The Investment Efficiency in the US technology sector: The Role of Conditional Conservatism

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ABSTRACT: (THE INVESTMENT EFFICIENCY IN THE US TECHNOLOGY SECTOR: THE ROLE OF CONDITIONAL CONSERVATISM) This study aims to investigate the relationship between conditional conservatism and investment efficiency in the technology sector. Previous studies show evidence of a positive impact of conditional conservatism on investment efficiency, neglecting how this relationship is manifested in high-tech firms. The technology sector's relevance in modern economies makes it necessary to fill this gap in the literature. Indeed, high-tech firms drive economic growth, productivity gains, and have created new industries and innovative products consequently occupying a central position in modern economies. We developed a regression analysis based on Biddle et al. (2009) in order to investigate the effects of accounting choices in reducing both over and under-investments. The sample analyzed consists of US non-financial firms from 2010 to 2018. Our results confirm that the effect of conditional conservatism on investment efficiency is positive, additionally showing that it is greater in high-tech firms compared to low-tech firms. In addition, we show that this greater effect is due to higher levels of information asymmetry which characterize high-tech firms. This study offers interesting insights for the growing number of researches on the relationship between accounting conservatism and investment efficiency, comparatively showing how this relationship is manifested in high-tech and low-tech firms. The research also contributes to enrich the stream of research on the comparison between high-tech and low-tech firms, highlighting how the differences between these groups of firms significantly impact on investment efficiency. This research has implications for both practitioners and investors. On the one hand, practitioners can make more conscious choices of accounting policies and forecast the potential effects of those choices on the basis of the sector (high-tech versus low-tech). Investors, on the other hand, can make more informed investment decisions to understand how and to what extent the sector (high-tech versus low-tech) influences the positive impact of conditional conservatism on investment efficiency. Results of this study are also beneficial to standard setters.

KEYWORDS: investment efficiency, technology sector, conditional conservatism
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1. Introduction

This paper aims to investigate whether changes in conditional conservatism may explain different investment efficiency strategies in the technology sector. Previous scholars provide evidence on the broad relationship between accounting conservatism and investment efficiency (FRANCIS and MARTIN, 2010; GARCÍA LARA *et al.*, 2016; LAUX and RAY, 2020; LI, 2013; LIU and ZHANG, 2023; SRIVASTAVA *et al.*, 2015; XU *et al.,* 2012) presenting different results for unconditional and conditional conservatism(1). While the unconditional conservatism seems to have a negative (BALL and SHIVAKUMAR, 2005; QIANG, 2007) or, at best, neutral effect (BASU, 2005) on investment efficiency, conditional conservatism seems instead to be beneficial (GARCÍA LARA *et al.*, 2016; LAUX and RAY, 2020; LIU and ZHANG, 2023; SRIVASTAVA *et al.*, 2015) since it *ex ante* discourages managers from selecting projects with a negative net present value (NPV), and *ex post* it facilitates monitoring of the managers' investment decisions (BALL and SHIVAKUMAR, 2005)

(1) Unconditional conservatism is *ex ante*, news-independent approach that involves a persistent understanding of net assets. Differently, conditional conservatism is *ex post*, news-dependent approach that refers to the asymmetric recognition of bad and good economic news (BASU, 2005).

However, this relationship has never been investigated in the technology sector which has peculiar features, although high-tech firms occupy a central position in modern economies since they drive economic growth, productivity gains, and create new industries and innovative products (GRINSTEIN and GOLDMAN, 2006). Some scholars argue that high-tech firms and low-tech firms behave differently in terms of accounting policies (KWON and YIN, 2015; LOBO *et al.*, 2018; LOMBARDI *et al.*, 2020). Consistently, conservatism accounting policies may differ between these two groups , affecting differently investment efficiency. However, previous studies limited their analysis to the level of conditional conservatism in high-tech and low-tech firms neglecting how it may influence their investment efficiency policies. We fill this gap in literature by analyzing how and whether the role of conditional conservatism in increasing investment efficiency differs in high-tech and low-tech firms, and also whether information asymmetry may explain such difference.

