Journal of
Risk and Financial Management

MDPI

Article

Investment Efficiency and Earnings Quality: European Evidence

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Abstract: This study aims to analyze the relationship between earnings quality and investment efficiency in the European context, in order to understand whether higher earnings quality mitigates investment inefficiencies. To further understand the relationship between earnings quality and investment efficiency, the roles of cash and financial constraints are also analyzed. We use firm-year data based on unbalanced panel data, and control for country, year, and industry fixed effects using a sample composed of listed and unlisted European companies from 19 countries and 17 industries for the period 2010–2018. The results show a positive and significant relationship between earnings quality and investment efficiency. In both scenarios of investment inefficiency, overinvestment and underinvestment, the results suggest that a higher quality of reported earnings mitigates investment inefficiencies. The results also suggest that the negative relationship holds for cash-constrained and unconstrained firms, and that in firms that are financially unconstrained (higher levels of cash and lower levels of leverage) the combined effect with earnings quality is associated with a lower investment efficiency.

Keywords: investment efficiency; earnings quality; financial constraints; European firms; discretionary accruals

Citation: Gaio, Cristina, Tiago Cruz Gonçalves, and João Cardoso. 2023. Investment Efficiency and Earnings Quality: European Evidence. *Journal of Risk and Financial Management* 16: 224. https://doi.org/10.3390/jrfm16040224

Academic Editor: Shigeyuki Hamori

Received: 16 February 2023
Revised: 14 March 2023
Accepted: 28 March 2023
Published: 3 April 2023

1. Introduction

The drivers of a firm's investment behavior is a fundamental question in corporate finance. Firms deviate from the optimal investment level due to the occurrence of frictions. Empirical studies mainly focus on two types of friction: information asymmetry and agency problems. According to Bushman and Smith (2001), information asymmetries and agency problems are the most common and important distorting factors that influence firms' investment efficiency in imperfect markets.

Prior research suggests that one of the drivers of firms' investment efficiency is the quality of financial reporting, suggesting mostly that higher accounting quality is associated with a higher level of investment efficiency. This relationship is explained by the lower information asymmetries between managers and investors reducing agency conflicts such as moral hazard and adverse selection, as well as the lower cost of capital (Bushman and Smith 2001; Verrecchia 2001). Furthermore, truthful accounting information leads to a better internal decision process for the identification of the best investment opportunities (Bushman and Smith 2001; McNichols and Stubben 2008).

Earnings quality is considered a key indicator of the quality of financial reporting (Ali and Kamardin 2018).[1] The first empirical study on the relationship between earnings quality and investment efficiency was conducted by Biddle and Hilary (2006) and later studies have been based on their seminal work. Biddle et al. (2009) were the first to study investment efficiency in terms of both overinvestment and underinvestment scenarios, while Chen et al. (2011) were the first to analyze private firms in emerging countries.

However, empirical research on the relationship between earnings quality and investment efficiency is fairly limited (Tahat et al. 2022). The association between earnings quality

and investment efficiency has mainly been analyzed in a single country, mostly the United States (U.S.) (Biddle and Hilary 2006; McNichols and Stubben 2008; Biddle et al. 2009; Tahat et al. 2022) or in specific regions (Cherkasova and Rasadi 2017; Chen et al. 2011), and most studies focus on public companies.

More recent studies provide evidence that several factors may play a role in the relationship between earnings quality and investment efficiency, such as debt maturity (Gomariz and Ballesta 2014; Hung et al. 2020); free cash flow (Wang et al. 2015); financial constraints (Biddle and Hilary 2006; Carvalho and Kalatzis 2018); ownership structure (Cherkasova and Rasadi 2017); legal origin and institutional ownership (Tahat et al. 2022); and corporate governance (Bzeouich et al. 2019).

Therefore, the main purpose of this study is to examine the relationship between earnings quality and investment efficiency in the European context using a sample of listed and unlisted firms from 19 countries and 17 industries for the period 2010–2018. To further explore this relationship, we study the moderating role of cash and financial constraints in this relationship.

Consequently, this study seeks to make several contributions to the existing literature. Firstly, it analyzes the relationship between two important issues in the accounting and financial literature, earnings quality and financial reporting quality, and investment efficiency, focusing on the European context since the previous literature focused on single countries, mostly the U.S. or specific regions. Secondly, it examines both listed and unlisted companies, which expands the existing literature that mainly focuses on listed companies. While unlisted companies are responsible for the vast majority of economic activity in Europe, and are important drivers of economic growth, there is limited research in this area. Thirdly, it evaluates the moderating role of financial constraints, allowing for a better understanding of the behavior and the impact of additional factors, such as the level of cash holdings and financial leverage on the relationship between earnings quality and investment efficiency.

Our earnings quality measure is derived from Dechow and Dichev (2002), and modified by McNichols (2002). Our investment efficiency measure is based on the model of growth opportunities developed by Biddle et al. (2009) and further expanded by Chen et al. (2011), Wang et al. (2015), and Cherkasova and Rasadi (2017).

The results show a positive relationship between earnings quality and investment efficiency. These results are consistent with Biddle and Hilary (2006), Biddle et al. (2009), and Gomariz and Ballesta (2014). When considering the two alternative scenarios of investment inefficiency, overinvestment and underinvestment, the main conclusion remains. In both scenarios, a higher quality of the reported earnings mitigates investment inefficiencies, consistent with prior literature (Biddle et al. 2009; Chen et al. 2011; Gomariz and Ballesta 2014; Wang et al. 2015; Cherkasova and Rasadi 2017).

Our main conclusion remains when we control for the impact of cash and financial constraints. We also find that when firms are financially unconstrained, that is, with a higher level of cash and a lower level of leverage, the combined effect with earnings quality is related to lower investment efficiency.

