

Intangible Assets and Crash Risk: The Case of Low Intellectual Capital Firms in Indonesia

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Abstract

This study explores how intangible assets affect crash risk in Indonesia as the representative of emerging markets, especially for low intellectual capital firms. We employ regression analysis to investigate the effect of intangible assets on crash risk in Indonesia. The findings suggest that firms with intangible assets are more vulnerable to crash risk. Our further investigations also find that intangible assets stimulate crash risk in low IC firms, but intangible assets cannot explain crash risk in high IC firms. This study implies that Indonesia's low IC firms with intangible assets use explorative innovation strategies rather than exploitative strategies. This paper warns investors about the increasing crash risk of overvalued intangible assets and guides investors in anticipating future crashes.

JEL Classifications: G11, G40, O31

Keywords

Intangible assets, crash risk, low IC firms, innovation, intellectual capital, accounting

Introduction

Industry 4.0 has been widely discussed in the economic literature. Industry 4.0 adopts computers and automation and enhances it with intelligent autonomous systems driven by data and machine learning (Marr, 2018). The Industrial Revolution 4.0 is considered a new industrial stage where the integration of manufacturing processes can help firms achieve higher industrial performance (Dalenogare et al., 2018). The fourth-generation industrial revolution interferes with an intelligent system and automation in the industry (Damani & June, 2020). Today's consumers and market preferences are the pathways to current technology and digitization. Murphy et al. (2021)

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demonstrate that the new economy firms dominate the market capitalization of the biggest firms in the S&P 500 Index. Following the trends and market needs, many firms strive to be at the forefront of global competition. New economy firms compete in an environment supported by the computer, internet, telecommunication and networking industries (Chen, 2008; Ittner et al., 2003). These new economy firms are characterized by technological sophistication and operate in a dynamic environment to maintain uniqueness and innovation and to sustain the firm's competitive advantage (Balkin et al., 2000). Innovation is crucial in the new economy environment (Liao et al., 2017). Intangible assets are closely related to innovation. Intangible assets represent innovation because those assets contain successful R&D and acquisition of intellectual property rights. According to McClure and Thomas (2019), R&D creates new avenues for the production of goods and services. These resources significantly contribute to the productivity and innovation systems of businesses. Furthermore, