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Article

The effect of shared auditors in the supply chain on cost stickiness

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The effect of shared auditors in the supply chain on cost stickiness[☆]



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ABSTRACT

Do supply chain audits have real effects? We focus on the effect of shared auditors in the supply chain on corporate cost stickiness. When a supplier shares auditors with its customers, the shared auditors provide informational advantages for suppliers' managers, thus revising their optimistic or pessimistic expectations and influencing suppliers' cost stickiness. Using a sample of Chinese A-share listed companies from 2009 to 2017, we explore the relationship between shared auditors and suppliers' cost stickiness conditional on management expectations. The results show that shared auditors in the supply chain reduce suppliers' cost stickiness significantly when suppliers' managers hold optimistic expectations, and increase suppliers' cost stickiness in cases of pessimistic expectations. Furthermore, the greater the number of shared auditors, the stronger the effect. Such effects are more pronounced when supplier firms share auditors with important customers, have higher demand uncertainty, and use big 10 auditors.

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1. Introduction

Cost and expense management are important and core issues for an enterprise to optimize its internal structure, earn profits, and maintain healthy development (Ma and Zhang, 2013). Understanding cost behavior is essential to cost and management accounting (Anderson et al., 2003). A fundamental assumption in cost accounting is that the magnitude of change in costs is the same for equivalent increases or decreases in activity volume (Noreen, 1991). Anderson et al. (2003) use the term ‘sticky costs’ to describe costs that increase faster than they decrease as demand fluctuates. Using a sample of US listed firms, they find that selling, general, and administrative (SG&A) costs increase, on average, at a rate of 0.55% per 1% increase in sales but decrease only 0.35% per 1% decrease in sales.

Studies show that managers’ optimistic expectations lead to cost stickiness (Anderson et al., 2003; Banker et al., 2011, 2014). If managers’ future sales expectations are optimistic, this optimism increases their willingness to acquire additional resources when sales increase and to retain unused resources when sales decrease, resulting in cost stickiness (Banker et al., 2014). However, if a manager is pessimistic about the future of the company, he or she will immediately reduce input resources when sales decline and not acquire additional resources or acquire insufficient resources when sales increase, resulting in weak cost stickiness or cost anti-stickiness. Managers’ expectations and judgments regarding future sales are based on existing information, which indicates that the information environment affects the accuracy of managers’ expectations.

Auditors not only play an important role in improving the credibility and reliability of financial statements but also facilitate the flow of information and ease information asymmetry (Dhaliwal et al., 2016a). When a supplier uses the same audit firm as its customers (hereafter shared auditors in the supply chain or shared auditors), the shared auditors gain client-specific information from both sides. Such information may add to over-all information for suppliers’ managers in both contracted and non-contracted manners, which in turn helps improve the accuracy of management expectations and thus subsequent expense decisions.

To examine the effect of shared auditors on suppliers’ cost stickiness, we use a sample of Chinese A-share listed companies from 2009 to 2017, of which about 9.1% share an auditor with at least one of their top five customers. We measure managers’ expectations using the prior period’s change in sales, whether the manager is overconfident or not, and economic growth. The results show that shared auditors help reduce supplier cost stickiness significantly when suppliers’ managers hold optimistic expectations, as indicated by a sales increase in the prior period, management overconfidence, and high economic growth, and increase supplier cost stickiness in cases of pessimistic expectations, as indicated by a sales decrease in the prior period and low economic growth. Furthermore, the greater the number of shared auditors, the stronger the effect. Additional tests suggest that such effects are stronger for supplier firms that share auditors with important customers, have higher demand uncertainty, and use big 10 auditors. We use a change model and adopt firm fixed effects to attenuate the potential endogeneity problem. The main conclusions remain unchanged.

Our study contributes to the literature in a number of ways. First, we add to the research on supply chain audits. The literature generally focuses on supply chain audit quality (Chen et al., 2012a; Huang et al., 2014; Johnstone et al., 2014). However, little is known about the real effects of supply chain audits.¹ We extend the literature by exploring the effect of supply chain audits on cost stickiness and document evidence consistent with supply chain auditors acting as information intermediaries and influencing firms’ cost stickiness.

Second, this paper contributes to the emerging literature on the auditor’s information role. Dhaliwal et al. (2016a) and Cai et al. (2016) find that a common auditor during merger and acquisition (M&A) transactions can help merging firms reduce uncertainty throughout the process, which allows managers to more efficiently allocate capital, resulting in higher quality M&As. Bae et al. (2017) declare that knowledgeable auditors provide informational advantages to their clients in a generalized investment setting, resulting in higher client investment efficiency. We enrich this literature by confirming the information role of supply chain auditors.

¹ Two recent studies examine the effect of supply chain audit on relationship-specific investment and corporate credit risk (Wang and Huang, 2014; Dhaliwal et al., 2016b).

Third, our study contributes to the supply chain literature that illustrates the importance of information sharing between supply chain partners. For example, the exchange of detailed customer demand and inventory information within the supply chain is associated with reduced supply chain costs (Chen, 1998; Cachon and Fisher, 2000) and improved efficiency in the use of resources (Matsumura and Schloetzer, 2014). We enrich this literature by exploring how supplier companies benefit in terms of enhanced accuracy of cost decision making when they purchase auditing services from the same audit firm as a major customer.

The remainder of this paper is organized as follows. We review the literature in Section 2 and pose our hypotheses in Section 3. Section 4 describes the sample selection, measures, and research design. We report our empirical findings in Section 5 as well as additional analyses and robustness tests in Section 6. Section 7 concludes this paper.

2. Literature review

2.1. Research on shared auditors in the supply chain

Research shows that a shared auditor in the supply chain is associated with higher audit quality (Chen et al., 2012a; Huang et al., 2014; Johnstone et al., 2014; Yang et al., 2015) and lower audit fees (Johnstone et al., 2014). Specifically, Chen et al. (2012a) document that firms that share an auditor with at least one of their major customers are less likely to misstate accounting numbers compared with firms that do not have such links. Huang et al. (2014) argue that a supply chain audit firm, coupled with firm-level industry expertise, results in low discretionary accruals and low restatement probability. Johnstone et al. (2014) find that auditor supply chain knowledge at the city level is associated with higher audit quality and lower audit fees compared with auditors with supply chain knowledge at the national level or without supply chain knowledge.

Moreover, a shared auditor in the supply chain can alleviate information asymmetry and mitigate investment inefficiency in relationship-specific assets, leading to an increase in relationship-specific investments (Dhaliwal et al., 2016b). Lastly, shared auditors in the supply chain help decrease credit risk (Wang and Huang, 2014).

2.2. Research on cost stickiness

Studies have predominantly explained cost stickiness with economic factors such as management opportunism, adjustment costs, and management expectations.

Management opportunism theory declares that managers' opportunistic behaviors, such as perks and empire-building incentives, motivate managers to increase costs rapidly when sales rise and to decrease costs slowly when sales fall, resulting in cost stickiness (Anderson et al., 2003; Banker et al., 2011; Chen et al., 2012b). Several studies examine management opportunism theory. For example, Chen et al. (2012b) document that cost asymmetry increases with managers' empire-building incentives due to the agency problem, but strong corporate governance mitigates the effects of the agency problem on SG&A cost asymmetry (Steliasos et al., 2006; Chen et al., 2012b; Xue and Hong, 2016). When managers face incentives to avoid losses or earnings decreases or to meet financial analysts' earnings forecasts, they expedite downward adjustment of slack resources for sales decreases, which lessens the degree of cost stickiness (Dierynck et al., 2012; Kama and Weiss, 2013). Upward earnings management decreases cost stickiness (Jiang et al., 2015; Xue and Hong, 2016), while downward earnings management increases cost stickiness (Jiang et al., 2015).

Adjustment costs theory suggests that committed resources invested by a manager, such as human capital and fixed capital, are more costly to decrease than increase (Jaramillo et al., 1993; Pfann and Palm, 1993, 1997; Goux et al., 2001; Balakrishnan et al., 2004; Cooper and Haltiwanger, 2006; Banker and Chen, 2006; Balakrishnan and Gruca, 2008). Sticky costs occur if committed resources are not reduced to the minimum level necessary to support a reduced activity demand while increased to the maximum level for an increased activity demand. The literature measures adjustment costs with asset intensity, employee intensity, business importance, stringent degree of labor protection law, and organizational capital and finds that adjustment costs are positively associated with cost stickiness (Anderson et al., 2003; Balakrishnan et al., 2004; Banker et al., 2013).