This study is structured as follows. Section 2 reviews the previous and discusses the theoretical framework and development of hypotheses. Section 3 describes the sample and methodology. Section 4 presents and discuss the results. Finally, Section 5 concludes.

2. Literature Review

Earnings quality is a broad concept, with several dimensions (Burgstahler et al. 2006) and thus different measurement approaches (Schipper and Vincent 2003). Dechow and Schrand (2004) outline earnings quality from a financial analysis point of view and consider that earnings are of high quality when they accurately annuitize the intrinsic value of the firm. Thus, "earnings are of quality if they reflect the company's current operating performance, are a good indicator of future operating performance and is a useful measure for assessing the firm value (Dechow and Schrand 2004, p. 5)".

In perfect capital markets, a firm's investment decisions are independent of their financial policies, and they invest until the marginal benefits equal the marginal costs. In this scenario, firms invest efficiently, choosing only projects with positive net present values (NPV) (Modigliani and Miller 1958). However, capital markets are not perfect. There are imperfections, such as information asymmetries, that can affect firms' investment decisions, leading to inefficiencies in the form of over and underinvestment (Hubbard 1998; Stein 2003). These imperfections in the markets are primarily caused by information asymmetries between firm insiders and outside capital providers, creating agency problems such as moral hazard (Jensen and Meckling 1976; Jensen 1986; Biddle and Hilary 2006) and adverse selection (Myers and Majluf 1984; Biddle and Hilary 2006).

Therefore, investment decisions may deviate from the optimal levels, either by overinvestment (accepting projects with a negative NPV) or underinvestment (rejecting projects with a positive NPV) (McNichols and Stubben 2008). According to Bushman and Smith (2001), information asymmetries and agency problems are the most common and important distorting factors that influence a firm's investment efficiency in imperfect markets.

Models of moral hazard suggest that managers tend to make sub-optimal investments in negative NPV projects that are not in the best interest of shareholders, in order to maximize their personal welfare (Jensen 1986; Jensen and Meckling 1976). Considering the natural tendency to overinvest in these situations, Jensen (1986) and Blanchard et al. (1994) predict that managers, when they are not the owners of the firm, have incentives to grow firms beyond their optimal size since growth increases managers' power by increasing the resources under their control. According to Biddle et al. (2009), moral hazard may lead to either over or underinvestment, depending on the capital availability.

Models of adverse selection suggest that if managers are better informed than investors regarding the firm's condition, they will try to time capital issuances, selling overpriced securities (Biddle et al. 2009) and, if successful, will be able to overinvest these excess resources (Baker et al. 2003). However, if suppliers of capital recognize this problem, they may react by restricting capital or raising its cost, which will lead to the rejection of profitable projects due to fund constraints and subsequent underinvestment (Lambert et al. 2007; Biddle et al. 2009). Myers and Majluf (1984) show that the existence of an adverse selection situation, where managers are better informed than investors regarding investment opportunities and the value of the firm's assets, can lead suppliers of capital to assume that a capital raise from the firm is of a bad type, resulting in a discount in the stock price and ultimately leading to underinvestment.

Naeem and Li (2019) use a conceptual framework to demonstrate that overinvestment scenarios are usually related to agency problems (Jensen 1986; Jensen and Meckling 1976; Blanchard et al. 1994; Baker et al. 2003; Biddle et al. 2009), and underinvestment scenarios are usually related with financial constraints, such as capital restrictions (Lambert et al. 2007; Biddle et al. 2009).

Prior research suggests that a higher earnings quality is associated with a higher level of investment efficiency. This influence may occur primarily because higher-quality financial reporting reduces information asymmetry between managers and stockholders by providing more information to investors on the firm's investment projects, thereby reducing agency conflicts and the cost of capital (Bushman and Smith 2001; Verrecchia 2001; Jiraporn et al. 2008; Marbun et al. 2016). On the other hand, higher-quality financial reporting could also improve investment efficiency by providing more truthful accounting information, which could improve the internal decision process for the identification of the best investment opportunities (Bushman and Smith 2001; McNichols and Stubben 2008)[2].

Biddle and Hilary (2006) analyze the association between firm-level capital investment efficiency and accounting quality. Considering a sample of U.S. public firms, they conclude that higher-quality accounting enhances investment efficiency by reducing information asymmetry between managers and outside suppliers of capital that gives rise to frictions such as moral hazard and adverse selection. They also outline that there is a stronger

relationship between earnings quality and capital investment efficiency in countries with predominant equity financing on firm-level capital investment.

Biddle et al. (2009) extend Biddle and Hilary's (2006) research by addressing whether higher quality financial reporting, proxied by earnings quality, is associated with a reduction in overinvestment and underinvestment, splitting these two suboptimal investment levels. They conclude that earnings quality is associated with both lower overinvestment and lower underinvestment, which is consistent with the idea that financial reporting quality mitigates the information frictions that affect investment efficiency. They also conclude that a higher earnings quality is associated with lower investment in firms that are cash rich and unlevered, and with higher investment in firms that have constraints in cash and are highly levered, which is consistent with the hypothesis that financial reporting quality facilitates investment for constrained firms and restrains investment for firms that are more likely to overinvest.

Following Biddle et al.'s (2009) approach, Chen et al. (2011) examine the role of financial reporting quality in private firms from emerging markets and also conclude that it mitigates both under and overinvestment. They outline that, compared to public firms, the link between financial accounting and management decisions is likely to be stronger in private firms. They also provide evidence that greater use of banking financing increases the role of accounting quality. Cherkasova and Rasadi (2017) also study the impact of earnings quality on investment efficiency in firms from Eastern European countries, and conclude that earnings quality mitigates both overinvestment and underinvestment, and that public companies have higher earnings quality and lower overinvestment issues.

