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Review

Auditor specialization, accounting information quality and investment efficiency

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ABSTRACT

This study is examined how the auditor specialization moderates the effect of accounting information quality on investment efficiency, i.e., whether the effect of accounting information quality on investment efficiency is increasing or decreasing with the presence of the specialist auditor.

The reached result reveals that the accounting information quality appears to help decrease the overinvestment problem. Similarly, the auditor specialization has been discovered to help greatly in improving investment efficiency, while reducing the underinvestment problem. We further find that the accounting information quality and the auditor specialization are two mechanisms with some degree of substitution in enhancing investment efficiency. The accounting information quality is positively associated with investment efficiency for firms whose auditor is an industry specialist.

In addition, to check the robustness of the main results, this paper investigates the causal relationships between investment efficiency, auditor specialization and accounting information quality from the dynamic simultaneous-equation models.

1. Introduction

A large theoretical and empirical literature examines the role of the accounting information quality (Bushman et al., 2001; Bushman and Smith, 2001; Bagaeva, 2008; Chan et al., 2009; Chan and Lee, 2009; Zhiying et al., 2012; Ran et al., 2015). One line of research (Biddle and Hilary, 2006; McNichols and Stubben, 2008; Biddle et al., 2009; Chen et al., 2011) suggests that higher quality information enables managers to identify better investment opportunities. Several studies also propose that auditor specialization can be used to reduce the information asymmetry problems (Almutairi et al., 2009; DeBoskey et al., 2012; DeBoskey and Jiang, 2012; Yaghoobnezhada et al., 2014): A specialist's knowledge of the industry can be developed through vast auditing experience, specialized staff training, and large investments in information technology. This industry-specific knowledge allows specialist auditors to provide higher quality audit service by reducing the information asymmetry through their greater ability to detect significant anomalies.

Theoretical models (Balsam et al., 2003; Lai, 2011) predict that, despite the limited evidence, a highly acquired audit quality is extremely useful for improving investment efficiencies, especially with respect to overinvestment. Based on these premises, the main purpose of this paper is to combine these two mechanisms and analyze the effect of the accounting information quality (AIQ) and the

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auditor specialization on investment efficiency.

Chen et al. (2011), who examines the relationship between the information quality and investment, find that financial reporting quality enhances investment in private firms in emerging countries. We also expect to find this association in a sample of industrial firms. In relation to the role of the auditor specialization in investment efficiency, to the best of our knowledge, this is the first study that empirically examines its effect on both underinvestment and overinvestment.

As an extension of our research, we examine how the auditor specialization moderates the AIQ effect on investment efficiency, i.e., whether such an AIQ effect on investment efficiency is increasing or decreasing with the presence of a specialist auditor. We could expect both effects:

On the one hand, the reduction of the information asymmetry and more reliable accounting numbers, due to higher AIQ, could lead to a more effective monitoring due to the specialist auditors and, consequently, the AIQ effect on investment efficiency would turn out to be higher for firms with greater AIQ and auditor specialization.

On the other hand, firms with higher accounting quality are likely to help the manager reduce the adverse selection and moral hazard and allow managers to better identify investment opportunities (Biddle and Hilary, 2006). So, under this assumption, we would expect that the importance of AIQ in reducing information asymmetries will be higher in firms whose auditor is an industry specialist than that with a company whose auditor is not a specialist.

Most studies use the discretionary portion as a measure of information quality. Gomariz and Bellesta (2014) consider different proxies for the quality of information: the model of discretionary accruals suggested by Kasznik (1999), the model of accruals quality suggested by Dechow and Dichev (2002) and the model of discretionary revenues developed by McNichols and Stubben (2008).

Our results show that the AIQ reduces overinvestment, while the specialist auditor reduces the underinvestment. Moreover, our results also reveal that the AIQ effect on investment efficiency is positive for the firms whose auditor is an industry specialist, highlighting the substitution role of AIQ and auditor specialization in reducing information asymmetries and monitoring manager's behavior to such a way as expropriation can be greatly restricted.

Our paper contributes to a growing body of literature dealing with empirical evidence on AIQ and auditor specialization roles in improving investment efficiency. Our findings reveal that, in this context, the main concern of auditors is overinvestment, because it is through overinvestment that auditors expropriate managers, and that it is only through higher AIQ and auditor specialization could inefficiency be reduced.

Moreover, the present work constitutes the first study to analyze the interaction effect between the AIQ and the auditor specialization on improving investment efficiency, and our findings suggest that both mechanisms can play a substitution role in reducing overinvestment.

The remainder of this paper is structured as follows: Section 2 comprises a review of the existing literature on investment efficiency, stressing the role of the AIQ and the auditor specialization, and develops our testable hypotheses. Section 3 depicts a thorough description of the research design, along with the applied models, variable measures and studies the sample. As for Section 4, it is devoted to highlighting the finding while the ultimate section depicts the major conclusion of this paper.

2. Literature review and hypothesis development

The purpose of our research is to test, on a sample, the impact of the accounting information quality on the investment efficiency for companies with the specialist auditors.

In this regard, we consider the previously produced literary research works' conceptual framework as a basic background to conduct our theoretical analysis and achieve our targeted objective.

2.1. Investment efficiency and the accounting information quality (AIQ)

A large body of literature shows that companies can improve the accounting information quality. According to the neo-classical theory, (Yoshikawa, 1980; Hayashi, 1982; Andrew, 1983) firms invest until the marginal benefit equals the marginal cost of this investment so as to maximize their values. According to the Keynesian framework (Gordon, 1992; Crotty, 1992) investment is determined by the preference for growth or for financial security, and according to the agency framework (Chen et al., 2011) which considers information asymmetry problems, companies can deviate from their optimal investment levels and therefore suffer from overinvestment or under-investment. Jensen and Meckling (1976), Myers and Majluf (1984) and Gomariz and Bellesta (2014) develop a framework for analyzing the role of the asymmetric information in investment efficiency through information problems, such as moral hazard and adverse selection.

However, in the agency theory (Healy et al., 2001; Healy and Palepu, 2001; Hope and Thomas, 2008; Gomariz and Bellesta, 2014; Martinez et al., 2015), there are various control mechanisms to attenuate information asymmetries and information risk and to enable better supervision of managerial activity that mitigates the opportunistic behavior of managers, such as the AIQ.