Management expectation theory argues that if managers' expectations for future sales are optimistic, they will be more willing to acquire additional resources when sales increase and to retain unused resources when sales decrease; pessimistic expectations have the opposite effect (Anderson et al., 2003; Banker et al., 2011, 2014). The literature uses economic growth, a successive decrease in sales, industry growth, sales change in the prior period, as well as managers' overconfidence as proxies for management expectation and finds that managers' optimistic (pessimistic) expectation is positively (negatively) associated with cost stickiness (Anderson et al., 2003; Banker et al., 2011, 2014; Liang, 2015).

3. Hypothesis development

Because the activity level cannot exceed the capacity of the resources committed to an activity, an increase in demand puts immediate and direct pressure on managers to increase committed costs. However, a decrease in demand for an activity does not put similar pressure on managers to decrease committed costs. Sticky costs occur if committed resources are not reduced to the minimum level necessary to support the reduced demand. Managers weigh the expected cost of slack resources and the expected adjustment cost of committed resources when sales fall and reduce committed resources more readily when the decline in demand is not transitory. That is, expected slack resource costs increase with the permanence of a decline in activity demand. Therefore, expectations about the duration of a change in sales influence managers' decisions on cost adjustment.

The literature suggests that managers' optimistic expectations drive cost stickiness (Anderson et al., 2003; Banker et al., 2011, 2014). Optimistic managers acquire additional committed resources rapidly when sales increase and retain unused resources when sales decrease, resulting in cost stickiness (Banker et al., 2014). Correspondingly, pessimistic managers reduce input resources immediately when sales decline and do not acquire additional resources or acquire insufficient resources when sales increase, resulting in weak cost stickiness or cost anti-stickiness. Managers' expectations about future sales are based on available information, indicating that the information environment affects the accuracy of managers' expectations.

Auditors are usually regarded as assurance providers; however, they can also be viewed as a component of management's information environment and a potential information intermediary in some respects (Bae et al., 2017). Auditors have extensive knowledge about their clients' operations coupled with broad knowledge of the industries in which their clients operate. Such knowledge can benefit clients not only by reducing their risk of audit failure but also through informational advantages if clients seek this additional resource.² Therefore, auditors may be an efficient and low-cost information source for managers.

Meanwhile, auditors also have incentives and opportunities to provide information to managers. Auditing is a low-growth industry, and audit fees typically do not increase substantially absent significant regulatory changes. Further, auditing has been frequently viewed as a commodity product (Christensen et al., 2012). To retain ongoing audit contracts, auditors must provide value in the eyes of their clients. Therefore, auditors have incentives to provide incremental information to clients through formal or informal discussions. In addition, auditors have frequent contact with their client's management throughout the year and, therefore, have opportunities to provide such valuable information to their clients. External auditors have unique access to senior executives, participate in audit committee meetings, and have access to board meeting minutes and general information about a firm (Dhaliwal et al., 2016a). Beginning with the reviews of quarterly financial statements and planning for the year-end audit, auditors meet with client management regularly to stay up to date on the activities of the company as well as to keep clients informed on regulatory matters and developments regarding accounting and auditing standards (Bae et al., 2017). Interactions with client management throughout the year take place in formal or informal meetings, such as lunch and dinner meetings. Thus, opportunities for soft talk and informational discussions regarding risks and opportunities facing the client firm are readily available.

In addition, according to "Chinese Auditing Standard No. 1324 - Going Concern Issue," auditors should evaluate whether there are events or circumstances that may cast doubts on the going concern assumption for

² Our interviews with audit practitioners suggest that audit firms have significant internal knowledge gathered from clients and such knowledge cleansed of specific client information can be shared in the aggregate. Such communications are usually informal and verbal.

a client during the risk assessment process. If a manager has made a preliminary assessment of the firm's going concern ability, auditors should discuss it with the manager and evaluate whether the manager has identified circumstances that may result in significant doubts about the firm's going concern, either alone or in the aggregate. If a manager has identified such issues, auditors should discuss a plan to deal with the issues with the manager. If the manager has not preliminarily assessed the firm's going concern ability, auditors should discuss with the manager the rationality of applying the going concern assumption and ask whether there are issues against the going concern assumption. In short, auditors are required to evaluate and discuss with managers a firm's going concern condition, which includes a forward-looking evaluation of future cash flows and planned activities for the firm (Bae et al., 2017). Therefore, auditors have the ability and opportunity to provide incremental information to managers during such discussions.

While all auditors have opportunities and incentives to provide value through information to their clients, the quality of information available from auditors is not expected to be uniform. Supply chain auditors have higher levels of supply chain expertise and knowledge resources, so we anticipate that the quality of information resources is likely higher coming from shared auditors in the supply chain in a similar nature to audit quality being influenced by the auditor's expertise and resources (Francis and Yu, 2009). Information is complementary between partners in the supply chain (Clement and Tse, 2005). When a supplier shares an auditor with its major customers, the shared auditor can gain deep understanding of the state of the businesses, potential developments, and business risks of the supplier during the audit process, such as information about market demand, customer satisfaction, the possibility of losing major customers and so on, thus helping managers develop more accurate expectations and make better operational decisions.

Therefore, shared auditors in the supply chain have incentives, abilities, and opportunities to provide information, and suppliers' managers have corresponding demands.³ In summary, shared auditors in the supply chain facilitate information flow, reduce information asymmetry between suppliers and customers, and weaken management's optimistic or pessimistic expectations, thus affecting suppliers' cost stickiness.

After analyzing the effect of shared auditors in the supply chain on managers' information environment, we use the model to derive the effect of the improvement in the information environment on cost stickiness.

Assuming that the signal of future demand changes received by managers is ΔS , $\Delta S = +\$1$ means that sales will increase by one unit, and $\Delta S = -\$1$ means that sales will decrease by one unit. The probability that the signal truly reflects future demand changes (in other words, demand changes are permanent) is p . The change in sales is due to changes in quantity, and price does not change over time.

After receiving the signal ΔS , managers should increase or decrease cost (SG&A) by C . At the same time, changes in cost result in adjustment costs. Adjustment cost brought about by increasing cost by C is $\lambda_1 C$, and adjustment cost incurred by reducing cost by C is $\lambda_2 C$, where $0 < \lambda_1 < \lambda_2 < 1$.⁴ Thus, the total cost of increasing cost by C is $(1 + \lambda_1)C$ and the total savings of reducing cost by C is $(1 - \lambda_2)C$. To ensure that the utility of additional resource inputs is positive when demand increases, we assume that $1 - (1 + \lambda_1)C > 0$.

When a supplier and customer do not share an auditor, the supplier's manager does not know whether the change in demand is temporary or permanent (incomplete information); if there is a shared auditor, the supplier's manager knows whether the change in demand is temporary or permanent (complete information).

According to Fig. 1, after receiving the signal of $\Delta S = +\$1$, the manager may increase SG&A or do nothing if there is not a shared auditor (incomplete information). If the manager chooses to increase cost by C , the company's utility will be $1 - (1 + \lambda_1)C$ when future demand increases by one unit and $-(1 + \lambda_1)C$ if future demand does not change. Therefore, the expected utility of increasing SG&A is $p - (1 + \lambda_1)C$.⁵ If the manager chooses to do nothing, the company's utility will be 0 when future demand increases by one unit or stays

³ Because the value of supply chain relationships to suppliers/customers depends on each company's prospects, supply chain partners may use earnings management to inflate earnings to favorably influence the perception of suppliers/customers and their willingness to undertake continuing relationship-specific investment (Raman and Shahrur, 2008). As a result, managers have incentives to obtain more reliable information from independent third parties, such as auditors.

⁴ Adjustment cost of reducing committed resources is higher than that of increasing committed resources (Jaramillo et al., 1993; Pfann and Palm, 1993, 1997; Goux et al., 2001; Balakrishnan et al., 2004; Cooper and Haltiwanger, 2006; Banker and Chen, 2006; Balakrishnan and Gruca, 2008).

⁵ $[1 - (1 + \lambda_1)C] * p + [-(1 + \lambda_1)C] * (1 - p) = p - (1 + \lambda_1)C$.