McNichols and Stubben (2008) have a different perspective and study the relationship between earnings management and investment efficiency to examine if U.S. firms that practice earnings management are more likely to make inefficient investments. They find firms overinvest substantially during the misreporting period, but after that they no longer overinvest, which suggests that a higher quality of financial information leads to more efficient investment levels. They argue that financial information of higher quality, being more unbiased, improves the quality of planning and valuation and, on the other hand, earnings management distorts information and managers' incentives, leading to inefficient investments.

Therefore, based on theoretical predictions and empirical evidence, our first hypothesis is formulated as follows:

H1: *Earnings quality is associated with investment efficiency. Firms with higher earnings quality exhibit higher investment efficiency.*

The availability of capital (Biddle et al. 2009; Chen et al. 2011; Cheng et al. 2013) may also contribute to investment inefficiency in the context of information asymmetry and moral hazard. In fact, Jensen (1986) and Myers (1977) argue that firms with plentiful financial resources are more likely to overinvest, while financially constrained firms are more likely to underinvest. Jensen (1986) and Blanchard et al. (1994) argue that firms with abundant cash holdings are more likely to grow beyond the optimal size, which may be the source of overinvestment.

Wang et al. (2015) conclude that the association between earnings quality and overinvestment is stronger for firms with high free cash flows, arguing that financial reporting quality, proxied by earnings quality, mitigates information asymmetries, lowers the cost of monitoring managers by shareholders, and improves capital budgeting.

In addition, the level of leverage may also influence investment efficiency. Myers (1977) suggests that firms which are more leveraged are more likely to face financing problems that will ultimately force them to underinvest. Similarly, Ji (2016) argues that firms with a high level of leverage may have debt overhang and face underinvestment problems. Barbiero et al. (2020) find that more leverage is associated with overinvesting, since there may be incentives to engage in risky and value-decreasing projects.

Consistent with prior research, our second hypothesis is developed:

H2: *The association between earnings quality and investment efficiency is moderated by cash holdings and financial constraints.*

3. Methodology

3.1. Data and Sample

Data were extracted from Bureau Van Dijk's Amadeus database. The sample period covers 9 years, from 2010 to 2018. All listed and unlisted companies in the Eurozone (EU28) were selected, excluding companies belonging to the financial, insurance, and public administration sectors, due to accounting and regulatory specificities, and small and medium firms, in order to increase the homogeneity of the sample and the comparability of the results across firms[3]. All companies with insufficient data availability for the calculation of the earnings quality measure in the database were excluded, as well as companies from countries with fewer than 10 firms (Gaio et al. 2020; Gonçalves et al. 2022). Finally, the outliers for the dependent variable of investment efficiency were removed, considering the percentiles 1 and 99 of the values.

The final sample is composed of 6921 companies from 19 countries and 17 industries, comprising 33.318 firm-year observations. Table 1 shows the distribution of the sample by country, where firms from the United Kingdom (UK) and Italy represent 26.30% and 22.50% of the total, respectively. About 88% of the firms are private, and from the publicly traded firms, the UK and France are the most represented countries, with 31.05% and 25.12%, respectively.

Table 1. Sample by country.

	Listed		Unlisted		Total	
Country	**Number**	**%**	**Number**	**%**	**Number**	**%**
Austria	3	0.35%	34	0.56%	37	0.53%
Belgium	7	0.81%	659	10.87%	666	9.62%
Bulgaria	14	1.63%	211	3.48%	225	3.25%
Croatia	3	0.35%	13	0.21%	16	0.23%
Czech Republic	1	0.12%	173	2.85%	174	2.51%
Deutschland	156	18.14%	57	0.94%	213	3.08%
Estonia	0	0.00%	27	0.45%	27	0.39%
Finland	47	5.47%	234	3.86%	281	4.06%
France	216	25.12%	653	10.77%	869	12.56%
Greece	47	5.47%	39	0.64%	86	1.24%
Hungary	2	0.23%	137	2.26%	139	2.01%
Ireland	4	0.47%	30	0.49%	34	0.49%
Italy	27	3.14%	1530	25.24%	1557	22.50%
Poland	14	1.63%	84	1.39%	98	1.42%
Portugal	0	0.00%	19	0.31%	19	0.27%
Slovakia	1	0.12%	175	2.89%	176	2.54%
Spain	43	5.00%	191	3.15%	234	3.38%
Sweden	8	0.93%	242	3.99%	250	3.61%
United Kingdom	267	31.05%	1553	25.62%	1820	26.30%
Total	860	100%	6061	100%	6921	100%

Table 2 presents the distribution of the sample by industry (Nace Rev.2). The industries with the highest representation are "Manufacturing" and "Wholesale and retail trade; repair of motor vehicles and motorcycles", with 30.17% and 28.70%, respectively.

Table 2. Sample by industry.

Industry	Number	%
Accommodation and food service activities	98	1.42%
Administrative and support service activities	349	5.04%
Agriculture, forestry and fishing	75	1.08%
Arts, entertainment and recreation	81	1.17%
Construction	438	6.33%
Education	49	0.71%
Electricity, gas, steam and air conditioning supply	176	2.54%
Human health and social work activities	73	1.05%
Information and communication	323	4.67%
Manufacturing	2088	30.17%
Mining and quarrying	40	0.58%
Other service activities	38	0.55%
Professional, scientific and technical activities	616	8.90%
Real estate activities	101	1.46%
Transportation and storage	315	4.55%
Water supply; sewerage, waste management and remediation activities	75	1.08%
Wholesale and retail trade; repair of motor vehicles and motorcycles	1986	28.70%
Total	6921	100%

3.2. Earnings Quality Measures

According to Francis et al. (2004), accruals quality is the most valued attribute of earnings quality. Based on the idea that accruals are estimates of future cash flows, accruals quality is important for investors to make good investment decisions but also to firms in terms of contract design and investment decisions. Several models were developed to measure accrual quality. One of the most used is the Dechow and Dichev (2002) model, which is based on the extent to which working capital accruals map into cash flow realizations where a poor match means poor accruals quality. Indeed, by comparing accruals with cash flow realizations, we can assess the quality of accruals and earnings.