In order to test our hypotheses, we develop a regression analysis, based on the Biddle *et al.* (2009) model, considering a sample of US firms where the technology sector is a key segment. We find that the effect of conditional conservatism on investment efficiency is positive and greater in high-tech firms than in low-tech firms. This higher effect exerted by the conditional conservatism on investment efficiency is due to higher levels of information asymmetry. This study offers interesting insights for the growing number of research on the relationship between accounting conservatism and investment efficiency and also contributes to enrich the stream of studies on the understanding of peculiarities of high-tech firms and their role on investment efficiency. The rest of this paper is organized as follows. Section 2 reviews existing literature and presents the developed hypotheses. Section 3 describes the research method used in the study. Section 4 presents our sample and reports the main empirical results. In conclusion, section 5 presents conclusions from the study.

2. Literature and Hypotheses Development

Investment efficiency occurs when a firm undertakes projects with a NPV (CHEN *et al.*, 2011). The capital market frictions may cause deviations to investment efficiency as a result of under-investment (if the deviation from planned investment is negative) or over-investment (if the deviation from planned investment is positive). Specifically, under-investment happens when firms facing financing constraints renounce positive NPV projects due to the high cost of raising capital (BIDDLE *et al.*, 2009). Conversely, over-investment occurs when managers select bad projects to improperly expropriate the accessible resources of their firms (GARCÍA LARA *et al.*, 2016). The two main frictions that emerged from previous literature, which are responsible for the hinder of investment efficiency, are information asymmetry and agency problems (e.g. JIANG *et al.*, 2011; MORA and WALKER, 2015; STEIN, 2003; AMADUZZI and PIEROTTI, 2021).

The conditional conservatism can limit capital market frictions (FIONDELLA, 2014; HU *et al.*, 2014) affecting the investments differently, depending on whether the firm is prone to over or under-investment (GARCÍA LARA *et al.*, 2016). In firms prone to under-investment, which are characterized by financial difficulties, conditional conservatism policies can reduce the skepticism of debt, and equity holders can invest in new capital and mitigate their financial constraints (BALAKRISHNAN *et al.*, 2016). Indeed, conditional conservatism provides investors with timely signals to investigate the existence of projects with a negative NPV and, consequently, implement corrective activities (WATTS, 2003).

Moreover, conditional conservatism can also mitigate agency problems due to asymmetric payoffs of debtholders, thus improving the firm's borrowing capacity and consequently contributing to the achievement of the optimal level of investment (HONG *et al.*, 2019).

In firms prone to over-investment, instead, managers often attribute their benefits to those of the firm and of the other stakeholders, thus supporting risky or negative NPV investments (GARCÍA LARA *et al.*, 2016). In these firms, the conditional conservatism can have beneficial effects on investment efficiency for several reasons. Firstly, conditional conservatism ex ante may discourage managers from the selection of projects with a negative NPV (BALL and SHIVAKUMAR, 2005). If the firm adopts conditional conservatism policies, managers know that losses derived from low-performing projects are timely recognized, thus causing the firm's performance to likely decline during their tenure. Secondly, conditional conservatism facilitates ex post monitoring of the managers' investment decisions (BALL and SHIVAKUMAR, 2005; FRANCIS and MARTIN, 2010; WATTS, 2003). Thus, the adoption of conditional conservatism policies may likely reduce the managers' incentives to continue unprofitable (SRIVASTAVA *et al.*, 2015) or risky projects (LAUX and RAY, 2020).

The effects of conditional conservatism on investment efficiency are valid also for more opaque investments, such as capital expenditure and research and development (AHMED and DUELLMAN, 2011; GARCÍA LARA *et al.*, 2016; LOMBARDI *et al.*, 2020). Overall, the relationship between conditional conservatism and investment efficiency has been deeply empirically analyzed by scholars providing consistent results (e.g. FRANCIS and MARTIN, 2010; GARCÍA LARA et al., 2016; LAUX and RAY, 2020; LI, 2013; LIU and ZHANG, 2023; SRIVASTAVA *et al.*, 2015; XU *et al.,* 2012). Instead, how this relationship is manifested in the technology industry is not still documented, despite the relevance and peculiarities of this sector (LOMBARDI *et al.*, 2020). Indeed, previous studies limited their analysis to the level of conditional conservatism between high-tech and low-tech firms neglecting its differential influence on investment efficiency. Furthermore, results are mixed (CHANDRA, 2011; KHALIFA *et al.*, 2022; KWON *et al.*, 2006). In particular, CHANDRA (2011) and KWON *et al.* (2006) asserted that U.S. high-tech firms have greater conditional conservatism than other U.S. firms since they face greater litigation risks and are affected by a greater degree of conservative accounting standards[2]. Conversely, KHALIFA *et al.* (2022) highlighted that high-tech firms have lower conditional conservatism since they are more financially constrained than low-tech firms. The above-mentioned studies are also supported by some scholars suggesting that the differentiation between high-tech firms and low-tech firms can influence firms' accounting policies (KWON and YIN, 2015; LOBO *et al.*, 2018). We intend to fill this gap in the previous literature by analyzing how and whether the role of conditional conservatism in increasing investment efficiency differs in high-tech and low-tech firms. Especially, we argue that the characteristics of high-tech companies may cause a greater sensibility of investments efficiency to changes in conditional conservatism, in both the case of over-and under-investment. It is suggested that high-tech firms have a higher risk appetite (Grinstein and Goldman, 2006; Guiso, 1998). This makes the investment of these firms more sensible to a change in the level of conditional conservatism, as they have a stronger need to limit and monitor the development of risky projects by managers who intend to adopt opportunistic behavior (Quagli and Avallone, 2020). Therefore, we predict that the impact of conditional conservatism on investment