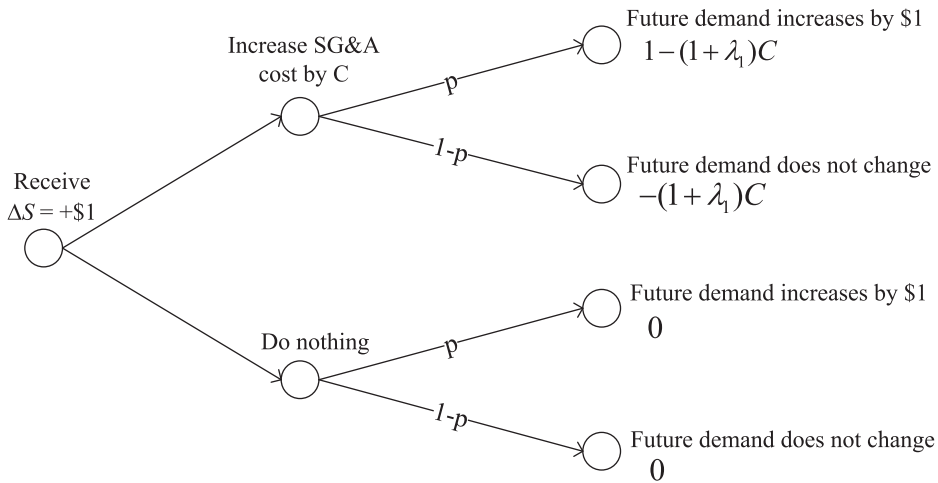


Fig. 1. Manager’s decision and utility after receiving $\Delta S = +\$1$ without shared auditors.

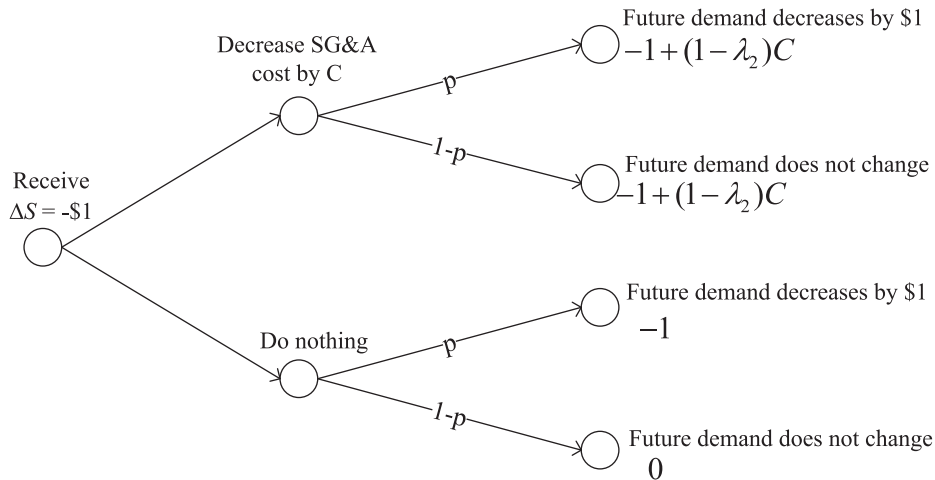


Fig. 2. Manager’s decision and utility after receiving $\Delta S = -\$1$ without shared auditors.

unchanged. As a result, the expected utility of doing nothing is 0. Only when the expected utility of increasing SG&A exceeds that of doing nothing, that is, $p - (1 + \lambda_1)C > 0$, would a manager choose to acquire additional committed resources.

Similarly, after receiving the signal of $\Delta S = -\$1$, the manager may decrease SG&A or do nothing if there is not a shared auditor, as shown in Fig. 2. If the manager chooses to decrease cost by C, the company’s utility will be $-1 + (1 - \lambda_2)C$ when future demand decreases by one unit or stays unchanged. Therefore, the expected utility of decreasing SG&A is $-1 + (1 - \lambda_2)C$. If the manager chooses to do nothing, the company’s utility will be -1 when future demand decreases by one unit and 0 if future demand does not change. As a result, the expected utility of doing nothing is $-p$. Only when the expected utility of decreasing SG&A exceeds that of doing nothing, that is, $-1 + (1 - \lambda_2)C > -p$, would a manager choose to decrease committed resources.

In summary, if a manager has optimistic expectations, he or she will increase resources if $p > (1 + \lambda_1)C$ after receiving signal $\Delta S = +\$1$ and do nothing if $p < 1 - (1 - \lambda_2)C$ after receiving signal $\Delta S = -\$1$. Therefore, without shared auditors, cost stickiness exists if $(1 + \lambda_1)C < p < 1 - (1 - \lambda_2)C$. However, if a manager has pessimistic expectations, he or she will do nothing if $p < (1 + \lambda_1)C$ after receiving signal $\Delta S = +\$1$ and decrease resources if $p > 1 - (1 - \lambda_2)C$ after receiving signal $\Delta S = -\$1$. Therefore, without shared auditors, cost anti-stickiness exists if $1 - (1 - \lambda_2)C < p < (1 + \lambda_1)C$.

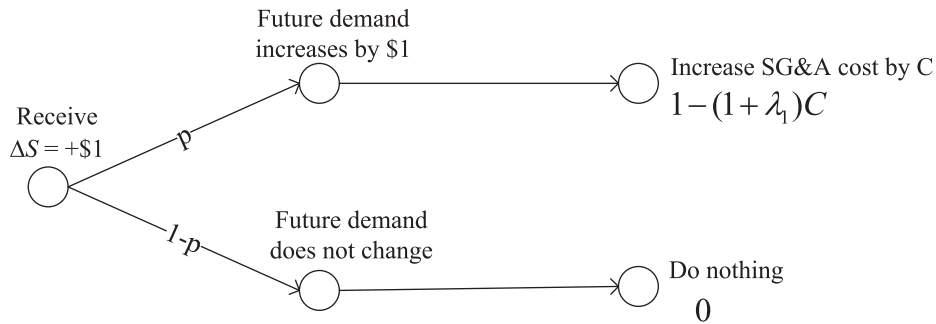


Fig. 3. Manager's decision and utility after receiving $\Delta S = +\$1$ with shared auditors.

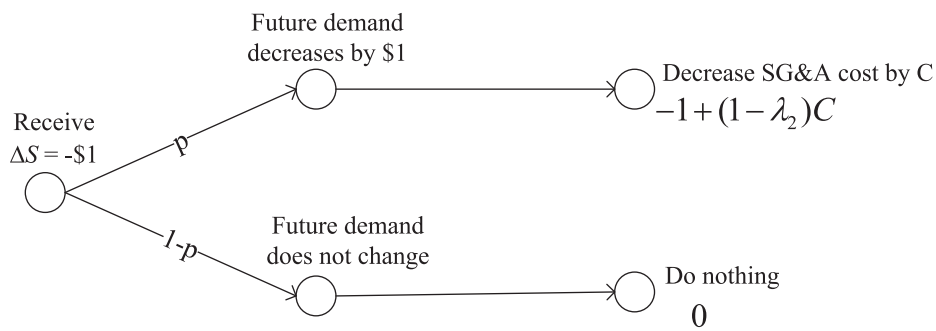


Fig. 4. Manager's decision and utility after receiving $\Delta S = -\$1$ with shared auditors.

When suppliers and customers share auditors (complete information), the shared auditors help ease information asymmetry by facilitating information flow. Managers acquiring more high-quality information know whether changes in demand are transitory and are able to make right decisions. According to Fig. 3, after receiving the signal of $\Delta S = +\$1$, the manager will increase cost by C if future demand will increase by one unit (the change is permanent) and do nothing if the change is transitory. Therefore, the expected cost to the enterprise will increase by pC after receiving the signal of $\Delta S = +\$1$. Similarly, after receiving the signal of $\Delta S = -\$1$ (as shown in Fig. 4), the manager may decrease cost by C if the change is permanent and do nothing if the change is transitory. Therefore, the expected cost to the enterprise will decrease by pC after receiving the signal of $\Delta S = -\$1$. Because the change in expected cost is pC for either signal, $\Delta S = +\$1$ or $\Delta S = -\$1$, cost asymmetry (including cost stickiness and cost anti-stickiness) does not exist with shared auditors.