Therefore, our measure of accruals quality is derived from the model of Dechow and Dichev (2002), modified by McNichols's (2002) study that introduced the innate components of accruals, changes in revenue and property, plant and equipment, to the original model. Specifically, we estimate the following regression cross-sectionally for each industry:

$$WCA_{i,t} = \beta_{0,i} + \beta_{1,i}CFO_{i,t-1} + \beta_{2,i}CFO_{i,t} + \beta_{3,i}CFO_{i,t+1} + \beta_{4,i}\Delta Rev_{i,t} + \beta_{5,i}PPE_{i,t} + \varepsilon_{i,t} \quad (1)$$

where for each company i and year t, WCA is working capital accruals; CFO is cash flow from operations; ΔRev is annual change in revenue; and PPE is property, plant and equipment, proxied with the value of the tangible fixed assets. All variables are scaled by total assets of the prior year.

The residuals from Equation (1) represents the estimation errors in the current accruals that are not related to operating cash flows and cannot be explained by the change in revenue and the level of property, plant, and equipment.

Working capital accruals and cash flow from operations are calculated as follows:

$$WCA_{i,t} = \Delta CA_{i,t} - \Delta CL_{i,t} - \Delta Cash_{i,t} + \Delta Debt_{i,t} \quad (2)$$

where ΔCA is annual change of current assets; ΔCL is annual change of current liabilities; ΔCash is annual change of cash and equivalents of cash; and ΔDebt is annual change in debt in current liabilities.

$$CFO_{i,t} = NI_{i,t} - \left(\Delta CA_{i,t} - \Delta CL_{i,t} - \Delta Cash_{i,t} + \Delta Debt_{i,t} - Dep_{i,t}\right) \quad (3)$$

where NI is net income and Dep is depreciation and amortization expenses.

Our measure of accruals quality is computed as the absolute value of the residuals from Equation (1). Following previous studies, we multiplied the absolute value of the

residuals by −1, so that the higher the value of the residuals, the higher the accruals quality is, and consequently, the higher earnings quality (Biddle et al. 2009; Gomariz and Ballesta 2014; Wang et al. 2015).

3.3. Investment Efficiency Measure

Conceptually, investment efficiency relates to firms that carry out all and only projects with positive net present values. Consistent with previous research, we measure investment efficiency using a model that predicts the level of investment based on growth opportunities and other lagged firm characteristics, and measures investment efficiency as deviations from expected investment (Biddle et al. 2009; Chen et al. 2011; Wang et al. 2015; Cherkasova and Rasadi 2017; Tahat et al. 2022).

The model is estimated as follows:

$$\begin{aligned}\text{Investment}_{i,t} = {} & \beta_0 + \beta_1 \text{Investment}_{i,t-1} + \beta_2 \text{Growth}_{i,t-1} + \beta_3 \text{NG}_{i,t-1} + \beta_4 \text{NG*Growth}_{i,t-1} \\ & + \beta_5 \text{Size}_{i,t-1} + \beta_6 \text{Age}_{i,t-1} + \beta_7 \text{Lev}_{i,t-1} + \beta_8 \text{Cash}_{i,t-1} + \beta_9 \text{ROA}_{i,t-1} + \varepsilon_{i,t}\end{aligned} \quad (4)$$

where for each company i and year t, Investment is net investment in property, plant, machinery, equipment and research and development, measured as the annual change in total fixed assets plus depreciation and amortization expenses scaled by net investment of prior period; Growth is revenue growth rate; NG represents negative growth and is a dummy variable that takes the value of 1 if revenue growth is negative and 0 otherwise; Size is the natural logarithm (ln) of total assets; Age is the ln of firm's age since its foundation; Lev is financial leverage, computed as the ratio of total liabilities to the sum of total liabilities and total shareholders' funds; Cash is the ratio of cash and cash equivalents to total assets; and ROA is return on assets, calculated as a ratio of net income to total assets.

Investment efficiency is measured by the magnitude of deviations from this expected level of investment. A positive residual means that the firm is investing at a higher rate than expected, so the firm is overinvesting, while a negative residual means that the real investment is less than expected, so the firm is underinvesting. Thus, both underinvestment and overinvestment are considered inefficient investments.

Thus, our investment efficiency measure (IE) is the absolute value of $\varepsilon_{i,t}$. Negative values of $\varepsilon_{i,t}$ represent underinvestment (UI) and positive values overinvestment (OI).

3.4. Empirical Model

We develop the following model to study the association between earnings quality and investment efficiency:

$$\begin{aligned}\text{IE}_{i,t} = {} & \beta_0 + \beta_1 \text{EQ}_{i,t-1} + \beta_2 \text{Size}_{i,t-1} + \beta_3 \text{Age}_{i,t-1} + \beta_4 \text{Lev}_{i,t-1} + \beta_5 \text{Tang}_{i,t-1} + \beta_6 \text{Cash}_{i,t-1} \\ & + \beta_7 \text{Listed}_{i,t-1} + \beta_8 \text{NNI}_{i,t-1} + \varepsilon_{i,t}\end{aligned} \quad (5)$$

where IE is the absolute value of the residuals of the Equation (4) multiplied by −1, so that higher values of IE represent higher investment efficiency. EQ is the earnings quality, as described before. In order to study both scenarios, overinvestment and underinvestment, we also consider as dependent variables the positive (OI) and the negative residuals (UI) of Equation (4), both in absolute values multiplied by −1, so that higher values represent higher investment efficiency.

Earnings quality is expected to be associated with higher investment efficiency, either considering the absolute value or the underinvestment and overinvestment scenarios, so, according to our hypothesis H1, the coefficient β_1 is expected to be positive.