[2] The generally accepted accounting principles (GAAP) mandate high-tech firms to be more conservative in accounting reporting. For example, high-tech firms are affected to a greater degree by standards such as SFAS 121 on asset impairments, SFAS 5 on contingencies, and SFAS 2, which requires immediate expensing of most R&D costs. High-tech firms are also more affected by industry-specific standards such as SFAS 86 on software development costs and AICPA SOP 97-2 that requires deferral of certain software revenue.

efficiency is higher in high-tech firms than in low-tech firms (both for under-investment and for over-investment). In other words, we expect that the conditional conservatism is plus (less) influential in investment decision of high-tech firms (low-tech firms). Hence, we formulate the following hypothesis:

H_1: The positive relation between conditional conservatism and investment efficiency is greater in high-tech firms compared to low-tech firms.

Considering that previous studies asserted high-tech firms are characterized by higher information asymmetry (ABOODY and LEV, 2000; BARTH *et al.*, 2001; GUISO, 1998; GHIO, 2016; DI MARTINO *et al.*, 2020), and that the effect of the conditional conservatism on investment is more pronounced among firms characterized by greater information asymmetry (GARCÍA LARA *et al.*, 2016), we expect also that information asymmetry may be a channel through which the relationship between conditional conservatism and investment efficiency is greater in high-tech firms compared to low-tech firms. It is likely that in case of under-investing, a high information asymmetry can cause financially constrained firms to face more difficulties securing credit or equity. Conversely, high information asymmetry can lead to exacerbate over-investment problems, as managers can more easily evade monitoring (GARCÍA LARA *et al.*, 2016). Based on the previous arguments, we predict that conditional conservatism positively influences investment efficiency in high-tech firms, by reducing information asymmetry. Hence, we formulate the following hypothesis to test this:

H_2: Information asymmetry plays a positive moderating role in the relation between conditional conservatism and investment efficiency in high tech firms compared to low tech firms

3. Research Method

3.1 Sample selection

The sample consists of non-financial companies listed on the New York Stock Exchange (NYSE) during the period from 2010 to 2018. The investigation on the North American context is motivated by considering that the technology sector is a key segment in the publicly traded U.S. firms, and it played a central role in the U.S. market, especially in recent decades (CHANDRA, 2011; KHALIFA *et al.*, 2022). Moreover, previous studies show that accounting conservatism has a high economic significance in the US technology sector (CHANDRA, 2011). The choice of the nine-year period, from 2010 to 2018 is motivated by the need to delete the influence of two significant events. Following Biddle *et al.* (2022), we start from 2010 in order to exclude years strictly related to the global financial crisis in U.S., and stop with 2018 in order to eliminate the effects of the COVID-19 Pandemic.

Accounting and stock market data are extracted respectively from COMPUSTAT North America and from the Center for Research in Security Prices (Wharton Data Research Services). Corporate governance data are extracted from Thomson Reuters Database. Consistent with previous studies (BENS *et al.*, 2020; KHALIFA *et al.*, 2022), we exclude financial companies and utilities. Starting from this full sample, we adopted the classification proposed by Francis and Schipper (1999) in order to identify two subsamples: Panel A (high-tech firms) and Panel B (low-tech firms). This classification is widely adopted in previous studies (CHANDRA, 2011; KWON *et al.* 2006). Thus, we identify 14 high-tech industries and 20 low-tech industries based on three-digit SIC codes. The full sample consists of 1,020 firms and 9,180 firm-year observations. All continuous variables were winsorized at the 1st and 99th percentiles, to mitigate the influence of outliers.