A great section of the pertinent literature associates the AIQ with investment efficiency. Since higher AIQ makes managers more accountable by allowing better monitoring, and it may reduce adverse selection and moral hazard, and thereafter decreases information asymmetries, it could thereby greatly reduce the overinvestment and the underinvestment problems. In addition, the AIQ could improve investment efficiency by enabling managers to make better investment decisions through a better identification of projects and more truthful accounting numbers for internal decision makers (Bushman et al., 2001; Bushman and Smith, 2001; McNichols and Stubben, 2008; Gomariz and Bellesta, 2014). Empirically, prior studies argue and find evidence that earnings management leads to overinvestment because it distorts the information used by managers (McNichols and Stubben, 2008). In turn, Hirshleifer et al. (2004), Biddle et al. (2009) and Chen et al. (2011) examine the effect of information quality on two inefficient scenarios, overinvestment and underinvestment, and reported that higher information quality helps greatly in encouraging underinvestment companies to make investments, and overinvestment companies to decrease their investment level. Consistent with this view, Gomariz and Bellesta (2014) find that conservatism leads to reducing both overinvestment and underinvestment, because it reduces investment-cash flow sensitivity with regard to overinvestment firms and facilitates access to external financing regarding underinvestment firms.

In this respect, we undertake to analyze the AIQ impact on investment efficiency, and our first hypothesis set up as follows:

H1. Firms with higher AIQ will show higher investment efficiency.

Since we examine whether the AIQ reduces the underinvestment and the overinvestment, we should also test the following two sub-hypotheses:

H1a. Firms with higher AIQ will mitigate the overinvestment problem.

H1b. Firms with higher AIQ will mitigate the underinvestment problem.

2.2. Investment efficiency and auditor specialization

In Some previously conducted studies, it has been shown that the auditor's ability and competence highlighting rigor and independence, can be assessed by its industry specialization (Craswell et al., 1995; Gramling et al., 2001; Gramling and Stone, 2001; Velury, 2003; Hammersley, 2006; Moroney, 2007; Autore et al., 2009; Hakim et al., 2010; Hakim and Omri, 2010; DeBoskey et al., 2012; DeBoskey and Jiang, 2012). Knowledge of the activity sector of the audited firms should be useful in the investment evaluation. By learning about the business of the client company, its strategies, motivation and accounting information system and accessing knowledge of the type of the frequency of potential errors and so on, auditors evaluate the accounting results (Hakim et al., 2010; Hakim and Omri, 2010; Sun et al., 2011; Sun and Liu, 2011). In turn, Hammersley (2006) and Stanley and DeZoort (2007) predict that the auditor specialization in a particular industry has considerable experience and significant investments in technology adapted to this particular sector. The specialist auditors are particularly relevant in this area and are likely to provide a relatively high audit quality.

In fact, appealing to a specialized auditor service can provide guaranteed assurance as to the information quality. The authors found that firms audited by a qualified auditor communicate forecast information on future cash flows more credibly than those audited by a non-specialist auditor.

The role of the auditor specialization in reducing managers' discretion and disciplining their investment decisions has been discussed in the related literature mainly by Gul et al. (2009) and DeBoskey and Jiang (2012). However, this literature has also emphasized the role played by auditors under information asymmetry, highlighting that the use of the auditor specialization is a mechanism whereby we can attenuate informational asymmetries and agency costs between shareholders, creditors and managers.

Auditors seem to have difficulty measuring amounts of discretionary part and have been forced to reissue their reports because of regulators findings (Balsam et al., 2003; DeBoskey et al., 2012; DeBoskey and Jiang, 2012). Hence, an empirical question may be posed as to whether the auditor industry specialization is similarly associated with investment efficiency.

An examination of the literature suggests that firms with high investment opportunities may need high quality audits because they have a weak internal control system which may not keep up with the growth pace, resulting in higher control and audit risk (Tsui et al., 2001; Cahan et al., 2006; Lai, 2009).

Gul et al. (2003) suggest that discretionary accruals help to increase audit risk because they are inherently more difficult to audit. In addition, it is also suggested that the employment of the Big 5 auditors is likely to be useful to firms with high investment rates, as firms with high investment opportunities tend to often have more discretionary accruals, which makes the Big5 auditors' ability to curb discretionary accruals fit suitably for such firms.

Thus, we expect an increased level of monitoring by the use of specialist auditor to be a key mechanism in this context, to reduce moral hazard problems and empire-building activities. Consequently, we expect that the specialist auditors will also help the investment efficiency.

Based on this, our second hypothesis and its sub-hypotheses are as follows:

H2. The firms that undertake a specialist auditor show greater investment efficiency.

H2a. The firms that undertake a specialist auditor can mitigate overinvestment problems.

H2b. The firms that undertake a specialist auditor can mitigate underinvestment problems.

2.3. The AIQ effect on investment efficiency conditioned to the auditor specialization

Aside from checking the isolated effect of the accounting information quality and the auditor specialization on investment efficiency (Biddle and Hilary, 2006; Cahan et al., 2006; DeBoskey et al., 2012; DeBoskey and Jiang, 2012; Gomariz and Bellesta, 2014; Lu et al., 2016), we examine their interaction effect, i.e., we investigate whether the effect of the AIQ on investment efficiency is increasing or decreasing with the presence of the auditor industry specialization.

In this sense, the AIQ effect on investment decisions could be mitigated by the absence of the specialist auditors because auditor specialization in a given sector have considerable experience and may exercise their oversight role on management in a bid to reduce overinvestment and can also be beneficial for managers to make positive investments in situations of underinvestment.

According to this, the auditor specialization stands as a crucial instrument useful for reducing the information asymmetry and the earnings management (DeBoskey et al., 2012; DeBoskey and Jiang, 2012; Mary et al., 2012; Mary and Bing, 2012). Hence, it follows that the AIQ impact on investment efficiency would turn out to be stronger for a company whose auditor is an industry specialist. The specialist auditor can mitigate the adverse selection and moral hazard and can provide guarantees to the information quality.

Accordingly, our third hypothesis which is put forward stipulates that the relationship between the AIQ and the investment efficiency depends highly on the presence of the auditor specialization.

H3. The relationship between investment efficiency and the AIQ should prove to be stronger for firms whose auditor is an industry specialist.

H3a. Firms using a specialist auditor and the AIQ will mitigate overinvestment problems.