Based on prior research, we consider the following control variables: Size, Age, Lev and Cash, as defined before; tangibility (Tang), calculated as a ratio of tangible fixed assets to total assets; type of firm (Listed), a dummy variable that takes the value of 1 if the firm is listed in a stock exchange and 0 otherwise; and negative net income (NNI), a dummy variable that takes the value of 1 if net income is negative and 0, otherwise (Biddle and Hilary 2006; Biddle et al. 2009; Gomariz and Ballesta 2014; Wang et al. 2015; Cherkasova and Rasadi 2017; Tahat et al. 2022).

Fixed effects are also included to control for country-specific, industry-specific, and year-specific effects, and to address potential omitted variable problems. Double-clustered standard errors at firm and year level are performed to mitigate possible heteroscedasticity problems.

4. Results

4.1. Descriptive Statistics

Table 3 provides descriptive statistics for our measures of earnings quality and investment efficiency as well as control variables. IE has a mean (median) value of 0.0753 (0.0530). In terms of over and underinvestment, 11,470 firm-year observations belong to the overinvestment group, while 21,848 belong to the underinvestment group, suggesting that there is a tendency for firms to underinvest. OI presents a mean (median) value of 0.0830 (0.0526), while UI presents a mean (median) value of 0.0712 (0.0532), suggesting that the inefficiency degree is, on average, more serious in overinvestment firms than in underinvestment firms. EQ has a mean (median) value of −0.1719 (−0.1393). Recall that we multiplied the absolute value of the residuals by −1, so that the higher the value of the residuals, the higher the earnings quality. On average, the level of leverage is about 60%, and the value of cash and cash equivalents represents almost 10% of total assets. Only 12% of the firms are listed and about 12% report a negative net income in the prior year.

Table 3. Descriptive Statistics.

Variable	Observations	Mean	Median	Standard Deviation	Minimum	Maximum
IE	33,318	0.0753	0.0530	0.0741	0.0000	0.5129
OI	11,470	0.0830	0.0526	0.0902	0.0000	0.5129
UI	21,848	0.0712	0.0532	0.0636	0.0000	0.3819
EQ	33,318	−0.1719	−0.1393	0.1429	−1.7162	0.0000
Size	33,318	11.389	11.042	1.6047	5.5759	19.8310
Age	33,318	3.1913	3.1781	0.7186	0.0000	5.5909
Lev	33,318	0.6044	0.6277	0.2132	0.0078	0.9999
Tang	33,318	0.2235	0.1514	0.2245	0.0000	0.9999
Cash	33,318	0.0996	0.0495	0.1317	0.0000	0.9940
Listed	33,318	0.1222	0.0000	0.3275	0.0000	1.0000
NNI	33,318	0.1208	0.0000	0.3259	0.0000	1.0000

IE is investment efficiency, measured with the absolute values of the residuals from the investment model; OI is overinvestment, the positive residuals from the investment model; UI is underinvestment, the negative residuals from the investment model, multiplied by −1; EQ is earnings quality; Size is calculated as the ln of total assets; Age is the ln of firm's age; Lev is firm's ratio of total liabilities to the sum of total liabilities and total shareholders' funds; Tang is asset tangibility, calculated as a ratio of tangible fixed assets to total assets; Cash is the cash and cash equivalents to total assets ratio; Listed is a dummy variable that takes the value "1" if the company is listed in the stock exchange and "0" otherwise; NNI is a dummy variable that takes the value "1" if the company has reported a negative net income in the prior period and "0" otherwise.

Table 4 provides the correlations among the variables. EQ is negatively and significantly correlated at the 1% level with the investment inefficiencies variables represented by the residuals of Equation (4): the absolute values (IE); the positive values (OI); and the negative values (UI). This indicates that higher EQ may mitigate investment inefficiency.

All other correlations are also significant at the 1% level and present low values, suggesting that the problem of multicollinearity is not present. In addition, the variance inflation factors were calculated for each independent variable (results not tabulated). All the values are less than 10 (the highest obtained value was 1.74), proving the absence of the multicollinearity problem.

Table 4. Pearson's correlation matrix.

	IE	OI	UI	EQ	Size	Age	Lev	Tang	Cash	Listed	NNI
IE	1										
OI	-	1									
UI	-	-	1								
EQ	−0.1127 ***	−0.1385 ***	−0.0760 ***	1							
Size	−0.0036 *	0.0095	−0.0671 ***	−0.1138 ***	1						
Age	−0.0566 ***	−0.0819 ***	−0.0456 ***	0.0811 ***	0.1819 ***	1					
Lev	−0.0008	0.0410 ***	−0.0243 ***	0.0958 ***	−0.0674 ***	−0.0959 ***	1				
Tang	0.0348 ***	0.0849 ***	−0.0521 ***	−0.5037 ***	0.1705 ***	0.0407 ***	−0.1657 ***	1			
Cash	0.0035	−0.0108	0.0187 ***	0.0137 ***	−0.0837 ***	0.0002	−0.1351 ***	−0.1989 ***	1		
Listed	0.0192 ***	0.0343 ***	−0.0354 ***	0.0108 **	0.4799 ***	0.1285 ***	−0.0968 ***	0.0307 ***	0.0364 ***	1	
NNI	0.0288 ***	−0.0241 ***	0.0691 ***	0.0138 ***	0.0513 ***	−0.0223 ***	0.1412 ***	0.0409 ***	−0.0647 ***	0.0202 ***	1

*** shows significance at 1% level, ** shows significance at 5% level, and * shows significance at 10%.

4.2. The Impact of Earnings Quality on Investment Efficiency

Table 5 presents the results of the regression of investment efficiency on earnings quality. First, we use IE as the dependent variable in order to assess the impact of earnings quality on the magnitude of the deviation from the optimal investment level, regardless of the type of investment inefficiency. Column (1) shows the results. Then, we use OI and UI as dependent variables, and provide the results in Columns (2) and (3), respectively.