Table 1 shows the details of the industries in the two subsamples and presents the number of firm-year observations for each industry. Coherently, with Kwon *et al.* (2006), the industry that contains most firms in high-tech is "*computer programming, software, data processing*", while the most noticeable industry in low-tech firms is "*motor vehicles and equipment*".

Table 1 – Subsamples composition

Panel A: High-Tech Firms			
Three-digit SIC code	Industry Description	N. obs.	Percent of subsample
283	Drug	217	10%
357	Computer and Office Equipment	173	8%
360	Electrical Machinery and Equipment	22	1%
362	Electrical Industrial Apparatus	43	2%
363	Household Appliances	22	1%
364	Electrical Lighting and Wiring Equipment	43	2%
366	Communication Equipment	87	4%
367	Electronic Components, Semiconductors	304	14%
481	Telephone Communications	282	13%
737	Computer Programming, Software, Data Processing	933	43%
873	Research, Development, Testing Services	43	2%
Total		2,169	*100%*
Panel B: Low-Tech Firms			
Three-digit SIC code	Industry Description	N. obs.	Percent of subsample
160	Heavy Construction, Excluding Building	65	6%
170	Construction-Special Trade	22	2%
202	Dairy Products	11	1%
240	Lumber and Wood Products, Excluding Furniture	33	3%
245	Wood Buildings, Mobile Homes	11	1%
324	Cement Hydraulic	22	2%
331	Blast Furnaces and Steel Works	142	13%
356	General Industrial Machinery and Equipment	131	12%
371	Motor Vehicles and Equipment	283	26%
401	Railroads	65	6%
421	Trucking, Courier Services, Excluding Air	54	5%
440	Water Transportation	98	9%
451	Scheduled Air Transportation, Air Courier	109	10%
541	Grocery Stores	43	4%
Total		1,089	*100%*

3.2 The model

3.2.1 The relation between conditional conservatism and investment efficiency

We developed panel analysis based on Biddle *et al.* (2009) in order to investigate the effects of accounting choices in reducing both over and under-investments.

Following the Francis and Schipper's (1999) classification, we run fixed effect - panel analysis with robust standard errors (adjusted using a cluster at the firm level) alternatively on the two subsamples: Panel A (high-tech firms) and Panel B (low-tech firms), to test H_1[3]. Specifically, we estimate the following model (Equation 1):

$$Inv_{i,t+1} = \alpha_t + \beta_1 COND_{i,t} + \beta_2 (COND_{i,t} * UnderOverInvest_{i,t}) + \beta_3 UnderOverInvest_{i,t} + \gamma Controls_{i,t} + \varepsilon_{i,t+1} \quad (1)$$

Where:

Test variables:

$Inv_{i,t+1}$ = A measure of the future investment of a firm "i", calculated as the sum of research and development expenditure and acquisition expenditure multiplied by 100 and scaled by lagged asset.

$UnderOverInvest_{i,t}$ = A ranked variable constructed at the industry-year level and captures settings based on which under- and over-investment is more likely. This variable is calculated based on Biddle *et al.* (2009) and takes values from 1 to 0; values closer to 1 (0) indicate settings in which under-investment (over-investment) is most likely at the industry level.

$COND_{i,t}$ = A proxy for conditional conservatism, calculated by adopting the measure by Khan and Watts (2009) which represents an extension of the Basu's (1997) model.

Following Biddle *et al.* (2022), we calculated the conditional conservatism proxy as the ratio of the sum of the C-Score and G-Score to the G-Score, where the G-Score captures the timeliness of earnings to good news, while the C-Score captures the incremental timeliness of earnings to bad news[4].

Following Biddle et al (2009), we also included in our model (Eq. 1) an interaction variable between $COND_{i,t}$ and $UnderOverInvest_{i,t}$, which allow to assess whether higher conditional conservatism is negatively (positively) associated with investment when firms are more likely to over-invest (under-invest).

Control variables ($\gamma Controls_{i,t}$)*:*

$ROA_{i,t}$ = The ratio of pretax income divided by total assets.

$Z - Score_{i,t}$ = A measure of bankruptcy risk based on Altman (1968).

$Tangibility_{i,t}$ = The ratio of property, plant, and equipment to the total assets.

$CFO\ Sales_{i,t}$ = The ratio of CFO to sales.

$Slack_{i,t}$ = The ratio of cash to net property, plant, and equipment.