H3b. Firms using a specialist auditor and the AIQ will mitigate underinvestment problems.

3. Research method and sample

The methodology used in research – quantitative versus qualitative – can refer to several things, especially data, or techniques for collecting and processing such data. Data collection methods are diversified: semi-informal interviews/interviews, ordinary conversations, observation, study of written or visual documents, etc.

The qualitative technique is sometimes used in a case study, but the practice of this technique is too difficult in the Tunisian context. Indeed, for some projects, one cannot imagine access to the markets.

The qualitative method is characterized by its practical inefficiency in the field, since the criteria of loyalty, credibility, validation and transferability can be lost before the professional secrets. This study does not focus on a qualitative method because the study region stimulates it.

We have been able to use a quantitative method which refers to work whose data are statistically analyzable. For most researchers, talking about quantitative research means studying large duly selected samples, whereas the qualitative searches covered usually only some cases. In this study, the quantitative technique allows for better testing of theories and assumptions, and allows measuring more rigorously the used variables.

In addition, the qualitative method cannot be used since the practice of the case study is difficult in our context. Indeed, Tunisia is characterized by strong competition in the economic market whereby professional secrets become important for investors and auditors, and the accounting information quality loses its value. Similarly, companies with very high levels of earnings management do not allow researchers to move into the field. For these reasons, the practice of the case study is too difficult in our subject.

This section serves to establish a link between the theoretical and empirical part, in which the study relevant temporal framework will be determined. In this respect, the purpose of our empirical investigation and study related sample will be determined along with the periodic data sources. After that, the different variables subject of the study will be defined together with their respective measures.

3.1. Sample selection

Our sample period covers the period 2007–2013, and for further identification of the study selected variables, we need to check the data for the years 2006 and 2005.

The sample selection covers only industrial firms, whereas firms related to finance are excluded from the sample. The information is collected from the company's annual reports, as downloaded from the Tunisia Stock Exchange website, the financial market Council, while some data have been gathered manually.

Tunisia is an interesting setting for a number of reasons. Firstly, it represents a less developed capital market than the U.S. and U.K., and secondly the information asymmetry and the auditor monitoring role are higher.

These additional requirement factors have ultimately led us to get a sample made up of 231 firm-year observations, pertinent to the investment efficiency model constitution. Table 1 below, depicts the firm's distribution according to selected sample.

The results, figuring on Table 1 present only 85 observations belonging to the overinvestment group, while most of sample observations relate to the underinvestment group.

Aside from that, this table indicates that the majority of sample observations pertain to the underinvestment for all years, except for the year 2009, in which the sample-depicted underinvestment appears to have a percentage of 9.58% while the overinvestment proportion turns out to be of 22.35%.

3.2. Variable measures

Our methodological approach is carried out by a measurement of the variables, which will be followed by model presentation to test the study hypotheses.

Table 1
Analysis of the sample according to the investment efficienc.

Panel: analysis by year	underinvestment	Percentage	overinvestment	Percentage
2013	25	17.12%	8	9.41%
2012	23	15.75%	10	11.76%
2011	24	16.43%	9	10.58%
2010	20	13.69%	13	15.29%
2009	14	9.58%	19	22.35%
2008	20	13.69%	13	15.29%
2007	20	13.69%	13	15.29%
Total	146	100%	85	100%

This table presents the distribution by year, including the number and the percentage for the firms which distributed from underinvestment and overinvestment problems. Underinvestment is the negative residuals of investment model proposed by Biddle et al. (2009). Overinvestment is the positive residuals of investment model multiplied by –1 Gomariz and Bellesta (2014).

3.2.1. Dependent variable: proxy for investment efficiency

In order to test the conditional relation between the accounting information quality, the auditor specialization and investment efficiency, we need a proxy for overinvestment and underinvestment. So an accounting-based framework is used to estimate total investment under the form of difference recorded between total investment and asset sales (Richardson, 2006).

In such a context, Biddle et al. (2009) and Gomariz and Bellesta (2014) appealed to a model that serves to predict investment in terms of growth opportunities, and using residuals as a firm-specific proxy for deviations from expected investment. Indeed, investment efficiency takes place at the moment when no deviation appears to persist out of the expected investment level, and firms that invest above their optimum (positive deviations from expected investment), would undertake an overinvestment process, while those that do not carry out all profitable projects (negative deviations from expected investment) are registered to undertake an underinvestment process. Hence, Investment efficiency is the residuals absolute value multiplied by -1 and therefore, a higher value would denote higher efficiency (Gomariz and Bellesta, 2014).

The model is described below:

$$\text{Invest}_{i,t} = \beta_0 + \beta_1 \text{SalesGrowth}_{i,t-1} + \varepsilon_{i,t}$$

Where:

Investment is the net increase in tangible and intangible assets and scaled by lagged total assets. SalesGrowth is the rate of change in sales of firm i from t-2 to t -1.

3.2.2. Accounting information quality (AIQ)

Following previous researchrs, (Chen et al., 2011; Gomariz and Bellesta, 2014) used a wide variation in the measure of earnings management, deployed in various studies, and used it as a measure of information quality.

In order to estimate the quality of accounting information, we follow a measure proposed by McNichols and Stubben (2008) and Stubben (2010), who consider discretionary revenues as a proxy for earnings management:

$$\Delta \text{AR}_{i,t} = \beta_0 + \beta_1 \Delta\text{Sales}_{i,t} + \varepsilon_{i,t}$$

Where: $\Delta \text{AR}_{i,t}$ is the annual change in accounts receivable for firm i in the year t.

$\Delta \text{Sales}_{i,t}$ is the annual change in sales revenues for firm i in the year t.

The model is estimated separately for each industry-year group. Discretionary revenues are the residuals, which represents the change in accounts receivable that is not explained by sales growth. Therefore, the proxy for AIQ will be the absolute value of the residuals multiplied by -1. Thus, higher values indicate higher AIQ, (AIQ = $-$Iεi,tl).

3.2.3. Auditor specialization

This study is based on an extensive literature to determine the audit specialization measure (Craswell et al., 1995; Gramling et al., 2001; Gramling and Stone, 2001; Cahan et al., 2006; DeBoskey et al., 2012; DeBoskey and Jiang, 2012).

Given the wide variation in auditor specialization measures deployed in various studies (measured by audit fees, market shares, the number of clients, according to a big 4), we chose to use the client to complete our analysis because the customer enters a similar aspect of the client-auditor relationship, a customer may be more likely to choose a specialist auditor because they satisfy a large number of companies from the client.

