2001; Chen et al., 2004). As expected, $LOSS_t$ is significantly positively related to the magnitude of asset write-downs (t = 7.84). Because the CSRC only identifies firms with reported loss, the amount of the loss incurred in the period is not relevant to the ST or PT labels. Therefore, firms with loss incurred in the current period will take "big bath" charges and write down assets further to reduce future expenses. Similarly, when a firm has reported losses in both the current and the previous periods, it is at a very high risk of being delisted and is more likely to write down assets further in the current year. $LOSS_t \times LOSS_{t-1}$ is significantly positive, as predicted (t = 6.87). Interestingly, SS_LOSS_t and $SS\_LOSS_t \times LOSS_{t-1}$ are negatively correlated to the write-down magnitude, and the latter is significant at the 1% level. A possible explanation may be that consistent with speculators' expectation, local governments are more likely to bail out PT companies (Wall Street Journal, 2001), and therefore management will try to save face by minimizing the amount of the loss reported. One way of reducing the loss magnitude is by making fewer allowances on asset write-down. However, if the firm has reported loss in the previous period, it will strive to reduce its expenses in the current period to save itself from being labeled as an ST firm. Hence, $LOSS_{t-1}$ and SS_LOSS_{t-1}, consistent with expectations, are negatively related to the write-down magnitude in the regression results.

Contrary to the expectation, the results of $ROE00\_01_t$ and $SS\_ROE00\_01_t$ are positive but are insignificant. The coefficients on $ROE00\_01_t \times LOSS_{t-1}$ and $SS\_ROE00\_01_t \times LOSS_{t-1}$ are negative as expected, although not significant. This shows that firms reporting a loss in period t − 1 will tend to avoid being labeled as ST firms and are likely to avoid loss in the current year. $ROE06\_07_{t-1}$ and $ROE06\_07_t \times ROE06\_07_{t-1}$ are negatively correlated with the write-down magnitude, and this result is consistent with the prediction. Firms surviving the 6% ROE level in the previous year may try to reduce assets write-down to fulfill the requirement of reporting the ROE level for rights issue. However, contrary to expectation, the coefficient on $ROE06\_07_t$ is positively related to the write-down magnitude. All of these variables, together with $SS\_ROE06\_07_{t-1}$, $SS\_ROE06\_07_{t-1}$ and $SS\_ROE06\_07_t \times ROE06\_07_{t-1}$, are insignificant. One possible reason is that firms are more likely to adjust their write-down magnitude when they report losses.

Table 5
Regression results on asset write-downs for years from 1998 to 2005. $WD_t = \alpha_0 + \alpha_{01}POST_{99} + \alpha_{02}POST_{01} + \alpha_{11}SS_t + \alpha_{12}SS_t \times POST_{99} + \alpha_{13}SS_t \times POST_{01} + \alpha_{21}RET_t + \alpha_{22}RET_t \times POST_{99} + \alpha_{23}RET_t \times POST_{01} + \alpha_{31}SS_t \times RET_t + \alpha_{32}SS_t \times RET_t \times POST_{99} + \alpha_{33}SS_t \times RET_t \times POST_{01} + \alpha_{41}Neg\_RET_t + \alpha_{42}Neg\_RET_t \times POST_{99} + \alpha_{43}Neg\_RET_t \times POST_{01} + \alpha_{51}SS_t \times Neg\_RET_t + \alpha_{52}SS_t \times Neg\_RET_t \times POST_{99} + \alpha_{53}SS_t \times Neg\_RET_t \times POST_{01} + \alpha_{61}RET_t \times Neg\_RET_t + \alpha_{62}RET_t \times Neg\_RET_t \times POST_{99} + \alpha_{63}RET_t \times Neg\_RET_t \times POST_{01} + \alpha_{71}SS_t \times RET_t \times Neg\_RET_t + \alpha_{72}SS_t \times RET_t \times Neg\_RET_t \times POST_{99} + \alpha_{73}SS_t \times RET_t \times Neg\_RET_t \times POST_{01} + \beta_{01}Locality_t + \beta_{02}SS_t \times Locality_t + \beta_{03}Big\_4_t + \beta_{04}SS_t \times Big\_4_t + \beta_{05}SIZE_{t-1} + \beta_{06}DR_{t-1} + \beta_{07}\Delta Sales_t + \beta_{08}\Delta ACC_t + \beta_{09}\Delta OCF_t + \beta_{10}LOSS_t + \beta_{11}SS_t \times LOSS_t + \beta_{12}LOSS_{t-1} + \beta_{13}SS_t \times LOSS_{t-1} + \beta_{14}LOSS_t \times LOSS_{t-1} + \beta_{15}SS_t \times LOSS_t \times LOSS_{t-1} + \beta_{16}ROE00\_01_t + \beta_{17}SS_t \times ROE00\_01_t + \beta_{18}ROE00\_01_t \times LOSS_{t-1} + \beta_{19}SS_t \times ROE00\_01_t \times LOSS_{t-1} + \beta_{20}ROE06\_07_t + \beta_{21}SS_t \times ROE06\_07_t + \beta_{22}ROE06\_07_{t-1} + \beta_{23}SS_t \times ROE06\_07_{t-1} + \beta_{24}ROE06\_07_t \times ROE06\_07_{t-1} + \beta_{25}SS_t \times ROE06\_07_t \times ROE06\_07_{t-1} +$ Industry Dummies $+ \varepsilon_t$.

Variable	Predicted Sign	Coefficient	*t*-value	Pr > |t|
Intercept	?	0.184	6.64	0.000***
Test Variables				
POST99	+/−	0.021	1.18	0.239
POST01	+/−	0.021	2.08	0.038**
SS_t	+/−	0.012	0.71	0.476
$SS_t \times POST99$	+/−	−0.001	−0.04	0.965
$SS_t \times POST01$	+/−	−0.006	−0.56	0.577
RET_t	+/−	−0.017	−0.52	0.605
$RET_t \times POST99$	+/−	0.024	0.70	0.487
$RET_t \times POST01$	+/−	−0.007	−0.36	0.719
$SS_t \times RET_t$	+/−	0.015	0.40	0.686
$SS_t \times RET_t \times POST99$	+/−	−0.013	−0.35	0.728
$SS_t \times RET_t \times POST01$	+/−	−0.001	−0.05	0.959
Neg_RET_t	+	0.014	0.54	0.589
$Neg\_RET_t \times POST99$	+	−0.066	−1.89	0.058*
$Neg\_RET_t \times POST01$	+	0.056	2.31	0.021**
$SS_t \times Neg\_RET_t$	−	−0.015	−0.54	0.593
$SS_t \times Neg\_RET_t \times POST99$	−	0.067	1.79	0.073*
$SS_t \times Neg\_RET_t \times POST01$	−	−0.063	−2.43	0.015**
$RET_t \times Neg\_RET_t$	−	0.057	0.67	0.500
$RET_t \times Neg\_RET_t \times POST99$	−	−0.159	−1.32	0.187
$RET_t \times Neg\_RET_t \times POST01$	−	0.115	1.3	0.193
$SS_t \times RET_t \times Neg\_RET_t$	+	−0.073	−0.80	0.423
$SS_t \times RET_t \times Neg\_RET_t \times POST99$	+	0.219	1.65	0.099*
$SS_t \times RET_t \times Neg\_RET_t \times POST01$	+	−0.191	−1.93	0.053*
Auditor Locality Variables				
$Locality_t$	−	−0.006	−1.50	0.133
$SS\_Locality_t$	−	−0.009	−1.95	0.051*
Big_4_t	+	0.002	0.18	0.854
$SS\_Big\_4_t$	+	0.002	0.15	0.881
Other Control Variables				
$SIZE_{t-1}$	+	−0.011	−9.06	0.000***
DR_{t-1}	+	0.050	9.59	0.000***
$\Delta Sales_t$	−	−0.011	−5.30	0.000***
ΔACC_t	+	−0.005	−0.65	0.517
ΔOCF_t	−	0.002	0.26	0.792
Regulatory Incentives Variables				
$LOSS_t$	+	0.053	7.84	0.000***
SS_LOSS_t	−	−0.007	−0.92	0.359
$LOSS_{t-1}$	+	−0.021	−2.35	0.019**
SS_LOSS_{t-1}	−	−0.028	−2.74	0.006***
$LOSS_t \times LOSS_{t-1}$	+	0.094	6.87	0.000***
$SS\_LOSS_t \times LOSS_{t-1}$	−	−0.046	−2.94	0.003***
$ROE00\_01_t$	−	0.002	0.23	0.817
$SS\_ROE00\_01_t$	−	0.003	0.36	0.721
$ROE00\_01_t \times LOSS_{t-1}$	−	−0.004	−0.20	0.839