$Dividend_{i,t}$ = A dummy variable that takes the value of 1 if the firm pays dividends and 0 otherwise.

$Loss_{i,t}$ = A dummy variable that takes the value of 1 if net income before extraordinary items is negative and 0 otherwise.

$Cash\ Ratio_{i,t}$ = The ratio of cash to total assets.

$INST_{i,t}$ = The percentage of shares held by institutional shareholders.

$Analyst_{i,t}$ = The number of analysts following the firm.

[3] We conducted the Hausman test in order to select the model between the Fixed Effect (FE) or Random Effect (RE).

[4] The validity of conservatism measures based on the Basu (1997) model is considered questionable by several authors (see BADIA *et al.*, 2021; DIETRICH *et al.*, 2007; DUTTA *et al.*, 2020). Indeed, we adopted also an alternative proxy for conditional conservatism as robustness test.

When a firm is classified as under-investing (coding: 1), we predict that the sum of coefficients β_1 and β_2 is positive, which means that conditional conservatism increases investments in settings where under-investment is more likely (consequently increasing investment efficiency). Conversely, when a firm is classified as over-investing (coding: 0), we predict that β_1 is negative, which means that conditional conservatism decreases investment in settings where over-investment is more likely (consequently increasing investment efficiency). In addition, we expect that the absolute value of the coefficients (β_1 and β_2) and their significance are greater for Panel A than for Panel B, thus showing that the effect of conditional conservatism on investment efficiency is more pronounced for high-tech firms than for low-tech firms.

3.2.2 Information asymmetry channel

To test the second hypothesis (H_2), we conducted two panel analysis to empirically show whether the greater impact of conditional conservatism on investment efficiency in high-tech firms versus low-tech firms may be explained by the information asymmetry channel. Following Biddle *et al.* (2022), we use seemingly unrelated regression (SUR) approach to estimate Eq. (2) and Eq. (3) to account for potential cross-equational covariance of error terms thus proceeding in two steps. Step one is to estimate Equation 2 for Panel A and Panel B to test whether conditional conservatism explains the level of information asymmetry (the channel). Then Equation 3 is estimated to test whether the channel explains investment efficiency for both panels, as follows:

$$IA_{i,t} = \alpha_0 + \alpha_1 COND_{i,t-1} + \gamma Controls_{i,t} + \varepsilon_{i,t+1} \quad (2)$$

$$Inv_{i,t+1} = \delta_0 + \delta_1 IA_{i,t} + \delta_2 IA_{i,t} * UnderOverInvest_{i,t} + \delta_3 UnderOverInvest_{i,t} + \gamma Controls_{i,t} + \varepsilon_{i,t+1} \quad (3)$$

Following Armstrong *et al.* (2011) two accounting-based measures are adopted to capture the channel. First, a scaled accruals quality is used to measure information asymmetry[6], obtaining the variable "IA". Second, the ratio of annual research and development expense to sales is calculated, obtaining the variable "IA_2" (Barth et al., 2001).

$Controls$ represents the set of control variables used in the models.

Finally, consistent with Biddle et al. (2022), we conducted the Sobel Test (SOBEL, 1982) to evaluate the channel validity.

4. Results

4.1 Descriptive statistics

Table 2 shows the descriptive statistics of the main variables for the full sample and for the two subsamples representing high-tech and low-tech firms. It emerges that the mean value

[6] Following Dechow and Dichev (2002), we estimated accruals quality as the standard deviation of residuals from the regression of working capital accruals on lagged, current, and future cash flows plus changes in revenue and property and plant and equipment. Namely, we adopted the following equation:

$$\Delta WC_t = \beta_0 + \beta_1 CFO_{t-1} + \beta_2 CFO_t + \beta_3 CFO_{t+1} + \beta_4 \Delta REV_t + \beta_5 \mathrm{PPE}_t + \varepsilon_t$$

of INV is higher for Panel A than for Panel B, thus confirming that high-tech firms invest more in R&D than low-tech firms (BOWONDER *et al.*, 2000; GRINSTEIN and GOLDMAN, 2006). In addition, the mean value of the variable UnderOverInvest shows that high-tech firms are more prone to over-investment. Moreover, coherently with CHANDRA (2011), Table 2 shows that the Panel A presents a higher COND mean value than Panel B, confirming that high-tech firms are characterized by greater conditional conservatism than low-tech firms.

The Pearson correlation is conducted to validate multicollinearity issues. The results (untabulated) confirm the absence of multicollinearity concerns in our panel data.