Balsam et al. (2003) justified this alternate measure as follows: They argue that industry specialization may be better achieved by having a large number of clients in a particular industry than by having a few large clients. In addition, Neal and Riley (2004) predict that the number of clients of industry specialization would be more appropriate in client decision settings.

We define all the variables in our models in Table 2:

Table 2
Explanatory variables definitions and measurements.

Variables	Symbols	Measures	Authors
investment efficiency	InvEf	investment efficiency is the absolute value of residuals of investment model multiplied by −1	Biddle et al. (2009) and Gomariz and Bellesta (2014)
Underinvestment	Under	Underinvestment is the negative residuals of investment model	Biddle et al. (2009) and Gomariz and Bellesta (2014)
Overinvestment	Over	Overinvestment is the positive residuals of investment model multiplied by −1;	Biddle et al. (2009) and Gomariz and Bellesta (2014)
Accounting information quality	AIQ	Accounting information quality is the absolute value of residuals of the model multiplied by −1	McNichols and Stubben (2008), Stubben (2010) and Gomariz and Bellesta (2014)
Auditor specialization	Spau	specialization coded 1 if the auditor has the most clients in the industry and 0 otherwise	Balsam et al. (2003) and DeBoskey and Jiang (2012)
sales	Lnsales	LnSales is the log of sales	Gomariz and Bellesta (2014)
Age of firms	LnAge	is the log of difference between the first year when the firm appears and the current year	Gomariz and Bellesta (2014)
Tangibility	Tang	is the tangibility measure calculated as the ratio of tangible fixed assets to total assets	Chen et al. (2011), Gomariz and Bellesta (2014)

3.3. Regression model

To test the effect of the AIQ and the auditor specialization on investment efficiency, we run the following OLS regression:

$$\text{InvEf}_{i,t} = ß_0 + ß_1\text{AIQ}_{i,t} + ß_2\,\text{Spau}_{i,t} + ß_3\,\text{LnSales}_{i,t} + ß_4\,\text{LnAge}_{i,t} + ß_5\text{Tang}_{i,t} + \varepsilon_{i,t}$$

Where: InvEf represents investment efficiency, AIQ represents the quality of accounting information, SPAU is the firms whose auditor is an industry specialist. Since our hypotheses predict that both AIQ and SPAU improve investment efficiency, we expect $ß_1$ and $ß_2$ to be positive and significant. The rest are control variables that may influence investment efficiency: sales, age and tangibility (Chen et al., 2011; Gomariz and Bellesta, 2014).

Following (Petersen, 2009; Gomariz and Bellesta, 2014), we estimate the model from which t-statistics based on standard errors clustered at the firm and the year level, which are robust to the heteroskedasticity and within-firm serial correlation.

As shown in the literature review section, the AIQ and the auditor specialization can contribute to the alleviation of the asymmetric information problems (DeBoskey et al., 2012; DeBoskey and Jiang, 2012; Gomariz and Bellesta, 2014; Yaghoobnezhada et al., 2014) and thus improve investment efficiency. After testing the effects of the AIQ and the auditor specialization on investment efficiency, we will extend the previous analysis to examine if the effect of AIQ on investment efficiency is increasing or decreasing with the presence of auditor specialization. To check this, we include an interaction effect between the AIQ and the auditor specialization, which takes the value 1 if the auditor has the most clients in the industry and zero otherwise (DeBoskey et al., 2012 DeBoskey and Jiang, 2012). The use of the interaction term indicates the moderating effect (Gomariz and Bellesta, 2014; Samet and Jarboui, 2017). Balli and Sorensen (2013) presented practical advice for the researchers regarding analysis and interpretation of linear regression models with interaction effects. In addition, they indicated that some published results employ interaction terms and examined whether they were robust to permutations of reasonable specifications.

Several studies have used the interaction term to show the moderating effect such as (DeBoskey et al., 2012; DeBoskey and Jiang, 2012; Gomariz and Bellesta, 2014; Samet and Jarboui, 2017).

The following models are used to test the moderating effect in this study:

$$\text{InvEf}_{i,t} = ß_0 + ß_1\text{AIQ}_{i,t} + ß_2\,\text{Spau}_{i,t} + ß_3\,\text{QIC} * \text{SPAU}_{i,t} + ß_4\,\text{LnSales}_{i,t} + ß_5\text{LnAge}_{i,t} + ß_6\,\text{Tang i,t} + \varepsilon_{i,t} \quad (1)$$

$$\text{Over}_{i,t} = ß_0 + ß_1\,\text{AIQ}_{i,t} + ß_2\,\text{Spau}_{i,t} + ß_3\,\text{QIC} * \text{SPAU}_{i,t} + ß_4\,\text{LnSales}_{i,t} + ß_A\text{LnAge}_{i,t} + ß_6\,\text{Tang i,t} + \varepsilon_{i,t} \quad (2)$$

$$\text{Under}_{i,t} = ß_0 + ß_1\,\text{AIQ}_{i,t} + ß_2\,\text{Spau}_{i,t} + ß_3\,\text{QIC} * \text{SPAU}_{i,t} + ß_4\,\text{LnSales}_{i,t} + ß_A\text{LnAge}_{i,t} + ß_6\,\text{Tang i,t} + \varepsilon_{i,t} \quad (3)$$

Where AIQ*Spau represent the interaction effect. In this model, b1 indicates the effect of AIQ on the efficiency of investment for firms whose specialization auditor and the sum of the coefficients on the main effect and interaction, $ß_1 + ß_2$, represents the AIQ effect on investment efficiency for firms whose auditor is an industry specialist.

4. Empirical results

Worth recalling our research objective has been to empirically test the AIQ impact on the investment level concerning the specialist auditor undertaking companies.

Accordingly, this section presents the major finding of our empirical analysis. These results will be used to accept or refute our

Table 3
Descriptive statistic.