We therefore hypothesize the following:

H1a: Sharing auditors with customers decreases suppliers' cost stickiness in the case of optimistic management expectations.

H1b: Sharing auditors with customers increases suppliers' cost stickiness in the case of pessimistic management expectations.⁶

⁶ In the case of pessimistic management expectations, sharing an auditor with the customer reduces suppliers' cost anti-stickiness, or in other words, increases the cost stickiness of suppliers.

4. Sample selection, measures, and research design

4.1. Sample selection

We choose Chinese non-financial firms listed in the A-share market from 2009 to 2017⁷ as our sample. We then delete (1) ST and *ST firms; (2) firms that do not disclose their top five customers in their annual report; (3) firms for which all of their top five customers are missing audit data to identify the audit firm; (4) firms in which the supplier and customer belong to a common business group and share auditors; (5) firms in which the sum of sales and administrative fees is greater than sales revenue; (6) observations missing necessary financial statement data or other data to compute the variables in the empirical tests. This leaves us with a sample of 938 firm-year observations, of which 85 observations share auditors with at least one of their top five customers. To mitigate the concern of outliers, all continuous variables are winsorized at 1% and 99%. We obtain top five customer data from Supply Chain Research Database of Chinese Companies (SCRD), GDP data from National Bureau of Statistics, and other financial statement data from the China Stock Market and Accounting Research (CSMAR) database.

4.2. Measures and research design

4.2.1. Measure of shared auditors

We measure shared auditors in two ways. First, because a firm can have multiple major customers in a fiscal year, we define *Shareaud* as a dummy variable that equals 1 if a firm shares its audit firm with at least one of its top five customers and 0 otherwise. Second, we define *Num* as the number of top five clients who uses the same audit firm as the supplier. For example, if a company shares its audit firm with three of its top five customers, *Num* equals 3.

4.2.2. Measure of cost stickiness

Consistent with the literature (Anderson et al., 2003), we use the following logarithmic model to measure cost stickiness:

$$\Delta \ln \text{Cost} = \beta_0 + \beta_1 \Delta \ln \text{Sales} + \beta_2 \text{Dec} * \Delta \ln \text{Sales} + \varepsilon \quad (1)$$

where $\Delta \ln \text{Cost}$ is the natural log of the change in total administrative and sales expenses, $\Delta \ln \text{Sales}$ is the natural log of the change in sales revenue, and *Dec* is a dummy variable with a value of 1 if sales decrease and 0 otherwise. Because the value of *Dec* is zero when revenue increases, the coefficient β_1 measures the percentage increase in cost with a 1% increase in sales revenue. That is, for every 1% increase in sales revenue, the cost changes by $\beta_1\%$, indicating the relative importance of variable costs. Because the value of *Dec* is 1 when revenue decreases, the sum of the coefficients, $\beta_1 + \beta_2$, measures the percentage decrease in cost with a 1% decrease in sales revenue. If cost is sticky, then the variation in cost with revenue increases should be greater than the variation for revenue decreases. Thus, the empirical hypothesis for stickiness, conditional on $\beta_1 > 0$, is $\beta_2 < 0$.

4.2.3. Measure of managers' expectations

Consistent with the literature (Anderson et al., 2003; Banker et al., 2011, 2014; Liang, 2015), we measure managers' expectations by the change in sales in the prior period, whether the manager is overconfident, and economic growth. Managers are more likely to be optimistic about the future if sales increased in the prior period, economic growth is rapid, or the manager is overconfident; conversely, if sales declined in the prior period or economic growth is slow, managers are more likely to hold pessimistic expectations.

Specifically, we measure the change in sales in the prior period ($\Delta \text{Sales}_{t-1}$) as the difference between sales in year $t - 1$ and those in year $t - 2$. A positive (negative) value of $\Delta \text{Sales}_{t-1}$ indicates that sales increased (decreased) in year $t - 1$, so managers are more likely to hold optimistic (pessimistic) expectations.

⁷ To avoid the impact of new accounting standards adopted in 2007, we use China's A-share listed companies from 2007 to 2017. For the calculation of prior sales changes ($\Delta \text{Sales}_{t-1}$), which needs data in year $t - 1$ and $t - 2$, our final sample is from 2009 to 2017.

Consistent with the literature (Ahmed and Duellman, 2013; Sun and Zhao, 2014), we measure management overconfidence (Overconf) using the change in management shareholding. If manager shareholdings increase in the current year and the increase is not due to equity incentives, share offerings, or share allotment, Overconf equals 1 and 0 otherwise.

Economic growth is measured as the GDP growth rate. Observations for which this variable is greater than or equal to the median value are classified in the $\Delta\text{GDP} > \text{Median}$ group, and those for which this variable is less than the median value are classified in the $\Delta\text{GDP} < \text{Median}$ group.

4.2.4. Research design

We estimate the following regression model to test H1a and H1b:

$$\begin{aligned} \Delta\ln\text{Cost} = & \beta_0 + \beta_1\Delta\ln\text{Sales} + \beta_2\Delta\ln\text{Sales} * D + \beta_3\Delta\ln\text{Sales} * D * \text{Shareaud}/\text{Num} \\ & + \beta_4\text{Shareaud}/\text{Num} + \beta_5\Delta\ln\text{Sales} * \text{Shareaud}/\text{Num} + \beta_6\Delta\ln\text{Sales} * D * \text{AI} \\ & + \beta_7\Delta\ln\text{Sales} * D * \text{EI} + \beta_8\Delta\ln\text{Sales} * D * \Delta\text{GDP} + \text{Year} + \text{Industry} + \varepsilon \end{aligned} \quad (2)$$

where $\Delta\ln\text{Cost}$ is the natural log of the change in total administrative and sales expenses, $\Delta\ln\text{Sales}$ is the natural log of the change in sales revenue, and D is a dummy variable with a value of 1 if sales decrease and 0 otherwise. Shareaud indicates there is a shared auditor in the supply chain if the value equals 1, and Num identifies the number of customers sharing auditors with the supplier. A negative value of β_2 documents the asymmetry of cost behavior.

The research design for Hypotheses 1a and 1b estimates empirical models separately for firms with optimistic and pessimistic management expectations and tests the equality of β_3 between the two subsamples using a Chow (1960) test.⁸ We anticipate that β_3 will be significantly positive if shared auditors reduce cost stickiness in the case of optimistic expectations (as indicated by a sales increase in the prior period, management overconfidence, and high economic growth), consistent with H1a. As H1b indicates, if managers hold pessimistic expectations (as indicated by a sales decrease in the prior period and low economic growth), β_3 should be significantly negative. Consistent with Banker and Byzalov (2014), we include the interaction terms of asset intensity (AI), employee intensity (EI), and economic growth (ΔGDP) with $\Delta\ln\text{Sales}*D$ separately as control variables. Detailed variable definitions are shown in Table 1.

Table 1
Variable definitions.

Variable	Definition
$\Delta\ln\text{Cost}$	Natural logarithm of the sum of administrative and sales expenses in year t divided by that in year $t - 1$
Shareaud	A dummy variable that equals 1 if a firm shares its audit firm with at least one of its top five customers and 0 otherwise
Num	Number of top five customers who use the same audit firm as the supplier
$\Delta\ln\text{Sales}$	Natural logarithm of revenue in year t divided by that in year $t - 1$
D	An indicator of revenue decrease in year t
ΔSales_{t-1}	Sales in year $t - 1$ minus sales in year $t - 2$
Overconf	Equals 1 if manager shareholdings increase in the current year and the increase is not due to equity incentives, share offerings, or share allotment and 0 otherwise
ΔGDP	GDP growth in year t multiplied by 100
AI	Ratio of total assets to sales
EI	Ratio of number of employees over sales (unit: million)

⁸ We adopt this approach, instead of a pooled model with an interaction on our test variable, for two reasons: (1) having fewer interactions eases economic interpretation of the coefficients and (2) this approach imposes fewer assumptions on the model, as all coefficients are allowed to vary across the management optimistic/pessimistic expectation subsamples.

Table 2
Descriptive statistics.