As hypothesized, there is a positive and significant relationship between earnings quality and investment efficiency, which means that a higher quality of reported earnings reduces deviations from the optimal investment, improving investment efficiency, consistent with previous results from the literature which indicate that earnings quality enhances firms' investment decisions (Biddle and Hilary 2006; Biddle et al. 2009; Gomariz and Ballesta 2014; Tahat et al. 2022). In fact, a non-trivial increase in earnings quality of about one standard deviation increases investment efficiency by about 0.06. The impact is consistent across both firms that over and underinvest.

In terms of the control variables, all present a significant relationship with investment efficiency, except for Lev, consistent with prior studies. Size and Age have a positive coefficient, suggesting that larger and older firms have less tendency to deviate from the optimal investment level (Biddle et al. 2009; Gomariz and Ballesta 2014). Tang and Cash also have positive coefficients, which suggests that a higher volume of tangible assets is related to lower investment deviations and thus higher investment efficiency (Biddle et al. 2009) and that a higher level of cash mitigates investment inefficiencies (Biddle et al. 2009). The results also show that listed firms (Listed) and firms that had reported a negative net income in the previous period have a higher tendency to deviate from the optimal investment level, consistent with previous studies by Cherkasova and Rasadi (2017) and Gomariz and Ballesta (2014), respectively.

Columns (2) and (3) report the results for the overinvestment (OI) and underinvestment (UI) scenarios, respectively. In both scenarios, EQ presents a positive and significant coefficient, suggesting that a higher quality of the reported earnings can reduce over and underinvestment problems, and so contribute to improving investment efficiency. These results are consistent with the prior literature which documents that earnings quality can enhance investment efficiency by avoiding large positive and negative deviations from

the expected level of investment (Biddle et al. 2009; Chen et al. 2011; Wang et al. 2015; Cherkasova and Rasadi 2017). Accordingly, Hypothesis 1 is accepted.

Table 5. The impact of earnings quality on investment efficiency.

	IE (1)	OI (2)	UI (3)
Constant	−0.1174 ***	−0.1370 ***	−0.1515 ***
	(−11.42)	(−6.85)	(−13.56)
EQ	0.0564 ***	0.0647 ***	0.0529 ***
	(16.23)	(8.78)	(14.06)
Size	0.0016 ***	0.0013 **	0.0040 ***
	(5.16)	(2.25)	(10.73)
Age	0.0041 ***	0.0073 ***	0.0022 ***
	(6.84)	(6.37)	(3.35)
Lev	−0.0027	−0.0319 ***	0.0144 ***
	(−1.31)	(−7.34)	(6.77)
Tang	0.0063 ***	−0.0068	0.0348 ***
	(2.64)	(−1.29)	(13.23)
Cash	0.0096 ***	0.0041	0.0107 ***
	(2.93)	(0.53)	(3.28)
Listed	−0.0072 ***	−0.0130 ***	0.0050 ***
	(−4.68)	(−4.98)	(2.62)
NNI	−0.0081 ***	0.0104 ***	−0.0201 ***
	(−6.43)	(4.04)	(−15.14)
Observations	33,318	11,470	21,848
Adjusted R^2	0.0310	0.0579	0.0481
f-statistic	24.18	16.32	24.99
p-value	0.0000	0.0000	0.0000

The model was estimated using the pooled OLS regression method. The absolute values of the dependent variables OI and UI were multiplied by −1, so that higher values represent higher investment efficiency. T-statistics double-clustered by firm and year are in parentheses. *** shows significance at 1% level, ** shows significance at 5% level.

In terms of control variables, all except for Cash and Tang in the OI scenario present a significant relationship with both under and overinvestment scenarios. Size and Age present positive coefficients, suggesting that larger and older firms have higher investment efficiency in both scenarios. The same results were obtained by Chen et al. (2011). In the UI, Lev has a positive coefficient, which suggests that a higher level of leverage mitigates underinvestment situations, whereas the negative coefficient in the OI scenario suggests that a higher level of leverage is related to higher overinvestment. This is consistent with Barbiero et al. (2020), who find that a high leverage may lead to overinvesting, since there may be an incentive to engage in risky and value-decreasing projects.

Cash and Tang present positive coefficients only for underinvestment situations, suggesting that higher levels of cash and tangible assets are related to lower underinvestment. Similar results were obtained by Cherkasova and Rasadi (2017).

The results also show that in the UI scenario, a firm being listed is positively related with investment efficiency, and negatively related in the OI scenario, which is not consistent with Cherkasova and Rasadi's (2017) conclusion that listed companies have, on average, lower overinvestment issues. In terms of NNI, the results suggest that a reported negative net income is associated with higher investment inefficiencies in a UI scenario, but with lower inefficiencies in an OI scenario, consistent with prior research (Biddle et al. 2009; Gomariz and Ballesta 2014; Cherkasova and Rasadi 2017).

In sum, our results suggest that earnings quality enhances investment efficiency by reducing over and underinvestment decisions and helping firms to move towards their optimal level of investment. Earnings quality mitigates information asymmetries and agency problems between managers and investors, increasing shareholders' ability to monitor managers and thus improve project selection.

4.3. The Role of Cash Constraints

To study the role of cash constraints on the relationship between earnings quality and investment efficiency, we split the sample into two subsamples based on the median of the variable Cash: cash constrained and cash unconstrained. Firms with Cash below the median were classified as cash constrained, while firms with Cash higher than the median were classified as cash unconstrained. Table 6 shows the results.

Table 6. The moderating role of Cash constraints.