Variables	Obs	Mean	Std. Dev.	Max	Min
InvEf	231	−0.0717	0.1226	−0.8054	−0.0002
Under	85	−0.0975	0.147	−0.852	−0.002
Over	146	−0.0568	0.103	−0.805	−0.0002
AIQ	231	−0.1299	0.2407	−2.8259	−0.0007
Spau	213	0.3679	0.4832	0	1
LnSales	231	17.2180	1.6139	10.74	20.4879
LnAge	231	3.496	0.5326	1.0986	4.4886
Tang	231	0.4135	0.1864	0.0927	0.9005

The panel of Table 2 presents the descriptive statistics, including the number of observation, mean, median, standard deviation, minimum and maximum, for the variables used in the analyses.
InvEf: investment efficiency is the absolute value of residuals of investment model multiplied by −1.
Under: Underinvestment is the negative residuals of investment model.
Over: Overinvestment is the positive residuals of investment model multiplied by −1.
AIQ: Accounting information quality is the absolute value of residuals of the model proposed by McNichols and Stubben (2008), multiplied by −1.
Spau: Auditors specialization coded 1 if the auditor has the most clients in the industry and 0 otherwise.
LnSales: is the log of sales.
LnAge: is the log of difference between the first year when the firm appears and the current year.
Tang: is the tangibility measure calculated as the ratio of tangible fixed assets to total assets.

postulated assumptions.

Therefore, we focus on the descriptive analysis of the dependent and independent variables in the model, and the correlation matrix analysis.

4.1. Descriptive statistics

Table 3 summarizes the descriptive statistics related to our measures of investment efficiency, overinvestment, underinvestment, AIQ, auditor specialization, as well as the major main control variables.

Investment efficiency (InvEf) in the sample appears to have a mean of −0.071 and a Std.Dev of 0.122. Separately, the over-investment scenario shows a mean of −0.0975, while the under-investment scenario mean is −0.056. These values seem to be consistent with the previous conducted studies by Gomariz and Bellesta (2014). Likewise, the AIQ measure attached values prove to be in-line with some earlier elaborated research work (McNichols and Stubben, 2008; Biddle et al., 2009; Chen et al., 2011; Gomariz and Bellesta, 2014).

Regarding the Spau variable, industry-specialist client firms report a lower mean compared to non-specialist ones and one may observe that, on average, only 36% of firms have an auditor who is an industry specialist. This finding is discovered to be consistent with the Habib and Bhuiyanb (2011) study, highlighting that in NewZealand around 36% of firms are audited by an industry specialist, which is quite close to 45% reported in the work conducted by DeBoskey and Jiang (2012). We have also discovered that the auditor industry specialization mean equals 0.041, which is very close to 0.042 as reported by Behn et al. (2008).

This table shows that only 85 observations appear to belong to the overinvestment group, while the overriding majority of sample observations belong to the underinvestment group. This result corroborates the study elaborated by Gomariz and Bellesta (2014) revealing that firms are more liable to the problem of underinvestment rather than overinvestment due to the difficulty they face in securing external financing.

4.2. Testing panel data

To qualify our panel data, several tests must be made making such as the presence of individual effect, Hausman test, heteroscedasticity and autocorrelation problem.

4.2.1. Individual presence test

This test allows us to assess the individual effects of our model. The Fisher test is applied in the presence of a fixed effects model and the Lagrange multiplier test in the presence of a random effects model.

According to the fourth tables, the probabilities associated with the two tests are significant at the 1% threshold, attesting to the presence of a specific effect. Therefore, it is essential to introduce individual effects.

4.2.2. Hausman test

The Hausman test is a specification test that determines whether the coefficients of the two estimates (fixed and random) are statistically different. Table 5 presents the results of the Hausman test.

The Hausman test displayed probabilities less than 10%. These results show that the individual effects are random and not fixed in the model.

Table 4
Individual Presence Test.

	Fisher Test	Lagrange multiplier Test
p-value (Model 1)	Prob > F = 0.000	Prob > chibar2 = 0.062
p-value (Model 2)	Prob > F = 0.000	Prob > chibar2 = 0.084
p-value (Model 3)	Prob > F = 0.000	Prob > chibar2 = 0.098

This table presents the presence test of individual effect for three models such as investment efficiency, overinvestment and underinvestment. The Fisher test is applied in the presence of a fixed effects model and the Lagrange multiplier test in the presence of a random effects model.

4.2.3. Heteroscedasticity test

In the framework of detection of heteroskedasticity, we choose the Breuf-Pagan test.

The heterosedicity test of Breush-Pagan for the three models is significant, so there is a problem of heteroscedasticity for these models (Table 6).

4.2.4. Autocorrelation tests

In the framework of autocorrelation detection, we take the Wooldrige test. In this regard, we will accept the null hypothesis which states the absence of autocorrelation of errors.

Table 7 shows the result of intra-individual autocorrelation tests for the two multiple regression models.

4.3. Correlation matrix

The main purpose of the test is to ensure whether any multicollinearity problems exist among the variables along with any association between variables. According to Tabachnick and Fidell (2007) the problem prevails in the case when correlation values exceed 0.9, i.e., whenever the independent variables turn out to be highly correlated among each other. Table 8 illustrates the correlation coefficients between dependent, independent and control variables.

The AIQ measure shows significant positive correlations with the investment efficiency, indicating that a higher AIQ level is usually associated with a higher investment efficiency level. Likewise, auditor specialization (Spau) presents significant positive correlation with investment efficiency, highlighting that a higher audit quality is also associated with higher investment efficiency, a result which is also consistent with previous studies (Cahan et al., 2006; DeBoskey et al., 2012; DeBoskey and Jiang, 2012). With respect to the (Spau*AIQ) measures, investment efficiency has a positive correlation with the variable, showing that the interaction effect is associated with higher investment efficiency. Noteworthy however, correlations among independent variables do not seem to be high underlining that multicollinearity is not likely to stand as major problem in our study.

4.4. Regression-analyses

In this section, we perform our investment efficiency examination distinguishing two alternative scenarios, overinvestment and underinvestment, depicted by positive and negative residuals in the investment efficiency model. Table 9 reports the estimation results of three respective models.

In regard of model 1, the result shows that the information quality helps improve the investment efficiency, since the quality measure coefficient is positive and significant ($p < 0.1$ for AIQ). These results are in line with those reported by Biddle et al. (2009), Chen et al. (2011) and Gomariz and Bellesta (2014), and confirm our (H1), stating that higher AIQ helps enhance investment efficiency.

Additionally, we undertake to test the auditor industry specialization effect on investment efficiency. In our models, the Spau variable is discovered to show a negative and significant coefficient, indicating that auditor specialization decreases investment efficiency.