Panel A: Descriptive statistics for the full sample

Variable	N	Mean	Std. dev	Min	Median	Max
$\Delta \ln \text{Cost}$	938	0.143	0.311	-1.325	0.118	3.870
$\Delta \ln \text{Sales}$	938	0.127	0.388	-2.374	0.114	3.798
D	938	0.298	0.458	0	0	1
Shareaud	938	0.091	0.287	0	0	1
Num	938	0.111	0.384	0	0	3
AI	938	2.245	1.884	0.194	1.768	26.730
EI	938	1.673	1.357	0.023	1.357	10.280
ΔGDP	938	8.235	1.256	6.700	7.900	10.600
Overconf	938	0.251	0.434	0	0	1
$\Delta \text{Sales}_{t-1}$	938	0.132	0.372	-1.449	0.111	3.798

Panel B: Descriptive statistics of the subsample and univariate tests

Variable	Mean			Median		z-statistics
	Shareaud = 0 n = 853	Shareaud = 1 n = 85	t-statistics	Shareaud = 0 n = 853	Shareaud = 1 n = 85	
$\Delta \ln \text{Cost}$	0.145	0.128	0.464	0.120	0.097	1.651*
$\Delta \ln \text{Sales}$	0.127	0.129	-0.049	0.116	0.095	0.439
D	0.301	0.271	0.589	0	0	0.590
AI	2.241	2.280	-0.183	1.783	1.595	0.501
EI	1.680	1.606	0.481	1.352	1.402	0.279
ΔGDP	8.227	8.307	-0.557	7.800	7.900	-0.375
Overconf	0.245	0.306	-1.235	0	0	-1.234
$\Delta \text{Sales}_{t-1}$	0.131	0.147	-0.382	0.112	0.095	-0.299

See Table 1 for variable definitions. All continuous variables are winsorized at the 1st and 99th percentiles of their annual distributions. The t- and z-statistics are obtained from the t- and Wilcoxon tests that compare the two-sample differences in the mean and median values, respectively. The superscripts ***, **, and * indicate two-tailed statistical significance at the 1%, 5%, and 10% levels, respectively.

5. Empirical results

5.1. Descriptive statistics

Panel A of Table 2 reports the descriptive statistics for the full sample. As shown in Panel A, the mean values of $\Delta \ln \text{Cost}$ and $\Delta \ln \text{Sales}$ are 0.143 and 0.127, respectively, suggesting that the operational expenses (sum of sales and administrative expenses) and revenue of Chinese listed companies are increasing year by year and that the increase in expenses is higher than that in revenue. The mean value of D was 0.298, indicating that 29.8% of the observations experienced a revenue decrease. The mean value of Shareaud is 0.091, indicating that 9.1% of firms in the sample share auditors with at least one of their top five customers. The mean value of Num is 0.111, the minimum value is 0, and the maximum value is 3. Panel B of Table 2 presents the univariate tests and all of the previously described variables between the shared auditor and non-shared auditor groups. As shown in Panel B, there is no significant difference between the groups.

5.2. Multivariate tests

Tables 3–5 present the estimates for H1a and H1b. In Table 3, we estimate the regression specification given in Eq. (2) to separately examine the relation between shared auditors and cost stickiness based on the subsamples of sales increase in the prior period and sales decrease in the prior period. For the subsample of sales increase in the prior period ($\Delta \text{Sales}_{t-1} > 0^9$), the coefficient of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ ($\Delta \ln \text{Sales} * D * \text{Num}$) is 0.320 (0.297); for the subsample of sales decrease in the prior period ($\Delta \text{Sales}_{t-1} < 0$), the coefficient of $\Delta \ln \text{Sa}$

⁹ Including $\Delta \text{Sales}_{t-1} = 0$.

Table 3
Regression analysis of the effect of a shared auditor on cost stickiness conditional on a sales change in the prior period.

Variable	(1)	(2)	(3)	(4)
	$\Delta \ln \text{Cost}$ $\Delta \text{Sales}_{t-1} > 0$	$\Delta \ln \text{Cost}$ $\Delta \text{Sales}_{t-1} < 0$	$\Delta \ln \text{Cost}$ $\Delta \text{Sales}_{t-1} > 0$	$\Delta \ln \text{Cost}$ $\Delta \text{Sales}_{t-1} < 0$
$\Delta \ln \text{Sales}$	0.715*** (5.95)	0.644*** (7.97)	0.715*** (5.97)	0.630*** (7.42)
$\Delta \ln \text{Sales} * D$	0.212 (0.19)	-0.235 (-0.29)	0.213 (0.20)	-0.249 (-0.32)
$\Delta \ln \text{Sales} * D * \text{Shareaud}$	0.320 (0.98)	-0.829* (-1.88)		
Shareaud	0.009 (0.24)	-0.128** (-2.50)		
$\Delta \ln \text{Sales} * \text{Shareaud}$	-0.153 (-0.77)	0.401*** (3.08)		
$\Delta \ln \text{Sales} * D * \text{Num}$			0.297 (1.16)	-0.479* (-1.72)
Num			0.007 (0.24)	-0.078* (-1.73)
$\Delta \ln \text{Sales} * \text{Num}$			-0.134 (-1.12)	0.243*** (4.75)
$\Delta \ln \text{Sales} * D * \text{AI}$	-0.016 (-1.39)	0.006 (0.81)	-0.016 (-1.39)	0.006 (0.80)
$\Delta \ln \text{Sales} * D * \text{EI}$	-0.046 (-0.66)	-0.014 (-0.57)	-0.046 (-0.66)	-0.015 (-0.61)
$\Delta \ln \text{Sales} * D * \Delta \text{GDP}$	-0.077 (-0.68)	-0.026 (-0.23)	-0.078 (-0.69)	-0.022 (-0.21)
Year & Industry fixed effect	Yes	Yes	Yes	Yes
_Cons	0.057 (0.52)	-0.150* (-1.85)	0.058 (0.52)	-0.141* (-1.76)
N	669	269	669	269
R-squared	0.535	0.683	0.536	0.690
Chow test	1.91		1.11	

All regressions are estimated by the model of ordinary least squares. The superscripts ***, **, and * indicate two-tailed statistical significance at the 1%, 5%, and 10% levels, respectively.

les*D*Shareaud ($\Delta \ln \text{Sales} * D * \text{Num}$) is -0.829 (-0.479) and is statistically significant at the 10% level. The Chow test shows that the difference between these subsamples is not statistically significant (F-statistics are 1.91 and 1.11 separately). The results in Table 3 imply that shared auditors decrease (increase) suppliers' cost stickiness in the case of a sales increase (decrease) in the prior period.

In Table 4, we conduct the regression in Model (2) with the overconfident and non-overconfident manager groups separately. For the subsample of overconfident managers ($\text{Overconf} = 1$), the coefficient of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ ($\Delta \ln \text{Sales} * D * \text{Num}$) is 1.173 (0.766); for the subsample of non-overconfident managers ($\text{Overconf} = 0$), the coefficient of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ ($\Delta \ln \text{Sales} * D * \text{Num}$) is -0.535 (-0.293). The Chow test shows that the difference between these subsamples is statistically significant (F-statistics are 13.74 and 6.07 separately). The results collectively suggest that shared auditors reduce suppliers' cost stickiness if the supplier's manager is overconfident.

Table 5 shows the results for Eq. (2) based on the subsamples of high and low economic growth. For the subsample of high economic growth ($\Delta \text{GDP} > \text{Median}$), the coefficient of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ ($\Delta \ln \text{Sales} * D * \text{Num}$) is 0.011 (0.037); for the subsample of low economic growth ($\Delta \text{GDP} < \text{Median}$), the coefficient of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ ($\Delta \ln \text{Sales} * D * \text{Num}$) is -1.491 (-1.246), which is statistically significant at the 1% level. The Chow test shows that the difference between these subsamples is statistically significant (F-statistics are 2.88 and 4.35 separately). The results in Table 5 indicate that when economic growth is rapid (slow), shared auditors reduce (increase) suppliers' cost stickiness.

In summary, the results in Tables 3–5 support H1a and H1b, which suggest that shared auditors reduce suppliers' cost stickiness in the case of optimistic management expectations (measured by sales increase in the prior period, management overconfidence, and high economic growth) and increase suppliers' cost stick-

Table 4
Regression analysis of the effect of shared auditor on cost stickiness conditional on manager overconfidence.