Table 2 – Descriptive statistics

Variable	Full sample				Panel A: High-Tech				Panel B: Low-Tech			
	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max
$INV_{i,t}$	10.25	10.24	3.11	15.78	13.12	11.63	3.56	16.98	8.72	7.85	2.56	14.01
$UnderOverInvest_{i,t}$	0.44	0.34			0.21	0.30			0.56	0.33		
$COND_{i,t}$	1.4	51.9	0.56	1.5	1.9	22.3	0.71	1.7	1.2	56.0	0.11	1.2
$ROA_{i,t}$	0.14	10.34	-0.02	0.25	0.04	0.27	-0.04	0.16	1.08	33.82	-0.01	0.22
$Tangibility_{i,t}$	0.37	0.28	0.11	0.53	0.22	0.19	0.08	0.42	0.40	0.25	0.16	0.55
$CFO\ sales_{i,t}$	0.23	23.16	0.09	0.44	0.15	0.58	0.01	0.22	0.31	0.18	0.13	0.53
$Slack_{i,t}$	2.81	42.93	-0.95	3.33	5.45	52.70	-0.23	6.68	2.70	32.24	-0.98	3.12
$Dividend_{i,t}$	0.65	0.48			0.52	0.50			0.68	0.47		
$Loss_{i,t}$	0.26	0.44			0.33	0.47			0.19	0.39		
$Cash\ ratio_{i,t}$	0.24	6.56	-0.22	0.79	0.33	2.19	-0.22	0.84	0.86	21.28	-0.01	1.26
$Z\text{-}Score_{i,t}$	6.64	19.92	-2.25	11.34	3.94	9.33	-2.98	13.01	17.91	48.73	-0.58	25.67
$INST_{i,t}$	36.00	0.30	0.00	100.00	39.00	0.32	0.00	100.00	27.00	0.25	0.00	85.00
$Analyst_{i,t}$	4.38	6.11	0.00	9.21	5.82	5.83	0.00	10.11	3.99	5.95	0.00	8.01

Note. Table 2 reports the descriptive statistics (mean, standard deviation, min, max) for the full sample and the high-tech and low-tech subsamples. Continuous variables were winsorized at the 1st and 99th percentiles.

4.2 Regression analysis

A fixed-effect panel regression is developed to analyze the effect of conditional conservatism on investment efficiency. Table 3 presents the results of estimating Equation 1 for the two subsamples: Panel A (high-tech firms) and Panel B (low-tech firms).

Consistently with our expectations, we found in the two subsamples that conditional conservatism is negatively associated with investment in firm-year observations with a greater likelihood of over-investment. In particular, the negative and significant β_1 coefficient informs that conditional conservatism decreases investment in firms that are likely to over-invest (consequently increasing investment efficiency). These results are consistent with previous studies (BALL and SHIVAKUMAR, 2005; GARCÍA LARA *et al.*, 2016), suggesting that in firms oriented to over-investment the conditional conservatism discourages the selection of project with negative NPV and acts as monitoring mechanism for manager's investment decisions, thus reducing the investments.

In addition, we found in both subsamples that conditional conservatism is positively associated with investment in firm-year observations with a greater likelihood of under-investment. Indeed, the sum of the coefficients $\beta_1$and β_2 is positive and significant at conventional levels, showing that higher conservative firms invest more in settings of under-investment, consequently increasing investment efficiency.

Similarly to previous studies (e.g. GARCÍA LARA *et al.*, 2016; HONG *et al.*, 2019), these results support the rationality that in firms prone to under-investment, the conditional conservatism can help to mitigate their financial constraints by reducing the skepticism of debt and equity holders to invest and by limiting the agency problems due to the asymmetric payoff of debtholders.

The results also show that the effect of the conditional conservatism on investment efficiency is higher in Panel A than in Panel B. Indeed, the β_1 coefficient for Panel A (-1.63, t-stat=-3.32) is higher than for Panel B (-0.00, t-stat=-1.84), thus suggesting that in firms prone to over-investment, the decrease of investments due to the increase of conditional conservatism is higher if the firm is high-tech than low-tech. Also, the sum of the coefficient β_1 and β_2 presents a higher value for Panel A (3.62, t-stat=3.41) than for Panel B (0.01, t-stat=1.69) revealing that in the presence of under-investment, more conservative firms invest more in high-tech settings. These results are explained by the greater risk appetite of high-tech firms compared to low-tech firms. This suggests that high-tech firms prone to over-investment have a stronger need to limit and monitor the manager's opportunistic behavior than low-tech firms.