Once the sample is divided into underinvestment and overinvestment scenarios, the reached results show that AIQ is more relevant for reducing overinvestment than underinvestment and that the auditor specialization would help decrease investment efficiency in both contexts.

Table 5
Hausman Test.

	Chi-Sq. Statistic	P-Value
Chi2 Test (Mode1)	6.15	0.407
Chi2 Test(Model2)	3.21	0.66
Chi2 Test(Model3)	4.99	0.544

This table presents the Hausman test for three models such as investment efficiency, overinvestment and underinvestment.

Table 6
Heteroscedasticity Test.

	Chi-Sq. Statistic	P-Value
Chi2 Test (Mode1)	116.07**	0.000
Chi2 Test(Model2)	4.91**	0.026
Chi2 Test(Model3)	210.77**	0.000

This table presents the Heteroscedasticity test for three models such as investment efficiency, overinvestment and underinvestment. ** denote significantly at the 5%.

Table 7
Autocorrelation Test.

wooldridge Test (Mode1)	0.891 (0.352)
Wooldridge Test (Model2)	15.957 (0.002)
Wooldridge Test (Model3)	0.126 (0.723)

This table presents the autocorrelation test for three models such as investment efficiency, overinvestment and underinvestment.

Table 8
Pearson correlation matrix.

	InvEf	AIQ	spau	LnSales	LnAge	tang
InvEf	1.0000					
AIQ	0.2288***	1.0000				
spau	−0.2024***	0.0347	1.0000			
LnSales	−0.0149	0.0101	−0.1690**	1.0000		
LnAge	0.1522**	0.0977	−0.0980	0.1361**	1.0000	
Tang	−0.0841	0.0349	−0.1127*	−0.1013	0.0513	1.0000

Table 4 presents Pearson correlations for these variables. The dependant variable is a measure of InvEf as defines by the absolute value of residuals of investment model multiplied by −1.
AIQ: the accounting information quality is the absolute value of residuals of the model proposed by McNichols and Stubben (2008), multiplied by −1.
Spau: auditor specialization coded 1 if the auditor has the most clients in the industry and 0 otherwise; LnSales: is the log of sales.
LnAge: is the log of difference between the first year when the firm appears and the current year.
Tang: is the tangibility measure calculated as the ratio of tangible fixed assets to total assets.
***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 9
Regression of investment efficiency, underinvestment and overinvestment.

Variables	Variables predicted	Model 1 Investment efficiency	Model 2 overinvestment	Model3 underinvestment
Independent variables				
AIQ	(+)	0.1172***	0.6140***	0.0424
Spau	(+)	−0.0617**	−0.0517*	−0.0586**
Control variables				
LnSales	(−)	−0.0073	−0.0008	0.0002
LnAge	(+)	0.0279	−0.1375	−0.0151
Tang	(−)	−0.0627	−0.0099	0.0488
R-sq		0.24	0.42	0.1
Wald chie2		27.71	64.38	12.33
p > chie2		0.0000	0.0000	0.03
Observation		231	85	146

This table presents results from linear regressions of three models: investment efficiency, underinvestment and overinvestment. The dependent variable is based on the level of investment. InvEf: investment efficiency is the absolute value of residuals of investment model multiplied by −1; Under: Underinvestment is the negative residuals of investment model; Over: Overinvestment is the positive residuals of investment model multiplied by −1; AIQ: The Accounting information quality is the absolute value of residuals of the model proposed by McNichols and Stubben (2008), multiplied by −1; Spau: Specialization auditors coded 1 if the auditor has the most clients in the industry and 0 otherwise; LnSales: is the log of sales;LnAge: is the log of difference between the first year when the firm appears and the current year; Tang: is the tangibility measure calculated as the ratio of tangible fixed assets to total assets.
*, **, *** denote significantly at the 1%, 5% and 10% levels, respectively.

Table 10
Regression of investment efficiency on AIQ, auditor specialization and interaction.

Variables	Variables predicted	Model 1 Investment efficiency	Model 2 overinvestment	Model3 underinvestment
Independent variables				
AIQ	(+)	0.0641*	0.4700***	0.0183
Spau	(+)	0.0405*	0.0091	0.0547*
AIQ*Spau	(+)	0.8244***	0.4991**	0.9477***
Control variables				
LnSales	(−)	−0.0043	0.0032	0.0005
LnAge	(+)	0.0174	−0.0141	−0.0094
Tang	(−)	−0.0366	−0.1170	0.0576
R-sq		0.47	0.52	0.26
Test B1 + B3		58.71***	40.8***	27.66***
Wald chie2		86.22	78.59	43.82
p > chie2		0.0000	0.0000	0.0000
Observation		231	85	146

This table presents results from linear regressions of three models: investment efficiency, underinvestment and overinvestment. The dependent variable is based on the level of investment. InvEf: investment efficiency is the absolute value of residuals of investment model multiplied by −1; Under: Underinvestment is the negative residuals of investment model; Over: Overinvestment is the positive residuals of investment model multiplied by −1; AIQ: The Accounting information quality is the absolute value of residuals of the model proposed by McNichols and Stubben (2008), multiplied by −1; Spau: Specialization auditors coded 1 if the auditor has the most clients in the industry and 0 otherwise; LnSales: is the log of sales;LnAge: is the log of difference between the first year when the firm appears and the current year; Tang: is the tangibility measure calculated as the ratio of tangible fixed assets to total assets.
*, **, *** denote significantly at the 1%, 5% and 10% levels, respectively.

Table 10 reports the three models' respective estimation results, along with those pertaining to the investment efficiency, overinvestment and underinvestment scenarios.

In this section, the previously conducted analysis will be further extended by testing whether auditor specialization helps decrease or increase the AIQ on investment efficiency.

As depicted, following the application of the already applied models, the reached result confirms the fact that the information quality participate in improving of investment efficiency, as the quality measure coefficient is discovered to be positive and significant ($p < 0.1$ for AIQ). These results turn out to be in-line with those reported by Biddle et al. (2009), Chen et al. (2011) and Gomariz and Bellesta, (2014), and confirm our (H1).

As can be noticed in regard to our implemented models, the Spau variable appears to detect a positive and significant coefficient, showing that the auditor specialization increases investment efficiency, which coincides with (H2). Actually, one may note the existence of some kind of synchronization between our findings and those achieved by Lai (2009), who administered an examination of the association between high investment opportunities and high quality audits (proxy by Big 5 auditors).