Variable	(1)	(2)	(3)	(4)
	$\Delta \ln \text{Cost}$ Overconf = 1	$\Delta \ln \text{Cost}$ Overconf = 0	$\Delta \ln \text{Cost}$ Overconf = 1	$\Delta \ln \text{Cost}$ Overconf = 0
$\Delta \ln \text{Sales}$	0.998*** (5.36)	0.615*** (10.54)	0.994*** (5.29)	0.609*** (10.39)
$\Delta \ln \text{Sales} * D$	-1.905 (-1.48)	0.009 (0.01)	-2.255* (-1.93)	0.025 (0.03)
$\Delta \ln \text{Sales} * D * \text{Shareaud}$	1.173** (2.48)	-0.535** (-2.16)		
Shareaud	0.091 (1.62)	-0.096*** (-3.08)		
$\Delta \ln \text{Sales} * \text{Shareaud}$	-0.533* (-1.86)	0.408*** (3.31)		
$\Delta \ln \text{Sales} * D * \text{Num}$			0.766 (1.59)	-0.293 (-1.49)
Num			0.064 (1.36)	-0.068*** (-3.02)
$\Delta \ln \text{Sales} * \text{Num}$			-0.311 (-0.97)	0.244*** (6.05)
$\Delta \ln \text{Sales} * D * \text{AI}$	0.051 (0.79)	-0.010 (-1.46)	0.055 (0.85)	-0.010 (-1.47)
$\Delta \ln \text{Sales} * D * \text{EI}$	-0.021 (-0.21)	-0.003 (-0.16)	-0.032 (-0.31)	-0.003 (-0.15)
$\Delta \ln \text{Sales} * D * \Delta \text{GDP}$	0.072 (0.51)	-0.048 (-0.51)	0.120 (1.01)	-0.050 (-0.52)
Year & Industry fixed effects	Yes	Yes	Yes	Yes
_Cons	0.093 (0.39)	-0.044 (-1.23)	0.108 (0.45)	-0.041 (-1.16)
N	235	703	235	703
R-squared	0.642	0.567	0.639	0.573
Chow test	13.74***		6.07**	

All regressions are estimated by the model of ordinary least squares. The superscripts ***, **, and * indicate two-tailed statistical significance at the 1%, 5%, and 10% levels, respectively.

iness in the case of pessimistic management expectations (measured by sales decrease in the prior period and low economic growth).

6. Additional tests and robustness tests

6.1. Additional tests

As mentioned above, shared auditors in the supply chain facilitate information flow, ease information asymmetry between suppliers and customers, and weaken management's optimistic or pessimistic expectations, thus decreasing or increasing the cost stickiness of suppliers. Next, we use economic growth¹⁰ to proxy for management expectations and examine whether the association between shared auditors and cost stickiness differs depending on customer importance, demand uncertainty, and auditor size.

6.1.1. The effect of customer importance

Sharing an auditor with different customers results in different shared auditor effects. Transactions with the customer that account for the greatest share of the supplier firm's revenue, its most important customer, have

¹⁰ Managers hold optimistic expectations if GDP growth is greater than or equal to median and hold pessimistic expectations otherwise. Compared with sales change in the prior period and management overconfidence, using economic growth to measure management expectations makes the number of subsamples equal; thus, the conclusion will be more reliable.

Table 5
Regression analysis of the effect of a shared auditor on cost stickiness conditional on economic growth.

Variable	(1)	(2)	(3)	(4)
	$\Delta \ln \text{Cost}$ $\Delta \text{GDP} > \text{Median}$	$\Delta \ln \text{Cost}$ $\Delta \text{GDP} < \text{Median}$	$\Delta \ln \text{Cost}$ $\Delta \text{GDP} > \text{Median}$	$\Delta \ln \text{Cost}$ $\Delta \text{GDP} < \text{Median}$
$\Delta \ln \text{Sales}$	0.561*** (9.56)	0.765*** (6.23)	0.562*** (9.60)	0.755*** (6.11)
$\Delta \ln \text{Sales} * \text{D}$	1.048 (1.20)	5.230** (2.38)	0.970 (1.10)	5.248** (2.39)
$\Delta \ln \text{Sales} * \text{D} * \text{Shareaud}$	0.011 (0.03)	-1.491*** (-3.45)		
Shareaud	-0.047 (-1.07)	-0.070* (-1.86)		
$\Delta \ln \text{Sales} * \text{Shareaud}$	0.096 (0.53)	0.259 (1.59)		
$\Delta \ln \text{Sales} * \text{D} * \text{Num}$			0.037 (0.14)	-1.246*** (-3.53)
Num			-0.029 (-0.93)	-0.053* (-1.94)
$\Delta \ln \text{Sales} * \text{Num}$			0.062 (0.56)	0.170** (2.48)
$\Delta \ln \text{Sales} * \text{D} * \text{AI}$	0.002 (0.44)	-0.009 (-1.15)	0.002 (0.40)	-0.009 (-1.16)
$\Delta \ln \text{Sales} * \text{D} * \text{EI}$	-0.004 (-0.29)	-0.024 (-0.45)	-0.005 (-0.31)	-0.025 (-0.46)
$\Delta \ln \text{Sales} * \text{D} * \Delta \text{GDP}$	-0.152 (-1.59)	-0.807*** (-2.68)	-0.143 (-1.49)	-0.808*** (-2.68)
Year & Industry fixed effects	Yes	Yes	Yes	Yes
_Cons	-0.014 (-0.51)	-0.009 (-0.06)	-0.012 (-0.45)	-0.005 (-0.04)
N	470	468	470	468
R-squared	0.469	0.645	0.469	0.649
Chow test		2.88*		4.35**

All regressions are estimated by the model of ordinary least squares. The superscripts ***, **, and * indicate two-tailed statistical significance at the 1%, 5%, and 10% levels, respectively.

the strongest influence on the supplier. The importance of customers decreases gradually from the top 1 to 5. Sharing an auditor with customers of higher importance enables the shared auditor to acquire information more relevant to the supplier, especially information about the customer's demand for enterprise products, thus mitigating optimistic (pessimistic) management expectations and decreasing (increasing) the suppliers' cost stickiness.

We use a customer's rank to measure the importance of that customer.¹¹ The higher the rank, the more important the customer is. Observations for customers that rank higher than or equal to the median value are classified in the customer importance > median group and those with a rank less than the median value are classified in the customer importance < median group. We regress these two groups separately, using Model (2) to examine the effect of customer importance.

Table 6 presents the estimates. When managers hold optimistic expectations, the coefficients of $\Delta \ln \text{Sales} * \text{D} * \text{Shareaud}$ and $\Delta \ln \text{Sales} * \text{D} * \text{Num}$ in the customer importance > median group are both significantly positive, while the coefficients of $\Delta \ln \text{Sales} * \text{D} * \text{Shareaud}$ and $\Delta \ln \text{Sales} * \text{D} * \text{Num}$ in the customer importance < median group are both significantly negative. The Chow test shows that the difference between these subsamples is statistically significant (F-statistics are 49.66 and 28.78 separately). These results collectively suggest that the relationship between shared auditors in the supply chain and suppliers' cost stickiness will be more pronounced in firms sharing auditors with customers of higher importance when suppliers' man-

¹¹ If a supplier shares an auditor with more than one customer, we choose the customer of highest rank to calculate customer importance.