(*continued on next page*)

Table 5 (*continued*)

Variable	Predicted Sign	Coefficient	*t*-value	Pr > |t|
$SS\_ROE00\_01_t \times LOSS_{t-1}$	–	−0.031	−1.44	0.150
$ROE06\_07_t$	–	0.003	0.45	0.651
$SS\_ROE06\_07_t$	–	−0.008	−0.97	0.332
$ROE06\_07_{t-1}$	–	−0.002	−0.32	0.752
$SS\_ROE06\_07_{t-1}$	–	−0.002	−0.28	0.782
$ROE06\_07_t \times ROE06\_07_{t-1}$	–	−0.008	−0.45	0.653
$SS\_ROE06\_07_t \times ROE06\_07_{t-1}$	–	0.014	0.79	0.431
Adjusted R^2				0.254
N				7258

Notes:
a. WD_t = write-downs on asset impairment (reflected as a positive amount) in period t, divided by total assets at the end of period t − 1;
$POST_{99} = 1$ if the observation is from post-1999 period, 0 otherwise; and
$POST_{01} = 1$ if the observation is from post-2001 period, 0 otherwise; and
$SS_t = 1$ if the largest shareholder holds ≥20% of the shares in the listed company, either in the form of state shares or state-owned legal person shares, and the holding percentage is greater than the sum of the holding percentage of the next four largest shareholders, 0 otherwise; and
RET_t = 12-month buy-and-hold annual stock returns from May in year *t* to April in year *t* + 1; and
$Neg\_RET_t = 1$ if the company generated negative annual stock returns, 0 otherwise; and
$Locality_t = 1$ if the company is audited by a local auditor, 0 otherwise; and
$Big\_4_t = 1$ if the company is audited by a Big 4 auditor, 0 otherwise; and
$SIZE_{t-1}$ = natural logarithm of beginning total assets value; and
DR_{t-1} = beginning debt-to-asset ratio; and
$\Delta Sales_t$ = percentage change in sales from period t − 1 to period t; and
ΔACC_t = change in total accruals between period t and t − 1, divided by total assets at period t − 1; and
ΔOCF_t = change in operating cash flows between period t and t − 1, divided by total assets at period t − 1; and
$LOSS_t = 1$ for company reporting loss after write-downs in period t, 0 otherwise; and
$LOSS_{t-1} = 1$ for company reporting loss after write-downs in period t − 1, 0 otherwise; and
$LOSS_t \times LOSS_{t-1}$ = interaction variable, 1 if the company reported loss after write-downs in period t − 1 and in period t, 0 otherwise; and
$ROE00\_01_t = 1$ for 0.00 ≤ ROE ≤ 0.01 after write-downs, 0 otherwise; and
$ROE00\_01_t \times LOSS_{t-1}$ = interaction variable, 1 if the company reported loss after write-downs in period t − 1 and is generating 0.00 ≤ ROE ≤ 0.01 after write-downs in period t, 0 otherwise; and
$ROE06\_07_t = 1$ for 0.06 ≤ ROE ≤ 0.07 after write-downs in period t, 0 otherwise; and
$ROE06\_07_{t-1} = 1$ for 0.06 ≤ ROE ≤ 0.07 after write-downs in period t − 1, 0 otherwise; and
ROE06_07t × ROE06_07t − 1 = interaction variable, 1 if the company reported ROE ≥ 0.06 and ≤0.07 after write-downs in periods t − 1 and t, 0 otherwise.
a. Industry dummies are not presented.
b. ***, ** and * represent significance at the 1%, 5% and 10% levels, respectively.

6. Robustness checks

6.1. Alternative definition of controlling ownership

I rerun the regressions by treating the local governments as the largest shareholder when the shareholding of state shares or state-owned legal person shares reached 20% or above and the ownership percentage of the largest shareholder should be greater than the sum of the next nine largest shareholders. The results are similar to the main findings.

6.2. Alternative definition of local auditors

In the main findings, I define a local auditor as one located in the same province as their audit clients. I further analyze whether the results will be different if auditors are located in the same city as their clients. The results are generally consistent with the main findings.

7. Conclusions

To improve the quality of accounting information, Chinese regulators issue more conservative accounting standards with reference to international standards and introduce asset write-down regulations in 1998 and 2001. This study examines the impact of state ownership of A-share listed companies in China on the magnitude of asset write-downs, with respect to the more conservative financial reporting requirements. However, the write-down decision allows management to discretionally determine the recoverable value of relevant assets and to opportunistically manage reported earnings.

From a sample of 7258 observations for 1998 to 2005, the study finds that asset write-downs are affected by the nature of company ownership, especially when companies are controlled by local governments through state shares and state-owned legal person shares. Local government-controlled companies tend to write-down fewer assets, especially after the introduction of the more conservative accounting rules implemented by the *2001 Accounting Standards*. One possible reason is that the inclusion of four additional asset categories, which are generally of larger size, allows these firms to reduce the asset write-downs (or reverse previous write-downs) to meet the target ROE level and to retain their listing status. When I examine the relationship of local auditors and the magnitude of asset impairment, I find that they tend to agree with management's decision for a lower level of asset write-downs. I do not find similar results with the Big Four audit clients.

The results of this study contribute to understanding the unique characteristics of the Chinese capital market. With the intention to achieve the target ROE level to safeguard their listing status and to meet the rights issue requirements, companies tend to adopt an aggressive asset write-down policy to report the required ROE level. Second, this paper shows the impacts of ownership structures on earnings management. Managers of local government-controlled companies in China are more politically connected to the government (Fan et al., 2007), but they are seldom rewarded in line with their performance. To strive for political promotion and to indicate their superior performance in the competition with managers of non-listed SOEs, these managers have strong incentives to be aggressive in reporting. Third, prior literature finds that local auditors have greater economic dependence on local clients and tend to issue clean auditor opinions to companies owned by local government (Chan et al., 2006). The study provides further evidence that the locality of audit firms and their clients impact the impairment decision, especially when the audit clients are controlled by local governments. Policy makers should assess the effectiveness of regulations to improve the quality and independence of auditors in China. Fourth, Chen and Wu (2007) find that accounting standards alone are insufficient in conservative financial reporting. The present results further show that companies controlled by local governments have fewer incentives to recognize asset impairments despite the availability of conservative accounting rules.

This paper examines the magnitude of asset write-downs in China. In view of the unique characteristics of capital markets, future research can study the reversal of asset impairment in meeting the listing or rights issue requirements in this emerging market.

Data availability

All data are available from public sources.

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Does corporate integrity improve the quality of internal control?

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ABSTRACT

Using unique survey data to measure corporate integrity, we examine the relation between corporate integrity and internal control quality. The results show that corporate integrity is significantly and negatively associated with internal control weaknesses. We find a substitution effect between informal and formal institutions for improving internal control quality. In other words, the negative association between corporate integrity and internal control weaknesses is more significant when the legal development or market competition is weaker. Furthermore, we find that more effective corporate governance can strengthen the relation between corporate integrity and internal control quality. These findings indicate that corporate integrity can improve the quality of internal control. Our findings also provide empirical evidence for the construction of stronger internal controls.

1. Introduction

The objective of this study is to examine whether and how corporate integrity culture affects internal control quality in Chinese listed firms. Our research question is important because internal control systems play a crucial role in protecting the interests of investors around the world, especially since the Sarbanes–Oxley Act (SOX) of 2002 was enacted. Therefore, the issue of how to improve internal control quality has become a heavily researched topic in theoretical and practical studies. In June 2008, Chinese authorities issued the Enterprise Internal Control Standard (EICS), which closely resembles SOX Section 404.

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The staggered implementation of the new requirements began in January of 2012, and this implementation provides an opportunity for us to investigate the determinants of the internal control weakness in China.

Previous research finds that corporate fundamental characteristics such as company traits, business complexity, financial conditions, employee quality and corporate governance are significantly associated with internal control quality (Ge and McVay, 2005; Krishnan, 2005; Doyle et al., 2007; Ashbaugh-Skaife et al., 2007; Goh, 2009; Hoitash et al., 2009; Dhaliwal et al., 2011; Johnstone et al., 2011; Lin and Rao, 2009; Liu and Yao, 2014; Liu et al., 2017). Several researchers also verify the association between the institutional environment and internal control quality. These researchers find that the degree of protection for home-country investors (Gong et al., 2013), the marketization process and the legal environment (Liu et al., 2012; Li, 2013) are all significantly correlated with internal control quality. However, few previous studies have investigated the relationship between informal systems (such as corporate integrity culture) and internal control quality.