In addition, the p-value of the coefficients β_1 and β_2 shows a stronger significance for Panel A than for Panel B, confirming that the relationship between conditional conservatism and investment efficiency is stronger for high-tech firms than for low-tech firms. Overall, the results discussed above, and presented in Table 3, verified our first hypothesis. Most of the control variables are significant at 1%.

Table 3 – Investment efficiency and conditional conservatism: High-tech versus low-tech firms

Variables	***Panel A: High-Tech***			***Panel B: Low-Tech***		
	Coef.	t	VIF	Coef.	t	VIF
$COND_{i,t}$	-1.63	-3.32***	1.53	-0.00	-1.84*	1.96
$COND_{i,t}$* $UnderOverInvest_{i,t}$	5.25	5.89***	1.29	0.03	2.06**	1.36
$COND_{i,t}$ + $COND_{i,t}$* $UnderOverInvest_{i,t}$	3.62	3.41		0.01	1.69	
Controls						
$UnderOverInvest_{i,t}$	-0.45	-16.08***	1.48	-0.26	-2.64***	1.10
$ROA_{i,t}$	-0.40	-11.86***	2.00	-0.33	-2.06**	1.13
$Z\text{-}Score_{i,t}$	0.31	9.64***	2.37	1.65	1.81*	1.07
$Tangibility_{i,t}$	0.04	2.15**	1.94	2.31	1.89*	1.81
$CFO\ sales_{i,t}$	-0.31	-2.99***	1.60	-0.34	-3.07***	1.80
$Slack_{i,t}$	-0.47	-0.86	1.82	-0.51	-1.02	1.83
$Dividend_{i,t}$	-0.83	-4.31***	1.44	-2.02	-1.97*	1.07
$Loss_{i,t}$	-0.23	-2.77***	1.83	-1.04	-3.32***	1.22
$Cash\ ratio_{i,t}$	-0.01	-0.36	1.09	-0.08	-0.48	1.10
$INST_{i,t}$	0.60	2.90***	1.63	0.81	4.23***	1.44
$Analyst_{i,t}$	0.45	1.05	2.25	0.01	1.02	1.20
_cons	5.78	8.83***		6.35	9.01***	
	F = 40.01***			F = 49.86***		

	$R^2 = 0.34$ Obs. = 2,169	$R^2 = 0.25$ Obs. = 1,089

Note. Table 3 reports the results of the fixed-effect panel regression (Eq. 1). Reported t-statistics are based on robust standard errors. The symbols ***, **, and * denote two-sided significance at the 1%, 5%, and 10% levels, respectively.

4.3 Information asymmetry channel

Table 4 and Table 5 present the results of estimating Equation 2 and Equation 3 respectively for the two sub-samples.

In particular, the results presented in Table 4 Panel A showed that α_1 is negative and significant at conventional levels, while for Panel B it is negative but insignificant (>10%). Similarly, the results from Table 5 showed that a negative and significant influence exists regarding the information asymmetry on the investment efficiency in high-tech firms (δ_1<0; $\{\delta_1 + \delta_2\}$>0), while this significance is not verified in low-tech firms. These results are confirmed by adopting also the second proxy for information asymmetry (i.e. IA_2) (untabulated results).

Table 4 – Association between conditional conservatism and information asymmetries

Variables	***Panel A: High-Tech***			***Panel B: Low-Tech***		
	Coef.	t	VIF	Coef.	t	VIF
$COND_{i,t-1}$	-0.04	-5.77***	1.03	-0.02	-1.51	1.22
Controls variables included		*Yes*			*Yes*	
	F = 40.14***			F = 50.26***		
	$R^2 = 0.33$			$R^2 = 0.24$		
	Obs. = 2,169			Obs. = 1,089		

Note. Table 4 reports the results of the fixed-effect panel regression (Eq. 2). Reported t-statistics are based on robust standard errors. The symbols ***, **, and * denote two-sided significance at the 1%, 5%, and 10% levels, respectively.