Table 6
Regression analysis of shared auditors' information role conditional on customer importance.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Management optimistic expectations				Management pessimistic expectations			
	$\Delta \ln \text{Cost}$	$\Delta \ln \text{Cost}$	$\Delta \ln \text{Cost}$	$\Delta \ln \text{Cost}$	$\Delta \ln \text{Cost}$	$\Delta \ln \text{Cost}$	$\Delta \ln \text{Cost}$	$\Delta \ln \text{Cost}$
	customer importance >median	customer importance <median	customer importance >median	customer importance <median	customer importance >median	customer importance <median	customer importance >median	customer importance <median
$\Delta \ln \text{Sales}$	0.583*** (7.10)	0.576*** (8.80)	0.578*** (7.16)	0.576*** (8.79)	0.721*** (4.46)	0.792*** (6.92)	0.718*** (4.44)	0.792*** (6.91)
$\Delta \ln \text{Sales} * D$	0.236 (0.16)	0.621 (0.55)	-0.065 (-0.04)	0.648 (0.57)	4.417 (1.44)	4.844*** (2.95)	4.443 (1.45)	4.842*** (2.95)
$\Delta \ln \text{Sales} * D * \text{Shareaud}$	0.858*** (2.78)	-2.390*** (-5.34)			0.210 (0.04)	-0.099 (-0.20)		
Shareaud	-0.010 (-0.20)	-0.275*** (-4.92)			-0.056 (-0.97)	0.037 (0.80)		
$\Delta \ln \text{Sales} * \text{Shareaud}$	-0.053 (-0.30)	1.618*** (5.12)			0.411*** (2.66)	-0.361 (-1.55)		
$\Delta \ln \text{Sales} * D * \text{Num}$			0.640** (2.29)	-1.989*** (-5.28)			0.816 (0.17)	-0.120 (-0.24)
Num			0.009 (0.27)	-0.246*** (-4.24)			-0.043 (-0.88)	0.034 (0.79)
$\Delta \ln \text{Sales} * \text{Num}$			-0.062 (-0.61)	1.277*** (5.80)			0.218*** (2.80)	-0.357 (-1.53)
$\Delta \ln \text{Sales} * D * \text{AI}$	0.027 (0.53)	0.006 (0.37)	0.025 (0.48)	0.005 (0.31)	0.003 (0.36)	-0.117** (-2.46)	0.003 (0.35)	-0.116** (-2.46)
$\Delta \ln \text{Sales} * D * \text{EI}$	0.031 (1.21)	-0.047 (-1.00)	0.026 (0.97)	-0.044 (-0.94)	0.053 (0.57)	0.039 (0.43)	0.052 (0.55)	0.038 (0.42)
$\Delta \ln \text{Sales} * D * \Delta \text{GDP}$	-0.124 (-0.85)	-0.082 (-0.68)	-0.085 (-0.56)	-0.085 (-0.70)	-0.723* (-1.69)	-0.714*** (-3.11)	-0.726* (-1.69)	-0.714*** (-3.12)
Year & Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
_Cons	-0.028 (-0.71)	0.043 (0.92)	-0.024 (-0.62)	0.043 (0.92)	-0.030 (-1.37)	0.092 (0.47)	-0.030 (-1.35)	0.093 (0.47)
N	236	234	236	234	208	260	208	260
R-squared	0.420	0.617	0.416	0.616	0.733	0.589	0.734	0.589
Chow test	49.66***		28.78***		0.01		0.00	

All regressions are estimated by the model of ordinary least squares. The superscripts ***, **, and * indicate two-tailed statistical significance at the 1%, 5%, and 10% levels, respectively.

agers hold optimistic expectations. However, if the suppliers' manager is pessimistic about the future, the coefficients of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ and $\Delta \ln \text{Sales} * D * \text{Num}$ in both groups are insignificant. The Chow test suggests that the difference between the subsamples is statistically insignificant. Therefore, the evidence does not support that sharing auditors with customers of high importance increases suppliers' cost stickiness when the supplier's managers hold pessimistic expectations.

6.1.2. The effect of demand uncertainty

If demand is hard to predict (high demand uncertainty), the bias of management expectation is more likely to exist. Shared auditors' information role should be more pronounced in cases of high demand uncertainty. We use the standard deviation of sales revenue in the most recent 3 years (sdSales) to measure demand uncertainty. Observations with demand uncertainty higher than or equal to the median value are classified in $\text{sdSales} > \text{median}$ group and those with demand uncertainty less than the median value are classified in $\text{sdSales} < \text{median}$ group. We regress the two groups separately using Model (2) to examine the effect of demand uncertainty.

Table 7 shows the results. When a suppliers' managers hold optimistic expectations, the coefficients of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ and $\Delta \ln \text{Sales} * D * \text{Num}$ in $\text{sdSales} < \text{median}$ group are both insignificantly negative, while the coefficients of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ and $\Delta \ln \text{Sales} * D * \text{Num}$ in $\text{sdSales} > \text{median}$ group are both

Table 7
Regression analysis of shared auditors' information role conditional on demand uncertainty.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Management optimistic expectations				Management pessimistic expectations			
	$\Delta \ln \text{Cost}$ sdSales >median	$\Delta \ln \text{Cost}$ sdSales <median	$\Delta \ln \text{Cost}$ sdSales >median	$\Delta \ln \text{Cost}$ sdSales <median	$\Delta \ln \text{Cost}$ sdSales >median	$\Delta \ln \text{Cost}$ sdSales <median	$\Delta \ln \text{Cost}$ sdSales >median	$\Delta \ln \text{Cost}$ sdSales <median
$\Delta \ln \text{Sales}$	0.541*** (6.71)	0.639*** (8.14)	0.538*** (6.59)	0.641*** (8.20)	0.830*** (5.43)	0.396*** (4.61)	0.827*** (5.41)	0.396*** (4.61)
$\Delta \ln \text{Sales} * D$	0.575 (0.42)	1.949 (1.55)	0.521 (0.38)	1.909 (1.51)	7.547*** (3.76)	2.240 (0.87)	7.563*** (3.78)	2.218 (0.86)
$\Delta \ln \text{Sales} * D * \text{Shareaud}$	0.382 (0.88)	-0.036 (-0.09)			-1.365*** (-3.85)	-0.294 (-0.17)		
Shareaud	0.0409 (0.59)	-0.134*** (-2.73)			-0.086 (-1.50)	-0.001 (-0.02)		
$\Delta \ln \text{Sales} * \text{Shareaud}$	-0.104 (-0.44)	0.179 (0.91)			0.294* (1.89)	-0.175 (-1.40)		
$\Delta \ln \text{Sales} * D * \text{Num}$			0.205 (0.57)	-0.021 (-0.07)			-1.012*** (-3.62)	-0.372 (-0.22)
Num			0.012 (0.27)	-0.115*** (-2.63)			-0.050 (-1.29)	-0.005 (-0.13)
$\Delta \ln \text{Sales} * \text{Num}$			0.024 (0.13)	0.228** (2.04)			0.159** (2.02)	-0.173 (-1.40)
$\Delta \ln \text{Sales} * D * \text{AI}$	-0.027 (-0.99)	-0.153 (-1.25)	-0.027 (-0.98)	-0.152 (-1.25)	-0.080 (-1.55)	-0.007 (-0.65)	-0.080 (-1.55)	-0.007 (-0.66)
$\Delta \ln \text{Sales} * D * \text{EI}$	0.077 (0.95)	0.082 (1.44)	0.075 (0.95)	0.082 (1.43)	0.073 (1.06)	0.039 (0.36)	0.073 (1.05)	0.039 (0.36)
$\Delta \ln \text{Sales} * D * \Delta \text{GDP}$	-0.102 (-0.71)	-0.263* (-1.73)	-0.096 (-0.66)	-0.259* (-1.70)	-1.133*** (-3.84)	-0.341 (-0.99)	-1.135*** (-3.85)	-0.337 (-0.98)
Year & Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
_Cons	-0.021 (-0.23)	-0.035 (-1.01)	-0.025 (-0.26)	-0.033 (-0.93)	-0.580* (-1.84)	0.200** (1.96)	-0.574* (-1.82)	0.200** (1.96)
N	247	223	247	223	205	263	205	263
R-squared	0.529	0.425	0.530	0.423	0.789	0.239	0.790	0.239
Chow test	1.36		2.19		3.96**		3.53**	

All regressions are estimated by the model of ordinary least squares. The superscripts ***, **, and * indicate two-tailed statistical significance at the 1%, 5%, and 10% levels, respectively

insignificantly positive. The Chow test shows that the difference between the subsamples is statistically insignificant. Therefore, the evidence does not support that shared auditors are more likely to decrease suppliers' cost stickiness for high demand uncertainty firms when suppliers' managers hold optimistic expectations. However, if suppliers' managers are pessimistic about the future, the coefficients of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ and $\Delta \ln \text{Sales} * D * \text{Num}$ in $\text{sdSales} > \text{median}$ group are both significantly negative, while the coefficients of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ and $\Delta \ln \text{Sales} * D * \text{Num}$ in $\text{sdSales} < \text{median}$ group are both insignificantly negative. In addition, the Chow test suggests that the difference between the subsamples is statistically significant (F-statistics are 3.96 and 3.53 separately). These results collectively indicate that the relationship between shared auditors in the supply chain and suppliers' cost stickiness is stronger in firms of high demand uncertainty when the suppliers' managers hold pessimistic expectations.