As the cornerstone of a market economy (Arrow, 1972), integrity culture acts as an important informal institution that not only alleviates moral hazard and reduces transaction costs, but also serves as a lifeline for improving an enterprise's efficiency, thereby enabling its survival and development (Fukuyama, 1995; Denison and Mishra, 1995; Guiso et al., 2015; Garrett et al., 2014). Guiso et al. (2015) define corporate integrity culture as the set of concepts and values that are shared by all corporate members and that affect the enterprise's performance. These researchers find that once corporate integrity increases by one standard deviation, the Tobin's Q increases by 0.19 standard deviations, and profit margins increase by 0.09 standard deviations. Jiang et al. (2015) find that a corporate culture that is oriented toward "integrity" can restrain corporate earnings management. Therefore, we consider how corporate integrity, as an informal system, affects internal control quality. This question is important for business managers, and it requires our further discussion and analysis. Therefore, this study focuses on the governance effect that corporate integrity culture has on internal control.

We argue that corporate integrity culture determines the key elements of internal control and has a significant impact on the entire internal control system. Therefore, we first test the relationship between corporate integrity and internal control quality. Furthermore, we consider that the formal and informal systems do not exist independently. In both mature and emerging transitional economies, these two systems inevitably coexist and influence each other (North, 1990; Greif, 1993). Therefore, this study examines the interaction between formal and informal systems, and it discusses the relationship between corporate integrity and internal control under different conditions of legal system development and market competition.

The empirical results show that corporate integrity displays a significant negative correlation with internal control weaknesses. In other words, the higher the degree of corporate integrity, the lower the probability of internal control weaknesses. We also find that there is a substitute relationship between corporate integrity and legal system/market competition. When the legal system is weaker or the market competition is lower, a negative correlation between corporate integrity and internal control weaknesses becomes more significant. However, this relationship is not significant. Further study finds that strong corporate governance helps to enhance the effect of corporate integrity on the internal control quality.

Our study contributes to two streams of literature. Our first contribution is to the literature on the economic consequences of corporate culture. The previous studies in this area explore the impact of corporate culture on firm performance (Guiso et al., 2015), but they rarely focus on the governance effects (Jiang et al., 2015). Our study focuses on the impact that corporate integrity culture has on corporate governance, and we find that corporate integrity is significantly related to the quality of internal control.

Our second contribution is to the literature on the determinants of internal control. At present, the available research in this area is mainly focused on the effects of company level characteristics (Doyle et al., 2007; Ashbaugh-Skaife et al., 2007). Little study has yet empirically examined the determinants of internal control from the perspective of informal systems such as corporate integrity culture. Our study's results indicate that corporate integrity, acting as an informal system, can influence internal control quality. Our findings should be of interest to regulators who wish to strengthen and expand their countries' credit systems.

The rest of the study is organized as follows. Section 2 presents the literature review. We discuss the theoretical analysis and research hypotheses in Section 3. Section 4 describes the research design, and Section 5

presents the results. Next we show the results of additional tests and a robustness test in Sections 6 and 7. Section 8 presents the study's conclusions.

2. Literature review

2.1. Role of corporate integrity

Prior researchers have generally focused on exploring the correlation between integrity cultures and corporate behaviors. Early studies in this area explored the effects of organization integrity on job attitudes, conflict management, cooperation, information communication and organizational transformation (Zand, 1972; Chami and Fullenkamp, 2002; McEvily et al., 2003; Libby and Lindsay, 2013; Chong and Ferdiansah, 2011). More recently, a meta-analysis by Dirks and Ferrin (2001) shows that corporate integrity can have a significant impact on business decisions through effectively reducing moral hazard and agency costs within the organization.

A limited body of empirical research directly investigates the association between corporate integrity and corporate behavior. Guiso et al. (2015) broadly define corporate integrity culture as the set of basic concepts and values that are shared by an organization's members. In general, the higher the level of corporate integrity, the better the corporate performance. Using the indicators proposed by the Great Place to Work Institution, Garrett et al. (2014) measure organizational integrity cultures in terms of the employees' trust in management, and these researchers empirically study the relationship between corporate integrity and financial reporting. Their findings indicate that corporate integrity promotes the delivery and sharing of information, and that the higher the level of corporate integrity, the higher the quality of corporate financial reporting. Other studies examine the impact of corporate integrity on corporate budgets (Chong and Ferdiansah, 2011), M&A activities (Wang, 2014; Bargeron et al., 2015) and earnings management (Biggerstaff et al., 2015; Jiang et al., 2015). Zhai et al. (2015) conduct tests and find evidence that an "integrity"-oriented corporate culture increases access to commercial credit.

2.2. Determinants of internal control

Several studies have investigated the impact of various company characteristics and institutional environments on the quality of internal control. In terms of company characteristics, Doyle et al. (2007) and Ashbaugh-Skaife et al. (2007) find that companies that disclose material weaknesses in their internal control tend to be smaller, younger, in poorer financial condition, more complicated as businesses, more rapidly growing or to have experienced reorganization during the previous year. In China, several researchers find similar results (Fang et al., 2009; Lin and Rao, 2009; Tian et al., 2010; Zhang and Zheng, 2010). These studies show that factors such as corporate complexity, financial condition, growth rate and internal audit quality are all related to internal control quality.

In terms of assessing corporate governance, our study finds that the characteristics of the board of directors and its audit committee (such as board diligence, audit committee independence and professionalism, or the professional ability of chief financial officer (CFO)) are all significantly related to the quality of internal control (Krishnan, 2005; Hoitash et al., 2009; Goh, 2009; Dhaliwal et al., 2011; Johnstone et al., 2011; Krishnan and Visvanathan, 2008).

The existing research also notes the impact of the institutional environment. Gong et al. (2013) find that the degree of protection for home-country investors plays a vital role in determining the efficiency of internal control in cross-listed companies. Managers are more capable and more motivated to encroach on the interests of small- and medium-sized investors if legal protections are relatively weak. In such cases, the managers are often reluctant to disclose internal control weakness, as they aim to protect the private interests that control their firms. Yang et al. (2011) finds that the disclosures made in self-assessment reports by Chinese listed companies have varying levels of transparency. The level of marketization, the legal environment and the nature of the shareholders can all affect information disclosure. Liu et al. (2012) also shows that the institutional environment has a significant impact on the quality of internal control.

The studies discussed above are mainly focused on the determinants of internal control at the formal, institutional level, for example in terms of corporate governance and legal counsel. To date, few studies have examined the relations between informal institutions and internal control behavior. Accordingly, this study attempts to explore the impact of corporate integrity on corporate internal control behavior. For those concerned with actively promoting an integrity-oriented business environment in China, this study should have important theoretical and practical significance.

3. Theoretical analysis and research hypotheses

3.1. Corporate integrity and internal control quality

For business enterprises, integrity involves having a stable code that all employees abide by (O'Reilly and Chatman, 1996). The sense of shared integrity can serve to guide the employees' psychological concerns or behaviors and to stabilize decision making. Clearly, the firm's integrity culture affects the implementation of internal control.

One channel through which corporate integrity may influence internal control quality is the formation of an effective control environment. Paying more attention to the firm's integrity and moral values tends to form an effective control environment, which then improves internal control quality. Within an enterprise, the shared sense of integrity and adherence to ethical values reflects the degree to which senior managers are able to form and maintain a moral company culture (Cremer, 1993; Erhard and Jensen, 2014; Guiso et al., 2015). According to COSO (2013), "Internal control is a process which can be implemented by an entity's board, managements, and other employees." Therefore, whether managers take their relevant responsibilities seriously becomes an important precondition for integrity (Liu et al., 2013). No internal control system can curb self-interested behavior without the presence of a faithful, ethically principled management team. Hence, the moral tone of management is highly important for ensuring an effective system.

Corporate integrity also affects the efficiency of information communication and transmission within an organization. Paying more attention to integrity and moral values can promote better communication and sharing of information, which can ultimately improve internal control quality. On one hand, integrity is a fundamental factor for achieving appropriate information delivery and sharing (Staples and Webster, 2008). Integrity can also provide employees with a set of reliable psychological expectations (Liu et al., 2009), while reducing the degree of information asymmetry and moral hazard. On the other hand, shared integrity and moral values promote mutual trust among employees (Guiso et al., 2015). Such trust, in turn, inspires the employees to voluntarily comply with the existing internal control system and to achieve self-regulation in their work standards (Wang and Sui, 2010). In that case, when employees discover problems and risks in implementing their directives, they are more willing to communicate promptly and openly with trusted executives, and to propose corrective suggestions for improving the efficiency of internal control.

To summarize the above-mentioned observations, we argue that greater attention to corporate integrity and shared moral values can significantly affect a firm's internal control quality. Therefore, we propose the following hypothesis:

Hypothesis 1. Higher corporate integrity has a significant positive relation with internal control quality.