Concerning the interaction term of the auditor specialization measure and AIQ, it has been designed to offer us evidence as to whether the presence of specialist auditors has a moderating effect on the interrelation between AIQ and investment efficiency. The positive and significant coefficient of the interaction variable ($p < 0.01$) indicates that investment efficiency is significantly higher for firms audited by specialists. For a more effective analysis of the relationship between the AIQ and investment efficiency, we consider examining the coefficients $ß1 + ß_3$ which indicate a positive and significant coefficient.

These findings prove that AIQ and auditor specialization are mechanisms with some degree of substitution in improving investment efficiency. Indeed a firm mitigates investment inefficiency by preparing information with higher quality or by using a specialist auditor, thus supporting H3).

Within the context of the overinvestment scenario, AIQ is likely to help reduce excess investment. it is worth noting that all coefficients are actually positive and significant, indicating that a higher AIQ has helped greatly in reducing the over-investment problem (thus confirming H1a), i.e., it is discovered to be a mechanism whereby companies can manage to reduce their investments, hence achieving an optimal investment level. This result is also consistent with the finding already attained by Gomariz and Bellesta (2014).

The empirical estimates reveal that the auditor specialization has had an insignificant effect on the overinvestment problem, unlike the results expected and attained by some previous research, such as that of Mary and Bing (2012), who underlies that better audit quality, can improve investment efficiency through reducing the overinvestment problem.

As expected, a positive relationship between the interaction term AIQ * Spau and the overinvestment problem, making the already set-up hypothesis confirmed by our empirical results (H3a). Indeed, the coefficient associated with this variable is positive, denoting that the AIQ can greatly reduce the overinvestment problem for companies hiring a specialist auditor. This can be explained by the fact that the existence of a better AIQ renders the auditor more responsible by allowing better monitoring, and therefore, it can reduce adverse selection and moral hazard.

In an underinvestment situation, AIQ has had no significant effect on improving efficiency, suggesting that in those companies with lower investment than expected the AIQ is not effective in increasing the investment level.

Regarding the variable (Spau), the estimated coefficient is positive and significant, so the auditor specialization reduces the underinvestment problem (confirmed H2b).

According to the three models' analysis, we find that the interaction coefficient is positive and significant. This can be explained by the fact that once a skilled auditor, whose training and experience are largely concentrated in a particular sector can provide better information because his or her specific knowledge, would help provide a greater capacity to detect material misstatements and constrain management's discretionary behavior. In this way, we affirm the third sub-hypothesis in this study (H3b). This result corroborates the findings reached by some previous studies, worth mentioning among them is that elaborated by Mary and Bing (2012), stating that discretionary accruals are significant indicators of overinvestment, and that earnings management greatly helps in influencing the overinvestment.

Taken together, these results appear to provide a strong support to our hypothesis advancing that AIQ helps mitigate the over-investment and underinvestment issues with regard to firms whose auditor is an industry specialist. Indeed, the test $ß + ß_3$, which indicates a positive and significant coefficient ($P < 0.01$). In this sense, the AIQ effect on investment could be mitigated by the absence of the specialist auditor.

Such results seem compatible with the findings of Lai (2011), Mary and Bing (2012) and Gomariz and Bellesta (2014).

Regarding the control variables, they have proved to be insignificant with respect to the entirety of our applied models.

As for tangibility (Tang) has a negative coefficient, denoting that an increase of tangible assets volume would help decrease investment efficiency, a finding that is quite consistent with that reached by Chen et al. (2011) and Gomariz and Bellesta (2014).

Besides, the (LnSales) variable turns out to be negatively associated with investment efficiency; the higher sales volatility proves to have a negative impact on investment efficiency. These findings are consistent with the previous study conducted by Gomariz and Bellesta (2014).

5. Robustness analysis: causality effect

To check the robustness of these main results, this paper investigates the causal relationships between investment efficiency, auditor specialization and accounting information quality.

The estimated econometric model is presented as follows:

$$\text{InvEf} = (\text{AIQ}, \text{SPAU})\ \alpha \tag{5.1}$$

The Log-linear transformation of Cobb–Douglus production function is modeled as follows:

$$\text{Ln}\ (\text{InvEf}_{t}) = ß_0 + ß_1\ \text{Ln}\ (\text{AIQ}) + ß_2\ \text{Ln(Spau)} + \varepsilon_{t} \tag{5.2}$$

Can be written in panel data form as follows Eq. (2) because since our study is a panel data study:

$$\text{Ln InvEf}_{it} = ß_0 + ß_1\ \text{Ln}\ (\text{AIQ})_{it} + ß_2\ \text{Ln(Spau)it} + \varepsilon_{it} \tag{5.3}$$

The main objective is to modeling the causal linkages that can exist between investment efficiency, auditor specialization and accounting information quality. To treat simultaneously these variables as endogenous, the investigation of the three-way linkages between them may be realized by the simultaneous-equations models present as follows:

$$\text{Ln InvEf}_{it} = ß_0 + ß_1\ \text{Ln}\ (\text{AIQ})_{it} + ß_2\ \text{Ln(Spau)it} + \varepsilon_{it} \tag{5.4}$$

$$\text{Ln AIQ}_{it} = \Omega_0 + \Omega_1\ \text{Ln}\ (\text{InvEf})_{it} + \Omega_2\ \text{Ln(Spau)it} + \mu_{it} \tag{5.5}$$

$$\text{Ln SPAU}_{it} = \alpha_0 + \alpha_1\ \text{Ln}\ (\text{AIQ})_{it} + \alpha_2\ \text{Ln(InvEf)it} + \pi_{it} \tag{5.6}$$

The extended Cobb– Douglas production framework helps us to explore the three-way linkage between the three variables: investment efficiency, auditor specialization and accounting information quality. These variables are in fact endogenous. It is therefore worth investigating the interrelationships between the three variables by considering them simultaneously in a one modeling framework (Saidi and Hammami, 2017).

Before analyzing the causality relations, we first study the panel unit roots test to check the stationary of each variable, and, if necessary, we employ the cointegration test.

5.1. Unit roots test and cointegration test

To identify the stationary properties of the variables, we apply the panel unit root test.