6.1.3. The effect of auditor size

Larger audit firms have greater resources to both generate and collect incrementally valuable information (Bae et al., 2017). Therefore, we anticipate that larger audit firms weaken management's optimistic (pessimistic) expectations to a greater extent, resulting in lower (higher) cost stickiness. Because the Chinese audit market is much more dispersed in contrast to the oligopolistic market structure in the US (Guan et al., 2016) and the market share of the big 4 is very low, we measure auditor size using big 10 and non-big 10 firms. We anticipate that shared auditors' informational role should be more pronounced for big 10 auditors.

Table 8
Regression analysis of shared auditors' information role conditional on auditor size.

Variable	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Management optimistic expectations								Management pessimistic expectations							
	$\Delta \ln \text{Cost}$		$\Delta \ln \text{Cost}$		$\Delta \ln \text{Cost}$		$\Delta \ln \text{Cost}$		$\Delta \ln \text{Cost}$		$\Delta \ln \text{Cost}$		$\Delta \ln \text{Cost}$		$\Delta \ln \text{Cost}$	
	Big10 = 1	Big10 = 0	Big10 = 1	Big10 = 0	Big10 = 1	Big10 = 0	Big10 = 1	Big10 = 0	Big10 = 1	Big10 = 0	Big10 = 1	Big10 = 0	Big10 = 1	Big10 = 0	Big10 = 1	Big10 = 0
$\Delta \ln \text{Sales}$	0.635***	0.573***	0.626***	0.573***	0.751***	0.774***	0.736***	0.774***								
	(6.87)	(8.11)	(6.90)	(8.11)	(4.59)	(6.17)	(4.47)	(6.17)								
$\Delta \ln \text{Sales} * D$	0.488	-0.471	0.444	-0.471	7.371***	0.538	7.431***	0.538								
	(0.68)	(-0.29)	(0.60)	(-0.29)	(3.15)	(0.19)	(3.20)	(0.19)								
$\Delta \ln \text{Sales} * D * \text{Shareaud}$	0.288	-0.630			-1.644***	1.172*										
	(0.84)	(-0.91)			(-3.32)	(1.83)										
Shareaud	-0.055	-0.087			-0.075	0.012										
	(-1.06)	(-0.99)			(-1.59)	(0.35)										
$\Delta \ln \text{Sales} * \text{Shareaud}$	-0.068	0.672			0.281	-0.429										
	(-0.33)	(1.27)			(1.42)	(-1.17)										
$\Delta \ln \text{Sales} * D * \text{Num}$			0.224	-0.630			-1.340***	1.172*								
			(0.95)	(-0.91)			(-3.12)	(1.83)								
Num			-0.026	-0.087			-0.054	0.012								
			(-0.81)	(-0.99)			(-1.59)	(0.35)								
$\Delta \ln \text{Sales} * \text{Num}$			-0.027	0.672			0.185**	-0.429								
			(-0.23)	(1.27)			(2.09)	(-1.17)								
$\Delta \ln \text{Sales} * D * \text{AI}$	-0.038***	0.046*	-0.038***	0.046*	-0.005	0.011	-0.005	0.011								
	(-2.87)	(1.75)	(-2.79)	(1.75)	(-0.63)	(0.10)	(-0.64)	(0.10)								
$\Delta \ln \text{Sales} * D * \text{EI}$	0.141***	-0.044***	0.139***	-0.044***	-0.026	0.114	-0.027	0.114								
	(3.45)	(-2.76)	(3.36)	(-2.76)	(-0.42)	(1.16)	(-0.44)	(1.16)								
$\Delta \ln \text{Sales} * D * \Delta \text{GDP}$	-0.143*	0.021	-0.137*	0.021	-1.107***	-0.191	-1.112***	-0.191								
	(-1.89)	(0.12)	(-1.75)	(0.12)	(-3.38)	(-0.50)	(-3.41)	(-0.50)								
Year & Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes								
_Cons	-0.046	0.276***	-0.045	0.276***	0.068	0.011	0.070	0.011								
	(-1.36)	(4.94)	(-1.30)	(4.94)	(0.48)	(0.37)	(0.52)	(0.37)								
N	220	250	220	250	254	214	254	214								
R-squared	0.427	0.537	0.426	0.537	0.707	0.558	0.713	0.558								
Chow test		0.46		0.39			9.14***							7.67***		

All regressions are estimated by the model of ordinary least squares. The superscripts ***, **, and * indicate two-tailed statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 9
Change Analysis.

Variable	(1) Δ Sticky	(2) Δ Sticky
Δ Shareaud	-0.069* (-1.65)	
Δ Num		-0.046** (-2.24)
Δ AI	0.018 (0.40)	0.019 (0.44)
Δ EI	-0.103** (-2.09)	-0.104** (-2.10)
Δ^2 GDP	0.019 (0.81)	0.018 (0.77)
Δ D	-0.070 (-1.19)	-0.070 (-1.20)
Year & Industry fixed effects	Yes	Yes
_Cons	0.525 (1.31)	0.526 (1.32)
N	324	324
R-squared	0.094	0.094

All variables are yearly change variables. The superscripts ***, **, and * indicate two-tailed statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8 presents the estimates. When suppliers' managers hold optimistic expectations, the coefficients of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ and $\Delta \ln \text{Sales} * D * \text{Num}$ in the big 10 group are both insignificantly positive, while the coefficients of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ and $\Delta \ln \text{Sales} * D * \text{Num}$ in the non-big 10 group are both insignificantly negative. The Chow test shows that the difference between these subsamples is statistically insignificant. Therefore, the evidence does not support that shared auditors are more likely to decrease suppliers' cost stickiness for big 10 auditors when suppliers' managers hold optimistic expectations. However, if suppliers' managers are pessimistic about the future, the coefficients of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ and $\Delta \ln \text{Sales} * D * \text{Num}$ in the big 10 group are both significantly negative, while the coefficients of $\Delta \ln \text{Sales} * D * \text{Shareaud}$ and $\Delta \ln \text{Sales} * D * \text{Num}$ in the non-big 10 group are both significantly positive. In addition, the Chow test suggests that the difference between the subsamples is statistically significant (F-statistics are 9.14 and 7.67 separately). These results collectively suggest that the relationship between shared auditors in the supply chain and suppliers' cost stickiness will be more pronounced for big 10 auditors if suppliers' managers hold pessimistic expectations.

6.2. Robustness tests

First, supplier companies audited by shared auditors may have some innate characteristics that are associated with cost stickiness, and those characteristics may not be controlled in our regression models, which may cause omitted variable problems. Consistent with Weiss (2010) and using quarterly data, we estimate firm-year level cost stickiness (Sticky) based on firms that experienced a sales increase in the prior period and conduct a change analysis to address this concern. The results in Table 9 show that the coefficients of $\Delta \text{Shareaud}$ and ΔNum are both significantly negative, suggesting that shared auditors reduce suppliers' cost stickiness if managers hold optimistic expectations.

Second, we include firm fixed effects in Model (2). The untabulated results¹² are consistent with those reported earlier, so our main conclusions remain unchanged using this alternative model specification.

¹² Readers can contact the authors for the table if necessary.

7. Conclusion

Supply chain relationships between suppliers and their major customers are of strategic importance in the modern economy, and prior research has investigated the effects of these relationships on partners within the supply chain (Johnstone et al., 2014). However, little is known about how other constituents in capital markets, such as auditors, might be affected by or have effects on supply chain relationships. Based on the data of Chinese A-share listed companies from 2009 to 2017, we explore the association between shared auditors and cost stickiness conditional on management expectations. The results show that sharing auditors with customers helps reduce suppliers' cost stickiness significantly in the case of optimistic management expectations, as indicated by a sales increase in the prior period, management overconfidence, and high economic growth and increase suppliers' cost stickiness in the case of pessimistic expectations, as indicated by a sales decrease in the prior period and low economic growth. Further, the greater the number of shared auditors, the stronger the effect. Additional tests suggest that such effects will be more pronounced for firms that share auditors with important customers, have higher demand uncertainty, and share big 10 auditors.

This study provides direct empirical evidence that supply chain auditors affect suppliers' cost stickiness, enriches research on supply chain audits, and sheds light on the improvement of supply chain audit and corporate cost management. In addition, this study reveals that the auditor is an integral part of the management information set and indicates the auditor's information role, thus helping investors, academic researchers, and regulators to develop an overall understanding of the auditor's role in corporate governance.

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