3.2. Legal development, corporate integrity and internal control quality

Informal institutions, such as standards of corporate integrity, cannot affect actual decision-making without the backing of formal institutions (North, 1990). Both types of institutions are necessary in forming the basis for social interactions in all types of societies (Greif, 1993). Previous studies have suggested that informal institutions (e.g., corporate integrity) become more significant in affecting trading behavior when formal systems fail to regulate markets in an orderly way (La Porta et al., 1997; Zak and Knack, 2001). For example, Guiso et al. (2004) examine an Italian sample, and find that the impact of social capital (including integrity) on financial development is more significant in areas with poor legal protection. In studying China's economy,

Allen et al. (2005) emphasize that reputation and relationship are important alternative mechanisms that can remedy the weakness of formal institutions in providing legal protection.

Corporate integrity has a more prominent role in countries and regions with weaker legal protection. When the legal system fails to control corporate behavior, informal institutions (e.g., corporate integrity) can help to maintain trust and confidence in market trading. In environments with stronger legal systems, however, enterprises are more willing to conduct high-quality internal control and achieve compliance with externally imposed requirements. This strength of formal institutions can weaken the role of informal institutions, and where formal institutions are weaker, the informal institutions become more crucial. In that case, integrity, which arises from an enterprise's own culture and morality, may form an alternative environmental basis for implementing internal control through regulating the conduct of all employees. Thus, we propose the following second hypothesis:

Hypothesis 2. Within a weak legal environment, higher corporate integrity has a more significantly positive relation with internal control quality.

3.3. Market competition, corporate integrity and internal control quality

External market competition can also restrain an enterprise's internal behaviors (Alchian, 1950), and can undermine the role of corporate integrity culture. In addition, fierce market competition can lower the ethical standards of society as a whole (Shleifer, 2004). Participating in market competition means that the enterprises involved are bound not only by social norms, but also by the need to actively deal with threats induced by fierce market competition. According to economic transition theory (Alchian, 1950; Stigler, 1958), product market competition is the strongest driver for achieving economic efficiency. To obtain a higher market share, companies typically try to reduce information asymmetry and to actively shape a good social and market image of themselves (Johnson et al., 2000).

In addition, fierce market competition affects corporate behaviors by increasing the risk of mergers and acquisitions. Especially for firms with weak internal control and poor risk-prevention capability, market competition can exert great pressure on managers. Such competition can force firms to enhance their level of corporate internal control and increase their capabilities for risk prevention. Therefore, we propose the following third hypothesis:

Hypothesis 3. When market competition is lower, higher corporate integrity has a more significantly positive relation with internal control quality.

4. Research design

4.1. Sample selection and data sources

We capture corporate integrity data from an internal control-related survey that was conducted by China's internal control research group in 2014.[1] This research group cooperated with the China Securities Regulatory Commission (CSRC) in sending questionnaires to A-share listed companies on the Shanghai and Shenzhen stock exchanges to investigate the implementation of internal controls in China's listed companies. A total of 2536 A-share listed companies from all industries received the questionnaires. Each of these companies received questionnaires addressed to the chairman, CEO, board secretary, CFO, the internal auditors, the IT director and the internal control director. After collecting the questionnaires, we conducted field research

[1] For details, please refer to Ministry of Finance, Corporate Internal Control Briefing (No. 4, 2015), available at http://kjs.mof.gov.cn/zhengwuxinxi/kuaijiguanlidongtai/201509/t20150925_1476561.html.

on a number of listed companies during late October and early November 2014, and we reviewed the questionnaire data to confirm its credibility.

Up to 31 October 2014, the research group recovered 12,551 questionnaires from 2154 A-share listed companies, for a response rate of 84.95%. We then sent questionnaires to 1427 companies listed in the main board market, and received 6898 responses from 1140 listed companies, for a response rate of 79.89%. Furthermore, we sent questionnaires to 722 small- and medium-sized listed companies, and received 3933 responses from 702 of these companies, for a response rate of 97.23%. In addition, questionnaires were distributed to 387 companies listed in the second board market, and we received 1720 completed forms from 312 of these companies, for a response rate of 80.62%. In this empirical research, we deleted the missing samples.

Our sample spans 2012 to 2014. The sample is limited to these years because the survey was conducted in 2014, and the reported levels of corporate integrity could have changed after that period. In addition to the data from the questionnaire survey, other data are obtained from the CSMAR database and the Wind financial database. Furthermore, we exclude some of the samples in the following ways: (1) we eliminate the sample companies that did not reply the questionnaire; (2) we eliminate B-share listed companies; (3) we eliminate financial firms; (4) we eliminate firms with missing variables in the regression; and (5) we eliminate ST, T and PT firms. Finally, we obtain a total of 5488 observations. To eliminate possible heteroscedasticity, we also use a robust function to readjust the data in the regression. Furthermore, we add year and industry dummy variables in the regression to control for fixed effects. We Winsorize all of the continuous variables in the model at the 1st and the 99th percentiles to mitigate the possible effects from outliers.

4.2. Variable definitions and model settings

4.2.1. The definitions of the main variables

(1) Corporate integrity

We construct the corporate integrity index *Integrity* by evaluating responses to the survey item inquiring about "the degree to which the enterprise attaches importance to integrity and moral values." In terms of variable processing, we refer to the method of Li et al. (2014). We recode the response to this item as 1 if a survey participant selects "strongly disagree," "disagree," or "neither disagree nor agree." We recode the responses as 2 if they select "agree," and as 3 if they select "strongly agree." We use the mean of the responses from each firm as our measure of corporate integrity (*Integrity*). The greater the measure of *Integrity*, the higher the level of corporate integrity.

We also test the reliability and validity of the questionnaires for reporting on integrity and its related problems. The coefficient of the reliability test is 0.780, which is greater than 0.4, which indicates that the questionnaire is reliable and stable. In terms of validity, there is a significant correlation between the indicators, which shows that the indicators have good validity.

(2) Internal control quality

We capture internal control quality by measuring the internal control weaknesses. The index we use comes from the DIB database of internal control evaluations and audit weaknesses. The information in this database is obtained from internal control evaluation reports, internal control audit reports and annual reports issued by listed companies. Specifically, the weakness index is classified according to the "Enterprise Internal Control Standards" and the "Guidelines for Enterprise Internal Control," which are manuals issued by five ministries and commissions, including the Ministry of Finance. In addition, we consider nonstandard audit opinions and the relevant information on corporate frauds to supplement our indicators of internal control weaknesses.

On this basis, we construct the indicator of internal control weaknesses (*IC_Dum*). *IC_Dum* equals 1 if an enterprise has internal control weaknesses, and 0 otherwise. In considering Hypothesis 1, we also classify internal control weaknesses by severity, based on the COSO (2013) and the "Guidelines for the Evaluation of Enterprise Internal Control." Specifically, we use "3", "2" and "1" to represent "material weakness," "significant deficiency" and "deficiency," respectively. We apply these ratings to test the impact of corporate integrity on the severity of internal control weaknesses (*IC_level*). In the robustness test, we evaluate the reliability of

our findings by comparison with data from the DIB internal control objective index (*IC_object*) and the disclosure index (*IC_disclosure*).

4.2.2. Empirical model

In considering the methods of previous studies (Doyle et al., 2007; Ashbaugh-Skaife et al., 2007; Liu et al., 2012), we construct the following logit regression model to test Hypothesis 1:

$$IC\_Dum_{it} = \alpha_0 + \alpha_1 Integrity + \alpha_2 Controlvariables_{it} + \alpha_3 \Sigma Industry_{it} + \alpha_4 \Sigma Year_{it} + \varepsilon. \quad (1)$$

To test Hypothesis 2, we construct the interaction index in model (2). Using the median value of the law variable, we construct a new dummy (*Dum_law*) to divide the sample into high and low legal systems, and we test model (1) to determine whether there is a significant difference in the α_1 coefficient. For the pooled sample, we further test the influence of the legal system on the relation between corporate integrity and internal control by adding the interaction terms of *Integrity* and *Dum_law* into model (2). According to Hypothesis 2, we expect that the coefficient of α_3 should be significantly positive.

$$IC_{Dum_{it}} = \alpha_0 + \alpha_1 Integrity + \alpha_2 Dum\_law + \alpha_3 Integrity * Dum\_law + \alpha_4 Controlvariables_{it} + \alpha_5 \Sigma Industry_{it} + \alpha_6 \Sigma Year_{it} + \varepsilon \quad (2)$$