	Cash Constrained			**Cash Unconstrained**		
	IE	**OI**	**UI**	**IE**	**OI**	**UI**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Constant	−0.0933 ***	−0.0716 *	−0.1416 ***	−0.1111 ***	−0.0935 ***	−0.1507 ***
	(−5.75)	(−1.95)	(−7.86)	(−7.13)	(−3.13)	(−9.72)
EQ	0.0458 ***	0.0571 ***	0.0404 ***	0.0652 ***	0.0749 ***	0.0609 ***
	(8.76)	(5.19)	(7.09)	(13.64)	(7.32)	(11.85)
Size	0.0021 ***	0.0030 ***	0.0032 ***	0.0011 ***	−0.0001	0.0049 ***
	(4.64)	(3.55)	(5.88)	(2.60)	(−0.16)	(9.27)
Age	0.0039 ***	0.0063 ***	0.0027 ***	0.0044 ***	0.0086 ***	0.0021 **
	(4.48)	(3.71)	(2.88)	(5.32)	(5.48)	(2.22)
Lev	−0.0058 *	−0.0302 ***	0.0099 ***	−0.0002	−0.0329 ***	0.0191 ***
	(−1.92)	(−4.76)	(3.17)	(−0.05)	(−5.42)	(6.45)
Tang	0.0034	−0.0031	0.0314 ***	0.0078 **	−0.0101	0.0355 ***
	(1.00)	(−0.40)	(8.55)	(2.19)	(−1.34)	(8.83)
Cash	0.0405	0.0325	0.0437	0.0009	−0.0167	0.0052
	(1.02)	(0.39)	(1.05)	(0.20)	(−1.63)	(1.23)
Listed	−0.0103 ***	−0.0158 ***	−0.0009	−0.0049 **	−0.0088 **	0.0058 **
	(−4.02)	(−3.58)	(−0.31)	(−2.44)	(−2.56)	(2.37)
NNI	−0.0092 ***	−0.0207 ***	−0.0192 ***	−0.0073 ***	0.0083 **	−0.0184 ***
	(−5.52)	(−2.80)	(−11.92)	(−3.77)	(2.20)	(−8.82)
Observations	16 659	5 602	11 057	16 659	5 868	10 791
Adjusted R^2	0.0318	0.0751	0.0364	0.0366	0.0565	0.0658
f-statistic	12.89	10.89	10.07	14.74	8.64	17.52
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

The model was estimated using the pooled OLS regression method. The absolute values of the dependent variables OI and UI were multiplied by −1 so that higher values represent higher investment efficiency. T-statistics double-clustered by firm and year are in parentheses. *** shows significance at 1% level, ** shows significance at 5% level and * shows significance at 10%.

Our main conclusion remains that earnings quality has a positive and statistically significant coefficient in all the specifications, suggesting that regardless of the level of cash holdings, earnings quality is positively associated with investment efficiency.

When considering the OI scenario, columns (2) and (5) show that the EQ coefficient is stronger in the cash-unconstrained subsample compared to the cash-constrained subsample. This suggests that when firms are cash-unconstrained, EQ has a higher effect in mitigating this type of inefficiency. Thus, in cash-constrained firms, EQ is lower, suggesting that EQ has a stronger effect in mitigating overinvestment in firms with a higher level of cash. According to Biddle et al. (2009), cash-rich firms are more likely to overinvest and earnings quality is negatively associated with the investment level, contributing to the reduction in the high level of investment.

In terms of the UI scenario, columns (3) and (5), the EQ coefficient is stronger in the cash unconstrained subsample, which suggests that when firms have a higher level of cash holdings, EQ has a stronger effect in mitigating underinvestment situations. Thus, when firms are cash constrained, the EQ effect is lower in mitigating underinvestment.

4.4. The Role of Financial Constraints

To further explore the role of financial constraints on the relationship between earnings quality and investment efficiency, we follow Biddle et al. (2009) and Cheng et al. (2013)

and add two new variables, *Unconst* and the interaction variable EQ* *Unconst*, to model (5). *Unconst* is created based on the average of a ranked measure of cash and leverage. *Unconst* takes the value of 1 if the value is above the median, meaning that the firm is financially unconstrained and expected to be more likely to overinvest, and 0 if the value is below the median, meaning that the firm is financially constrained and more likely to underinvest.

The prior literature suggests that cash-rich and low-leverage firms which are less financially constrained are more likely to overinvest (Biddle et al. 2009; Cheng et al. 2013). We expected, therefore, a positive relationship between *Unconst* and overinvestment, and that the interaction between *Unconst* and EQ reduces the earnings quality effect in mitigating investment inefficiencies in an overinvestment scenario. Table 7 presents the results.

Table 7. The moderating role of financial constraints.

	IE **(1)**	**OI** **(2)**	**UI** **(3)**
Constant	−0.1241 ***	−0.1337 ***	−0.1519 ***
	(−11.34)	(−6.68)	(−13.60)
EQ	0.0642 ***	0.0811 ***	0.0497 ***
	(13.39)	(8.45)	(9.36)
Unconst	0.0022	0.0060	0.0032 *
	(1.33)	(1.57)	(1.83)
EQ* *Unconst*	−0.0143 **	−0.0288 ***	0.0038
	(−2.48)	(−2.79)	(0.79)
Size	0.0012 ***	0.0002	0.0038 ***
	(3.42)	(0.26)	(9.53)
Age	0.0041 ***	0.0073 ***	0.0022 ***
	(6.68)	(6.37)	(3.37)
Lev	0.0037	−0.0170 ***	0.0178 ***
	(1.37)	(−3.15)	(6.19)
Tang	0.0064 ***	−0.0063	0.0347 ***
	(2.68)	(−1.21)	(13.17)
Cash	0.0057 *	−0.0060	0.0086 **
	(1.66)	(−0.72)	(2.5)
Listed	−0.0077 ***	−0.0142 ***	0.0047 **
	(−4.97)	(−5.38)	(2.47)
NNI	−0.0081 ***	0.0105 ***	−0.0201 ***
	(−6.45)	(4.06)	(−15.09)
Observations	33 318	11 470	21 848
Adjusted R^2	0.0315	0.0600	0.0482
f-statistic	23.60	16.26	24.03
p-value	0.0000	0.0000	0.0000

The model was estimated using the pooled OLS regression method. The absolute values of the dependent variables OI and UI were multiplied by −1 so that higher values represent higher investment efficiency. T-statistics double-clustered by firm and year are in parentheses. *** shows significance at 1% level, ** shows significance at 5% level and * shows significance at 10%.