Table 5 – Association between information asymmetries and investment efficiency

Variables	***Panel A: High-Tech***			***Panel B: Low-Tech***		
	Coef.	t	VIF	Coef.	t	VIF
$IA_{i,t}$	-5.61	-9.76***	1.44	-1.19	-0.98	1.43
$IA_{i,t}$* $UnderOverInvest_{i,t}$	9.01	12.51***	1.61	2.48	1.27	1.32
$IA_{i,t} + IA_{i,t}$* $UnderOverInvest_{i,t}$	3.40	2.64		1.29	0.62	
Controls variables included		*Yes*			*Yes*	
	F = 35.34***			F = 49.98***		
	$R^2 = 0.39$			$R^2 = 0.24$		
	Obs. = 2,169			Obs. = 1,089		

Note. Table 5 reports the results of the fixed-effect panel regression (Eq. 3). Reported t-statistics are based on robust standard errors. The symbols ***, **, and * denote two-sided significance at the 1%, 5%, and 10% levels, respectively.

Overall, the results suggest that the information asymmetry channel may explain the higher effect of conditional conservatism on investment efficiency in high-tech firms, compared to low-tech firms. The same is not true for low-tech firms, which have lower information asymmetry problems. The Sobel test confirms that the validity of the information asymmetry channel is verified only in high-tech firms and not in low-tech firms (untabulated results).

4.4 Robustness tests

We conduct robustness tests to validate our findings. We adopt an alternative measure of conditional conservatism by GIVOLY and HAYN (2000), calculated as the accumulated non-operating accruals deflated by accumulated total assets.

In addition, following previous literature (GARCÍA LARA *et al.*, 2016; HONG *et al.*, 2019), we adopted an alternative measure for the investment of firms, including both capital and non-capital expenditures (capital expenditure multiplied by 100 and scaled by property, plant and equipment, plus the sum of R&D and acquisition expenditures multiplied by 100 and scaled by lagged total assets).

We also use another classification method to identify high-tech firms. Following Bravo and Reguera-Alvarado (2017) we rely on the Kile and Philipps's (2009) classification based on the North American Industry Classification System (NAICS) codes.

The results (untabulated) obtained running all the robustness tests are consistent with our main findings and validate our hypothesis.

Finally, to explore if the research is affected by a reverse causality issue, we conduct the Granger causality test (Granger, 1969) between investment efficiency and conditional conservatism. The results (untabulated) confirm that conditional conservatism influences investment efficiency and not vice versa, thus supporting the absence of reverse causality.

5. Conclusions

The aim of this study is to investigate the relationship between conditional conservatism and investment efficiency strategies analyzing whether, and to what extent, it is differently manifested in high-tech firms as compared to low-tech firms.

We find evidence that the positive effect exerted by the conditional conservatism on investment efficiency is greater in high-tech firms compared to low-tech firms. We attribute the greater sensitivity of investment efficiency to an increase in conditional conservatism in high-tech companies to their greater information asymmetry.

The results of this study are beneficial for practitioners and investors. Practitioners can better assess accounting policies in a way that forecasts their potential impacts on the specific high-tech sector. Indeed, the understanding the dynamics of the influence of conservative policies on investment decisions in specific settings enables them to develop a deeper awareness of the implications of accounting policies in terms of investment efficiency. Investors could benefit from the influence of conditional conservatism in reducing information asymmetries which could have positive effects in supporting their investment decisions. This may allow investors to exploit conditional conservatism as a mechanism for monitoring managers' performance and limit agency problems. In addition, this study may be of interest for standard setters providing insights for the controversial debate on the role of the conservatism principle, which highlighted only a superficial understanding of its

application (ALEXANDER *et al.*, 2018; ALLINI and MEUCCI, 2021; FIONDELLA, 2014; MATTEI and PALETTA, 2021; PELGER, 2020). In this regard, our study may be helpful in clarifying the implications of adopting conservative policies to provide useful financial information to users, in terms of investment efficiency in a specific context (i.e. high-tech and low-tech).

However, this study is not exempt from limitations. First, we focused on a sample of US non-financial firms, this does not allow to generalize the results. Second, we assume that the relationship between conditional conservatism and investment efficiency is linear, but different options should also be considered. Further studies can investigate other contexts and the possibility that the relation between conditional conservatism and investment efficiency is not linear in order to enrich the evidence on this topic. Lastly, this study considered the information asymmetry channel, but there can be other channels in which conditional conservatism may serve to increase investment efficiency, for example, by facilitating monitoring. Moreover, this study does not consider other potential corporate governance mechanisms (e.g. board composition, board size, board gender diversity) that may affect this relationship.

Future studies can explore whether the greatest effect of conditional conservatism on investment efficiency is related to further firms' characteristics or macro-economic conditions.

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