To test Hypothesis 3, we assess the influence of corporate integrity on the quality of internal control under different levels of market competition. In accordance with Yin et al. (2010), we use each industry's Herfindahl–Hirschman index (*HHI*) to reflect the degree of industry concentration. A lower *HHI* represents higher market competition. Using the median of the law variable, we construct a new dummy (*Dum_HHI*) to divide the sample into high and low levels of market competition, and we test model (1) to determine whether there is a significant difference in the coefficient α_1. For the pooled sample, we further test the influence of market competition on the relationship between corporate integrity and internal control by adding the interaction terms of *Integrity* and *Dum_HHI* into model (3). According to Hypothesis 3, we expect that the coefficient of α_3 should be significantly positive.

$$IC\_Dum_{it} = \alpha_0 + \alpha_1 Integrity + \alpha_2 Dum\_HHI + \alpha_3 Integrity * Dum\_HHI + \alpha_4 Controlvariables_{it} + \alpha_5 \Sigma Industry_{it} + \alpha_6 \Sigma Year_{it} \quad (3)$$

Following the prior literature, we also control for a series of characteristics that can affect internal control quality (Doyle et al., 2007; Ashbaugh-Skaife et al., 2007; Rice and Weber, 2012). These characteristics include the size of the company (*Size*), the asset debt ratio (*Lev*), sales growth (*Growth*), CEO duality (*Dual*), board size (*Bdsize*), supervision mechanism (*ZH*), the ratio of independent directors (*Pindepen*), whether the firm hires a big ten accountant (*Big10*), whether the enterprise suffers losses in two consecutive years (*Loss*) and whether the enterprise has engaged in a merger or acquisition activity (*MA*). We also control for the form of ownership (*Soe*). In China, the form of ownership is an important factor that affects the implementation of internal controls. The quality of internal control in a state-owned listed company is, in general, significantly higher than that in a private company. In accordance with Wang et al. (2017), we also use the Lawindex[2] from "China's sub-province market index report" (2016) as a control variable to measure the level of legal system development in the area concerned. A summary of the variable definitions is included in Table 1.

5. Empirical analysis

5.1. Descriptive statistics

Table 2 reports the descriptive statistics of the main variables. For the period we survey, 18.3% of the participating firms report being exposed to internal control weaknesses. Regarding the independent variables, the mean (median) of *Integrity* is 2.386 (0.627), the Max (Min) is 3 (1), and the standard deviation is approximately 0.627. These figures suggest that there are tremendous differences among corporate behaviors. Pertain-

[2] As this index is updated every two years, our study uses the index of 2012 for 2013.

Table 1
Variable definitions.

Dependent variable	
IC_Dum	Dummy variable that equals 1 if there are internal control weaknesses in that year, and otherwise 0
Independent variable	
Integrity	Integrity is constructed from a survey conducted by China's internal control research group in 2014. The survey asks about "the degree to which enterprises attach importance to their integrity and moral values." We recode the responses to this question as 1 if a survey participant answers "strongly disagree," "disagree" or "neither disagree nor agree," as 2 if they select "agree" and as 3 if they select "strongly agree." Next, we average the responses of all respondents from one firm to produce a firm level measure of corporate integrity
Control variables	
Size	A company-size scale, measured as the natural logarithm of the total assets of a company at the end of the year
Lev	Measured as the sum of a firm's long-term and short-term loans divided by total assets
Loss	A dummy variable that equals 1 if a firm suffers a loss in two consecutive years, and 0 otherwise
Growth	Measured as the rate of sales growth
MA	A dummy variable that equals 1 if a firm has engaged in merger or acquisition activity, and 0 otherwise
Dual	A dummy variable that equals 1 if the chairman and the general manager are the same person, and 0 otherwise
Bdsize	The size of the board, measured by the number of board members
ZH	A measure of the supervision mechanism, which equals the ratio of the largest shareholder's holdings to those of the second-largest shareholder
Pindepen	The ratio of independent directors, measured as the number of independent directors divided by the number of board members
Big10	A dummy variable for auditor style that equals 1 if the firm's auditor belongs to a top ten accounting company, and 0 otherwise
Soe	A dummy variable that equals 1 if the firm is state-owned, and 0 otherwise
Law	The level of legal development at the site of the company, which is measured by a legal environment index on the site of the company (Wong et al., 2017)
asIndustry	A dummy variable that equals 1 if the firm belongs to one single industry, and 0 otherwise. The industry classifications are based on the standards used by the CSRC in 2012
Year	A dummy variable that equals 1 if the sample belongs to one single year, and 0 otherwise

ing to the control variables, the mean of size is 21.92, the mean of *Lev* is 0.152, and the mean of *MA* is 0.446, which indicates that 44.6% of the firms in the sample have engaged in merger and acquisition activities. Also, 26.2% of the sample firms have a chairman and general manager who are the same person. The mean of *Bdsize* is 2.148, and the mean of *Independ* is 0.371 (0.333). The Max (Min) of *law* is 12.680 (0.440), and the standard deviation is approximately 6.314, which suggests that there are tremendous variations among the legal environments in different regions.

Table 3 presents the Pearson correlations of the main variables. This table shows that corporate integrity is significantly and negatively correlated with internal control weaknesses. These results provide preliminary proof for Hypothesis 1, indicating that the higher the level of corporate integrity, the lower the likelihood of experiencing internal control weaknesses.

5.2. Empirical results

5.2.1. Corporate integrity and internal control quality

We test the relation between corporate integrity and internal control weaknesses by estimating the *Logit* regression model specified in model (1), and we present the results in Table 4. The coefficient estimates for the industry and the year fixed-effect variables are suppressed for brevity. As predicted by model (1), the

Table 2
Descriptive statistics for the main variables.

Variable	*N*	Mean	Median	Min	Max	SD
IC_Dum	5488	0.183	0.000	0.000	1.000	0.386
Integrity	5488	2.386	2.000	1.000	3.000	0.627
Size	5488	21.920	21.760	18.780	25.960	1.239
Lev	5488	0.152	0.123	0.000	0.709	0.145
Loss	5488	0.012	0.000	0.000	1.000	0.111
Growth	5488	0.520	0.131	-0.983	13.840	1.720
MA	5488	0.446	0.000	0.000	1.000	0.497
Dual	5488	0.262	0.000	0.000	1.000	0.440
Bdsize	5488	2.148	2.197	1.609	2.773	0.195
ZH	5488	12.670	4.281	1.006	252.100	25.060
Pindepen	5488	0.372	0.333	0.182	0.556	0.052
Big10	5488	0.620	1.000	0.000	1.000	0.485
Soe	5488	0.381	0.000	0.000	1.000	0.486
Law	5488	6.314	6.730	0.440	12.680	2.185

coefficient of *Integrity* in column (1) is negative with a significance level of 5%, which reveals that higher corporate integrity has a negative relation with internal control weaknesses. Furthermore, we consider the weaknesses classified by severity, and we find that the coefficient of *Integrity* in column (2) is negative with a significance level of 1%. All of these findings indicate that higher corporate integrity can truly improve internal control quality.

Concerning the control variables, Table 4 shows that corporate size can significantly reduce the severity of internal control weaknesses. The table also indicates that higher leverage and poor financial conditions can drive poor internal control quality. These results are consistent with those of prior research on the determinants of internal control (Doyle et al., 2007; Ashbaugh-Skaife et al., 2007; Liu et al., 2013).

5.2.2. Relation between corporate integrity and internal control quality: Depending on legal system

To investigate the influence of the legal system, we again use model (2) to retest the association between corporate integrity and internal control weaknesses in the subsamples of high and low law (or high and low legal system strength). Table 5 presents the corresponding results of the logit regression, with the coefficient estimates for the industry and year fixed-effects suppressed for brevity. In the high law subsample, column (1) shows no significant association between these variables, but in the low law subsample, column (2) shows that the coefficient of *Integrity* displays a significantly negative relation to internal control weaknesses. Finally, with the pooled sample, we add the interaction of *Integrity* and *Dum_law* into model (2). Column (3) shows that the coefficient of the interaction between *Integrity* and *Dum_law* is positive at a significance level of 10%. These findings show that a substitute effect exists between corporate integrity and the level of the legal system, thereby providing proof for Hypothesis 2.

5.2.3. Relation between corporate integrity and internal control quality: Depending on market competition

To investigate the influence of market competition, we again use model (3) to retest the association between corporate integrity and internal control weaknesses in the subsamples of high and low market competition. Table 6 presents the results of the logit regression, in which the coefficient estimates for the industry and year fixed-effects are suppressed for brevity. For the high market competition subsample, column (1) shows that the coefficient of *Integrity* displays an insignificant negative relation, but in the low market competition subsample, column (2) shows that the coefficient is positive with a significance level of 1%. Finally, in the pooled sample, we add the interaction of *Integrity* and *HHI* into model (3), and column (3) shows that the coefficient of interaction between these factors is significantly positive. These results show that a substitute effect exists between corporate integrity and market competition, thereby providing proof for Hypothesis 3.