Among the numerous methods for panel unit root test, we employ two tests of the first generation, propose by Levin and Chu test, (LLC, 2002) and the Im, Pesaran-Shin (IPS, 2003) test, to check for the stationarity of the variables. The objective is thus to decide which of the considered variables should enter into our empirical modeling.

The null hypothesis (H_0) of the above two unit root tests, state that there exist unit root and that all variables are non-stationary, whereas the alternative hypothesis (H1) states that no unit root exists in the series and suppose the stationarity of all variables.

The acceptance or rejection of the null hypothesis is based on the level of p-value. By comparing the p-value to the threshold level of 10%, we accept H0 if the p-value is greater than 10% and we accept the alternative hypothesis if the p-value is less than 10%.

When the results of the panel unit root tests for levels of variables are statistically insignificant, we can be use the variables in first difference. If the results are statistically significant under the LLC and IPS tests, that is to say that all our series are non-stationary and integrated of order 1. In that case, the next step is to test for the existence of cointegration between them. For this purpose, we can

Table 11
Results of panel unit root tests.

Variable	LLC TEST		IPS TEST	
	Level		Level	
	T-Statistics	p-value	T-Statistics	p-value
InvEf	−25.119(0)***	0.000	−6.416(0)***	0.000
AIQ	−32.295(0)***	0.000	−7.354(0)***	0.000
SPAU	−13.002(0)***	0.000	−10.151 (0) ***	0.000

The lag length is shown in small parentheses. *, **and *** indicate significance at the 1%, 5%, and 10%levels, respectively.

Table 12
Estimation result for the causality Links (Test Arellano-Bond).

	Model (InvEf)	Model (Spau)	Model (AIQ)
InvEf	0.413 (0.003)	−0.892 (0.001)	0.46 (0.031)
Spau	−0.143 (0.001)	0.393 (0.03)	0.131 (0.129)
AIQ	0.101 (0.03)	0.217 (0.066)	0.056 (0.544)
Constant	0.219 (0.323)	0.168 (0.004)	−0.136 (0.000)
AR_2 test (p-value)	23.86 (0.000)	19.34 (0.000)	6.35 (0.095)

AR2 test: Arellano-Bond's test. * Significant at 1% level. ** Significant at 5% level. *** Significant at 10% level.

implement the well-known panel cointegration tests proposed by Pedroni (1999) whose null hypothesis is joint non-cointegration.

The results are presented in Table 11 denote the test statistics for the log levels of investment efficiency, accounting information quality and auditor specialization.

This table shows the results of panel unit root tests for the levels of variables. It can be seen that all the variables in level are statistically significant under the LLC and IPS tests, indicates that all variables are integrated of order zero.

5.2. Dynamic simultaneous-equation

At the empirical level, we allow our dynamic simultaneous-equation models in Eqs. (5.4), (5.5) and (5.6) to have a dynamic panel specification where the one-period lagged levels of the dependent variables (i.e., the investment efficiency, auditor specialization and accounting information quality) can affect their current levels. Our dynamic models with panel data are then simultaneously estimated by using the Arellano and Bond (1991) GMM estimator to find the three-ways linkages (Omri et al., 2014; Saidi and Hammami, 2017).

The correlation between the lagged dependant variables (ln $InvEf_{,t\text{-}1}$, ln $Spau_{,t\text{-}1}$, and $lnAIQ_{,t\text{-}1}$) and the error term poses critical problem, it makes the use of panel ordinary least squares (OLS) estimators (with fixed and random effects) problematical. (Table 12)

6. Conclusions

Several previously elaborated studies have revealed that the accounting information quality can greatly help in improving investment efficiency by reducing information asymmetries that give rise to frictions such as moral hazard and adverse selection. This work is designed as an extension to those researches by attempting to document the panel through which accounting information quality can relate to the investment efficiency. More specifically, the special attempt has been made to test the hypothesis that a higher accounting information quality can be associated with either mitigating the overinvestment or the underinvestment problems. For a more reliably effective estimation of accounting information quality, an appeal has been made to the measure proposed by Stubben (2010), considering that discretionary revenues stand as a proxy for earnings management.

In this respect, prior conducted studies dealing with such a subject have also put a great emphasis on the role played by auditors in information asymmetry, highlighting that the use of the auditor specialization may stand as a mechanism that can attenuate informational asymmetries and agency cost. Indeed, the use of a specialized service auditor can provide assurance on the information quality. In this particular context, the authors find that firms audited by a qualified auditor turn out to be likely to communicate forecast information on future cash flows more credibly than those audited by a non-specialist auditor.

The beneficial effects of auditor industry specialization are most marked in the industrial firms. Hence, our second hypothesis focuses on the auditor industry specialization impact on the investment efficiency.

Further, an examination of whether the auditor specialization does have influences on the investment efficiency. In addition to checking the isolated effect of the accounting information quality and the auditor specialization on investment efficiency, we examine whether the AIQ effect helps either increase or decrease the investment efficiency for firms whose auditor is an industry specialist.

In our paper, the AIQ and the auditor specialization effect on investment efficiency has been analyzed through a representative sample derived from a Tunisian context, in which AIQ is expected to be higher, over the period 2007–2013. According to some previously conducted studies (Biddle et al., 2009; Chen et al., 2011; Gomariz and Bellesta, 2014) has been discovered, that in the U.S. and emerging markets, the financial reporting quality can greatly help in solving underinvestment problems. In Tunisia, the auditor specialization proves to constitute the major mechanism implemented to control underinvestment, and AIQ is relevant only when the audit quality level is high.

As indicated by our attained results, a higher AIQ and a higher use of auditor specialization appear to contribute in increasing investment efficiency.

However, if we distinguish between overinvestment and underinvestment, it can be noted that the AIQ plays an important role in reducing overinvestment. Similarly, the specialist auditors' presence is a mechanism that contributes positively to improving the investment efficiency in underinvestment scenarios.

In addition, we find that the accounting information quality and the auditor specialization have a substitution relationship in improvement of investment efficiency: The relationship between investment efficiency and AIQ is stronger for firms whose auditor is an industry specialist.

Our achieved results are exclusively limited to findings from our sample, which includes only industrial companies in Tunisia, for this reason our sample of 33 firms could be considered too small. Despite such limits, the study results may be potentially useful for shareholders, investors, managers and policy makers to help in further enhancing firms' investment efficiency.

As a future research perspective, one could consider other investment affecting factors, and extend the result findings to companies belonging to other countries.

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