When considering the investment efficiencies in the full sample, in column (1), the interaction EQ* *Unconst* coefficient is negative and statistically significant, which suggests that when firms are financially unconstrained the joint effect with EQ results in a decrease in investment efficiency. As expected, in the OI in column (2), the EQ* *Unconst* coefficient is negative and statistically significant at the 0.01 level, suggesting that financial constraints decrease the role of EQ to improve investment efficiency for firms that overinvest. In terms of the UI scenario in column (3), the EQ* *Unconst* coefficient is positive, consistent with the prior literature but not statistically significant.

Consistently, we validate hypothesis 2, and argue for a moderating effect of financial constraints on the association between earnings quality and investment efficiency. This moderating effect is asymmetric and shows that cash availability and low leverage interacted with lower earnings quality in firms that overinvest.

5. Conclusions

To examine the relationship between earnings quality and investment efficiency, we used a cross-country sample composed of listed and unlisted European firms. Theoretical frameworks and empirical research imply that earnings quality plays an important role in mitigating investment inefficiency.

Our main results suggest that higher earnings quality is related to higher investment efficiency. This conclusion holds when considering overinvestment and underinvestment scenarios, consistent with previous studies on different geographic contexts (Biddle and Hilary 2006; Biddle et al. 2009; Chen et al. 2011; Gomariz and Ballesta 2014; Wang et al. 2015; Cherkasova and Rasadi 2017; Tahat et al. 2022), allowing us to conclude that this positive relationship is also effective in the European context.

We also examine the role of cash and financial constraints in the relationship between earnings quality and investment efficiency and find that our main conclusion remains. Earnings quality is positively associated with investment efficiency even after controlling for the level of cash holdings and financial leverage.

In terms of cash constraints, our results also indicate that in both overinvestment and underinvestment scenarios, the relationship between earnings quality and investment efficiency is stronger for firms that are cash unconstrained. This suggests that when firms have a higher level of cash holdings, earnings quality has a stronger effect in mitigating investment inefficiencies. Our results point to the important role of earnings quality in reducing managerial incentives to overspend available cash flow, thus contributing to monitoring and minimizing agency costs.

In terms of the role of financial constraints, our results suggest that when firms are financially unconstrained, that is, with a higher level of cash and a lower level of leverage, the joint effect with earnings quality is related to a lower investment efficiency. This finding is asymmetric and is only significant in the group of firms that exhibit overinvestment. These results, although puzzling, point to the importance of debt monitoring effects on investment efficiency.

Overall, our result of a positive relationship between earnings quality and investment efficiency suggests that higher earnings quality is related to a better environment, including lower information asymmetries and reduced agency problems (such as moral hazard and adverse selection), which contributes to the improvement of investment decisions, in line with agency theory. Thus, earnings quality plays a crucial role in mitigating overinvestment and underinvestment problems by leading to a better internal decision process for the identification of the best investment opportunities, and by increasing shareholders' ability to monitor managers and thus improve project selection. Making more efficient and profitable investment decisions promotes sustainable growth and the maximization of stakeholder wealth.

This study continues and expands the literature on the role of earnings quality in investment efficiency started by Biddle and Hilary (2006). It has practical implications for a large group of stakeholders, such as creditors, managers, and investors, as it provides evidence that a higher quality of reported earnings has a significant impact on investment efficiency, and stresses the importance of a good information environment with low information asymmetries and reduced agency conflicts.

Our study has some limitations. Despite the fact that they are the most used measures in the literature, we are aware that our measures of earnings quality and investment efficiency likely suffer from measurement errors. Another limitation is the missing data that reduce the size of our sample and make it impossible to include all the countries from the EU 28. Finally, we believe that our study would have benefited from the introduction of other control variables related to ownership structure and corporate governance. Therefore, further research might examine the role of ownership structure, mainly concentration, as well as the role of corporate governance in the relationship between earnings quality and investment efficiency.

Author Contributions: Conceptualization, all authors; methodology, all authors; software, all authors; validation, all authors; formal analysis, all authors; investigation, all authors; resources, C.G. and J.C.; data curation, C.G. and J.C.; writing—original draft preparation, C.G. and J.C.; writing—review and editing, C.G. and T.C.G.; visualization, all authors; supervision, C.G.; project administration, C.G.; funding acquisition, C.G. and T.C.G. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by FCT, I.P., the Portuguese national funding agency for science, research and technology, under the Project UIDB/04521/2020.

Data Availability Statement: Restrictions apply to the availability of these data. Data were obtained from Bureau Van Dijk's Amadeus and are available from the authors with their permission.

Conflicts of Interest: The authors declare no conflict of interest.

Notes

1 The terms "earnings quality" and "financial reporting quality" are sometimes used in the literature as synonyms. However, it is important to keep in mind that the latter has a more generic meaning and that earnings quality contributes, among other attributes, to financial reporting quality.

2 The decision to manage earnings and thus improve (or decrease) earnings quality is also affected by managers' traits and management context and environment (see e.g., Kouaib and Jarboui 2016; Gavana et al. 2019; Gaio et al. 2022), consistent with agency conflicts.

3 According to the size criteria defined in Recommendation 2003/361/EC of the European Commission.

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