Table 3
Correlation matrix of main variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. IC_Dum													
2. Integrity	−0.034**	1.000											
3. Size	−0.079***	0.124***	1.000										
4. Lev	0.089***	−0.006	0.336***	1.000									
5. Loss	0.071***	−0.009	−0.032**	0.109***	1.000								
6. Growth	−0.009*	−0.003	−0.006	0.021	0.014	1.000							
7. MA	−0.007	0.013	0.100***	0.046***	−0.051***	0.054***	1.000						
8. Dual	0.007	−0.031**	−0.183***	−0.081***	−0.007	−0.037***	0.006	1.000					
9. Bdsize	0.003	0.051***	0.282***	0.118***	0.001	−0.021	−0.016	−0.182***	1.000				
10. ZH	−0.015	−0.015	0.149***	0.116***	0.028**	0.028**	−0.015	−0.089***	0.010	1.000			
11. Pindepen	−0.004	0.006	0.006	0.001	0.028**	0.006	0.007	0.117***	−0.488***	0.015	1.000		
12. Big10	0.043***	−0.035***	−0.016	0.001	0.010	0.004	0.010	0.051***	0.003	0.018	−0.013	1.000	
13. Soe	0.022*	0.092***	0.363***	0.188***	0.061***	0.019	−0.060***	−0.278***	0.250***	0.219***	−0.074***	0.016	1.000
14. Law	−0.035***	−0.023*	0.013	−0.123***	−0.024*	−0.009	0.032**	0.053***	−0.079***	−0.022	0.021	0.003	−0.071***

Table 4
Regression analysis: Corporate integrity and internal control quality.

	IC_Dum (1)	(*IC_level*) (2)
Integrity	−0.097**	−0.113***
	(−2.18)	(−2.60)
Size	−0.270***	−0.282***
	(−9.91)	(−9.33)
Lev	1.999***	2.096***
	(5.19)	(4.87)
Loss	0.738***	0.915***
	(5.16)	(5.68)
Growth	−0.003	−0.002
	(−0.13)	(−0.09)
MA	0.056	0.048
	(0.56)	(0.48)
Dual	0.015	0.019
	(0.30)	(0.34)
Bdsize	0.153	0.175
	(0.70)	(0.81)
ZH	−0.003**	−0.003**
	(−2.23)	(−2.37)
Pindepen	0.354	0.427
	(0.45)	(0.54)
Big10	0.225***	0.206***
	(4.23)	(4.40)
Soe	0.267***	0.253**
	(2.73)	(2.47)
Law	0.005	0.007
	(0.53)	(0.70)
Cons1	4.260***	−4.519***
	(5.35)	(−5.48)
Cons2		−3.475***
		(−4.22)
Cons3		−3.251***
		(−3.89)
Year & Industry	Yes	Yes
N	5488	5488
p_R2	0.041	0.032

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively (two-tailed test).

6. Additional tests: The effect of corporate governance

We consider that other conditions (such as the corporate governance condition) may also affect the relation between corporate integrity and internal control weaknesses. Corporate governance involves a series of institutional measures that can be used to coordinate the relationships of interest between the company and its clients, and such governance can ultimately affect corporate decision making on matters including the implementation of internal controls. Hoitash et al. (2009) and Goh (2009) show that stronger corporate governance can improve internal control effectiveness. Our study further investigates whether corporate governance can affect the relation between corporate integrity and internal control quality.

Table 5
The relation between corporate integrity and legal system in affecting internal control quality.

	IC_Dum		
	High	Low	Pooled sample
	(1)	(2)	(3)
Integrity	−0.015	**−0.166*****	**−0.159*****
	(−0.29)	**(−2.79)**	**(−2.90)**
Dum_law			−0.192
			(−0.97)
*Integrity * Dum_law*			**0.129***
			(1.84)
Size	−0.325***	−0.229***	−0.274***
	(−8.10)	(−6.22)	(−10.07)
Lev	2.335***	1.720***	2.029***
	(5.35)	(4.13)	(5.35)
Loss	0.484	0.973***	0.731***
	(1.60)	(4.00)	(5.08)
Growth	−0.003	−0.003	−0.003
	(−0.06)	(−0.13)	(−0.12)
MA	0.025	0.095	0.054
	(0.17)	(1.22)	(0.54)
Dual	0.101	−0.072	0.009
	(0.90)	(−1.30)	(0.16)
Bdsize	0.179	0.171	0.157
	(0.33)	(0.59)	(0.72)
ZH	−0.001	−0.004**	−0.003**
	(−0.67)	(−2.00)	(−2.28)
Pindepen	1.154	−0.387	0.369
	(1.24)	(−0.37)	(0.47)
Big10	0.384***	0.082	0.222***
	(4.90)	(1.37)	(4.18)
Soe	0.272	0.240***	0.270***
	(1.55)	(3.00)	(2.80)
Cons	4.744***	3.992***	4.491***
	(3.90)	(3.68)	(5.64)
Year & Industry	Yes	Yes	Yes
N	2728	2760	5488
p_R2	0.048	0.042	0.042

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively (two-tailed test).

First, in accordance with the study by Bai et al. (2005), we choose eight indicators and build a comprehensive governance index (*Governance*) via principal component analysis. These eight indictors include a dummy that reflects whether the CEO and the chairman of the board are the same person, a dummy that reflects whether an enterprise owns its parent company, a dummy that reflects whether an enterprise is listed in another market, a dummy that reflects whether a company is state-controlled, and indicators giving the proportion of independent directors, the management shareholding ratio, the shareholding ratio of the largest shareholder and the ratio of the company's largest shareholder to its second largest shareholder. After controlling for this comprehensive variable, the results listed in column (1) of Table 7 show that a significantly

Table 6
Relation between corporate integrity and market competition on internal control quality.

	IC_Dum		
	High	Low	Pooled sample
	(1)	(2)	(3)
Integrity	0.016	**−0.209*** **	**−0.209*** **
	(0.19)	**(−5.83)**	**(−2.95)**
Dum_HHI			**−0.488** **
			(−2.41)
*Integrity * Dum_HHI*			**0.223*** **
			(2.61)
Size	−0.290***	−0.239***	−0.272***
	(−3.64)	(−7.80)	(−9.76)
Lev	1.632***	2.389***	2.018***
	(8.70)	(5.57)	(5.19)
Loss	0.962***	0.491	0.745***
	(5.41)	(0.65)	(5.27)
Growth	0.008	−0.035	−0.004
	(0.25)	(−1.10)	(−0.16)
MA	0.027	0.090	0.056
	(0.28)	(0.39)	(0.55)
Dual	0.159	−0.140**	0.015
	(1.53)	(−2.42)	(0.29)
Bdsize	0.001	0.208	0.167
	(0.00)	(0.74)	(0.76)
ZH	−0.001***	−0.004*	−0.002**
	(−3.12)	(−1.85)	(−2.17)
Pindepen	0.613	0.023	0.401
	(0.56)	(0.02)	(0.51)
Big10	−0.024	0.451***	0.224***
	(−0.23)	(5.36)	(4.26)
Soe	0.351***	0.171	0.264***
	(5.34)	(1.23)	(2.76)
Law	0.013	−0.009	0.005
	(1.64)	(−0.56)	(0.51)
Cons	4.675*	3.955***	4.483***
	(1.92)	(4.42)	(5.66)
Year & Industry	Yes	Yes	Yes
N	2757	2731	5488
p_R2	0.047	0.052	0.042

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively (two-tailed test).

negative correlation still exists between corporate integrity (*Integrity*) and internal control weaknesses (*IC_Dum*).

Second, we further divide the sample based on the median of the corporate governance index. Columns (2) and (3) of Table 7 show the empirical results for the subsamples in the high and low governance conditions. In the high corporate governance subsample, the coefficient of *Integrity* is negative with a significance level of 1%. However, in the low corporate governance subsample, *Integrity* is insignificantly negative. In the pooled sam-

Table 7
Relation between corporate integrity and internal control quality: Dependent on corporate governance.

	(*IC_Dum*)			
	Pooled sample (1)	Higher govern (2)	Lower govern (3)	Pooled sample (4)
Integrity	**−0.091***	**−0.208*****	0.018	0.017
	(−1.93)	**(−3.89)**	(0.18)	(0.18)
Governance	−0.056***			
	(−6.17)			
Govern				0.355**
				(2.33)
*Integrity * Govern*				**−0.222****
				(−2.82)
Size	−0.255***	−0.251***	−0.266***	−0.257***
	(−8.63)	(−3.29)	(−5.67)	(−4.99)
Lev	2.065***	2.145***	2.071***	2.089***
	(5.37)	(8.21)	(3.86)	(6.03)
Loss	0.619***	0.761	0.499**	0.609**
	(3.61)	(1.23)	(2.17)	(1.22)
Growth	−0.003	−0.024	0.008	−0.003
	(−0.13)	(−0.53)	(0.36)	(−0.17)
MA	0.046	−0.019	0.113	0.048
	(0.44)	(−0.13)	(1.46)	(0.38)
Big10	0.235***	0.228**	0.242***	0.235***
	(4.02)	(2.01)	(4.62)	(2.90)
Law	0.007	0.006	0.014	0.008
	(0.79)	(0.28)	(0.94)	(1.11)
Cons	4.388***	4.659***	4.241***	4.256***
	(6.32)	(2.73)	(5.37)	(3.46)
Year & Industry	Yes	Yes	Yes	Yes
N	5354	2678	2676	5354
p_R2	0.040	0.0364	0.049	0.041

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively (two-tailed test).

ple, we add the interaction of *Integrity* and the dummy of governance (*Govern*). As shown in column (4), the interaction coefficient of *Integrity* and *Govern* is significantly negative. These results indicate that effective corporate governance helps to enhance internal control quality.

7. Robustness test

7.1. Endogeneity problem

According to the results reported above, we believe that corporate integrity has a clear effect on corporate internal control behaviors. However, there is also a possibility that better internal control tends to produce higher integrity and stronger moral values. Therefore, internal control can also affect corporate integrity, which could result in a certain endogeneity problem. We use the instrumental variable method to solve this potential endogeneity issue. Guiso et al. (2004) believes that blood donations reflect the public morals of a region, and that the presence of such values can affect the level of local integrity. Therefore, in accordance with Pan et al. (2009), we conduct a two-stage regression analysis, with the provincial blood donation rate (*Blood*) in 2000 as an instrumental variable. First, the results show that the p value is 0.433, which reveals that the

Table 8
Relation between corporate integrity and internal control quality: Instrumental variable method.

	Internal control weakness (*IC_Dum*)					
	First stage	Second stage				
		Pooled sample	Higher legal	Lower legal	Higher competition	Lower competition
	(1)	(2)	(3)	(4)	(5)	(6)
Blood	**0.031***** **(2.88)**					
Integrity		**−5.161***** **(−4.41)**	−1.756 (−0.65)	**−8.114**** **(−2.14)**	−3.077 (−0.96)	**−6.836**** **(−2.23)**
Size	0.050*** (4.35)	0.000 (0.00)	0.116 (0.59)	−0.151 (−1.01)	0.093 (0.57)	−0.110 (−0.63)
Lev	−0.193 (−1.28)	0.879* (1.90)	0.649 (0.77)	1.269* (1.86)	0.306 (0.41)	1.494* (1.95)
Loss	−0.040 (−0.35)	0.698*** (2.79)	0.438 (0.75)	1.048** (2.49)	0.860* (1.94)	0.484 (0.91)
Growth	−0.000 (−0.06)	−0.006 (−0.26)	−0.008 (−0.19)	−0.004 (−0.14)	0.002 (0.07)	−0.027 (−0.60)
MA		0.070 (0.74)	0.040 (0.34)	0.098 (0.91)	0.057 (0.49)	0.075 (0.67)
Dual		0.043 (0.85)	0.176 (1.22)	−0.066 (−0.46)	0.222 (1.63)	−0.157 (−1.01)
Bdsize		0.199 (1.03)	0.328 (0.78)	0.127 (0.33)	−0.158 (−0.40)	0.446 (1.04)
ZH		−0.003* (−1.65)	−0.001 (−0.38)	−0.004 (−1.44)	−0.002 (−0.64)	−0.004 (−1.23)
Pindepen		0.532 (0.66)	1.506 (0.98)	−0.272 (−0.21)	0.495 (0.34)	0.132 (0.09)
Big10	−0.049** (−1.99)	0.024 (0.33)	0.110 (0.45)	−0.009 (−0.05)	−0.357* (−1.92)	0.422** (1.98)
Soe	0.065*** (3.13)	0.552*** (5.42)	0.784*** (2.64)	0.311 (1.53)	0.746*** (3.18)	0.319 (1.25)
Law		−0.004 (−0.35)			−0.007 (−0.21)	−0.005 (−0.15)
Cons	1.493*** (6.58)	11.486*** (5.84)	16.009*** (2.72)	6.557 (1.50)	14.661*** (2.90)	8.109 (1.62)
Year & Industry	Yes	Yes	Yes	Yes	Yes	Yes
N	4872	4872	2200	2672	2452	2420
R2/p_R2	0.021	0.041	0.054	0.039	0.049	0.050

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively (two-tailed test).

instrumental variables are not related to the disturbance items. Second, we examine the correlation between the instrumental variables and the endogenous variables. The test results show that the *F* statistic is 13.774, which is greater than 10, thus indicating that the correlation between the instrumental variables and the endogenous variables is strong. These results show that the selected instrumental variables are valid.

Concerning the empirical test, column (1) in Table 8 shows the results of the first stage of the regression, and columns (2)–(6) give the regression results for Hypotheses 1–3 in the second stage. In the first stage, the blood donation rate (*Blood*) is significant at the 1% level. In the second stage, the integrity of the enterprise (*Integrity*) is significant at the 1% level, which verifies Hypothesis 1. Concerning Hypotheses 2 and 3, the

Table 9
Robustness check of main tests: Other measurements of corporate integrity indicators.

	Internal control weakness (*IC_Dum*)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pooled sample	Legal system			Market competition		
		High	Low	Pooled sample	High	Low	Pooled sample
Integrity_culture	**−0.120*****	−0.080	**−0.165*****	−0.146**	−0.080	**−0.186*****	−0.150***
	(−3.62)	(−0.93)	**(−2.80)**	(−2.57)	(−1.38)	**(−3.70)**	(−3.08)
Dum_law				0.079			
				(1.37)			
*Integrity_culture * Dum_law*				0.061			
				(0.80)			
Dum_HHI							0.013
							(0.24)
*Integrity_culture * Dum_HHI*							0.053
							(0.56)
Size	−0.269***	−0.323***	−0.221***	−0.270***	−0.285***	−0.235***	−0.268***
	(−9.64)	(−6.20)	(−5.72)	(−9.51)	(−3.79)	(−3.60)	(−9.49)
Lev	2.004***	2.334***	1.707***	2.023***	1.614***	2.370***	2.005***
	(5.43)	(4.81)	(4.27)	(5.58)	(4.89)	(5.18)	(5.40)
Loss	0.746***	0.490*	0.995***	0.745***	0.964***	0.482	0.744***
	(5.35)	(1.81)	(4.19)	(5.36)	(7.20)	(1.30)	(5.33)
Growth	−0.003	−0.003	−0.004	−0.003	0.008	−0.035	−0.004
	(−0.15)	(−0.11)	(−0.17)	(−0.13)	(0.37)	(−0.95)	(−0.15)
MA	0.056	0.026	0.092	0.053	0.028	0.090	0.056
	(0.56)	(0.31)	(1.16)	(0.52)	(0.21)	(1.17)	(0.56)
Dual	0.010	0.100	−0.078	0.006	0.156	−0.146**	0.009
	(0.19)	(0.74)	(−1.46)	(0.11)	(1.52)	(−2.53)	(0.18)
Bdsize	0.146	0.177	0.161	0.151	−0.008	0.199	0.152
	(0.67)	(0.27)	(0.54)	(0.70)	(−0.03)	(0.56)	(0.70)
ZH	−0.003**	−0.001	−0.004**	−0.003**	−0.001	−0.005**	−0.003**
	(−2.12)	(−0.65)	(−2.01)	(−2.18)	(−0.54)	(−2.50)	(−2.13)
Pindepen	0.303	1.126	−0.466	0.323	0.575	−0.104	0.309
	(0.39)	(0.92)	(−0.46)	(0.42)	(0.81)	(−0.08)	(0.41)
Big10	0.236***	0.389***	0.100*	0.233***	−0.020	0.472***	0.236***
	(4.59)	(6.16)	(1.70)	(4.51)	(−0.27)	(2.70)	(4.58)
Soe	0.257**	0.272	0.226***	0.262**	0.353***	0.152	0.256**
	(2.48)	(1.61)	(2.58)	(2.53)	(2.61)	(1.34)	(2.47)
Law	0.005				0.013	−0.009	0.005
	(0.54)				(1.13)	(−0.47)	(0.54)
Cons	4.079***	4.719***	3.542***	4.117***	4.665***	3.521***	4.039***
	(5.10)	(3.56)	(3.04)	(5.05)	(2.82)	(2.88)	(4.99)
Year & Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	5488	2728	2760	5488	2757	2731	5488
R2/P_R2	0.041	0.048	0.042	0.042	0.047	0.051	0.041

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively (two-tailed test).

Table 10
Robustness check of main tests: Other measurements of corporate integrity ranking.

	Internal control weakness (*IC_Dum*)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pooled sample	Legal system			Market competition		
		High	Low	Pooled sample	High	Low	Pooled sample
Rank	**0.124***** **(−2.61)**	−0.061 (−0.53)	**0.175***** **(−2.72)**	**0.176***** **(−4.06)**	−0.003 (−0.03)	**0.257***** **(−3.21)**	**−0.192**** **(−2.38)**
Dum_law				−0.019 (−0.56)			
*Rank * Dum_law*				**0.147***** **(2.89)**			
HHI							**−0.170*** **(−1.73)**
*Rank * HHI*							**0.227**** **(2.13)**
Size	−0.271*** (−9.87)	−0.322*** (−5.02)	−0.230*** (−8.68)	−0.275*** (−8.83)	−0.289*** (−4.24)	−0.240*** (−3.73)	−0.273*** (−9.69)
Lev	2.006*** (5.23)	2.326*** (5.16)	1.730*** (10.64)	2.034*** (14.14)	1.624*** (3.75)	2.401*** (5.02)	2.023*** (5.28)
Loss	0.736*** (5.18)	0.486 (0.94)	0.972*** (2.77)	0.741** (2.18)	0.961** (2.45)	0.476 (1.24)	0.739*** (5.28)
Growth	−0.003 (−0.14)	−0.003 (−0.08)	−0.003 (−0.12)	−0.003 (−0.17)	0.008 (0.30)	−0.035 (−0.96)	−0.003 (−0.14)
MA	0.056 (0.56)	0.025 (0.23)	0.093 (0.81)	0.053 (0.40)	0.027 (0.25)	0.091 (1.15)	0.054 (0.53)
Dual	0.014 (0.29)	0.103 (0.75)	−0.073 (−0.72)	0.011 (0.22)	0.159 (1.20)	−0.140** (−2.52)	0.016 (0.30)
Bdsize	0.160 (0.73)	0.184 (0.45)	0.180 (0.30)	0.155 (0.46)	0.001 (0.00)	0.225 (0.63)	0.158 (0.73)
ZH	−0.003** (−2.24)	−0.001 (−0.47)	−0.004*** (−2.83)	−0.003*** (−2.99)	−0.001 (−0.36)	−0.005*** (−2.68)	−0.002** (−2.20)
Pindepen	0.364 (0.46)	1.157 (0.81)	−0.345 (−0.26)	0.351 (0.31)	0.611 (0.44)	0.050 (0.04)	0.371 (0.47)
Big10	0.225*** (4.23)	0.383*** (3.01)	0.083*** (4.90)	0.223*** (2.60)	−0.024 (−0.19)	0.454** (2.57)	0.226*** (4.36)
Soe	0.266*** (2.71)	0.275* (1.73)	0.241** (2.39)	0.269*** (3.37)	0.353** (2.49)	0.168 (1.63)	0.261*** (2.72)
Law	0.005 (0.57)				0.013 (0.42)	−0.009 (−0.46)	0.005 (0.55)
Cons	4.134*** (5.26)	4.695*** (2.82)	3.740** (2.56)	4.293*** (2.67)	4.689*** (2.89)	3.632*** (2.98)	4.039*** (4.99)
Year & Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	5488	2728	2760	5488	2757	2731	5488
R2/P_R2	0.041	0.048	0.042	0.042	0.047	0.052	0.041

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively (two-tailed test).

Table 11
Robustness check of main tests: Other measurements of internal control quality.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pooled sample	Legal system			Market competition		
		High	Low	Pooled sample	High	Low	Pooled sample
	Panel A Internal control objective index (*IC_object*)						
Integrity	**0.030****	0.014	**0.040*****	0.044**	0.005	**0.056*****	0.056**
	(2.53)	(1.16)	**(2.61)**	(2.61)	(0.43)	**(2.94)**	(2.71)
Dum_law				0.034			
				(0.57)			
*Integrity * Dum_law*				**−0.027***			
				(−1.72)			
Dum_HHI							0.118*
							(2.06)
*Integrity * Dum_HHI*							**−0.052****
							(−2.43)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year & Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	5457	2706	2751	5457	2740	2717	5457
P_R2	0.032	0.046	0.029	0.032	0.042	0.052	0.032
	Panel B Internal control disclosure index (*IC_disclosure*)						
Integrity	**0.013****	0.011	**0.013****	0.015*****	0.007	**0.018***	0.017*
	(2.88)	(1.58)	**(2.59)**	(3.61)	(1.55)	**(1.83)**	(1.98)
Dum_law				0.014			
				(0.81)			
*Integrity * Dum_law*				−0.005			
				(−0.75)			
Dum_HHI							0.014
							(0.50)
*Integrity * Dum_HHI*							−0.009
							(−0.81)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year & Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	5457	2722	2735	5457	2740	2717	5457
P_R2	0.093	0.093	0.106	0.120	0.095	0.103	0.121

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively (two-tailed test).

negative correlation between corporate integrity (*Integrity*) and internal control weakness (*IC_Dum*) is more significant in the samples with weaker legal systems and lower market competition. In general, the regression results of using instrumental variables are consistent with the conclusions from previous research.

7.2. Robustness check of main tests: Other measurements of corporate integrity indicators

To provide further evidence for the effect of corporate integrity, we draw on the study by Guiso et al. (2015) and use text analysis to obtain the corporate integrity culture index (*Integrity_culture*) based on materials published through the firms' official websites, annual reports, internal control reports and media reports. The dummy of *Integrity_culture* equals 1 if keywords such as sincerity, integrity, honest, genuine, piety, morality, credibility, trust, confide, credit, responsibility, fairness, justice or transparency are found in the materials that express the firm's corporate culture, and 0 otherwise. The empirical results shown in Table 9 indicate that corporate integrity culture (*Integrity_culture*) also has a significant negative correlation with internal control

weaknesses, which indicates that a culture of corporate integrity can significantly inhibit the occurrence of internal control weaknesses. These results are consistent with the conclusions of previous research, even in comparing firms that operate under different legal systems and different levels of market competition.

Based on the study by Zhang and Li (2012), we also build a new variable (*Rank*) for ranking firms in terms of corporate integrity. Table 10 shows that after controlling for other factors, *Rank* still holds a significant negative relation to internal control weaknesses.

7.3. Robustness check of main tests: Other measurements of internal control quality

We also use other variables to measure internal control quality. *IC_object* represents the Dibo internal control objective index, and *IC_disclosure* represents the Dibo internal control disclosure index.

First, concerning the firms' internal control frameworks, an internal control objective index (*IC_object*) is calculated based on the degree of achievement in terms of internal control compliance, asset security, reports, operations and strategy. The index is then revised according to the levels of material weaknesses that are disclosed in the internal control evaluation reports and the audit reports (Research Group on Internal Control Index of Listed Companies in China, 2011). The larger the internal control objective index figures, the better the quality of internal control. At present, this index is widely used in academic research (e.g., Zheng et al., 2013; Liu et al., 2015; Liu et al., 2017; Wang et al., 2018). We use the natural log of the internal control objective index as a variable. Panel A of Table 11 shows a significant positive correlation between corporate integrity and the internal control objective index. These results are consistent with the conclusions of previous research, even for firms operating under different legal systems and different levels of market competition.

Second, for the internal control framework, the internal control disclosure index (*IC_disclosure*) is calculated based on the establishment and improvement of internal control's five elements (namely the control environment, risk assessment, control activities, information and communication, and internal supervision) (Lin et al., 2016). We use the natural log of the internal control disclosure index as a variable. Panel B of Table 11 shows a significant positive correlation between corporate integrity and the internal control disclosure index. These results are consistent with those of previous research, even for firms operating under different legal systems and different degrees of market competition.

8. Conclusions

This study investigates the role played by corporate integrity in improving firms' levels of internal control quality. In a comprehensive sample collected through a questionnaire survey, we find that corporate integrity has a significant effect on internal control quality, and that corporate integrity can reduce internal control weaknesses. Considering the interactions and correlations with formal institution variables, including levels of legal development and market competition, we find a pattern of relationships between corporate integrity, legal development and market competition. In particular, the negative relation between corporate integrity and internal control weaknesses is more pronounced when legal development is weaker or when market competition is higher. Additional tests suggest that strong corporate governance can enhance the effect of corporate integrity on improving internal control quality.

This study contributes to a growing field of research that connects informal institutions with corporate behaviors. Our findings show that corporate integrity matters, especially when formal institutions are unable to effectively regulate corporate behaviors. This study extends the current literature on corporate integrity, and it highlights the need for new theories that can account for behaviors that cannot be explained by the activities of formal institutions.

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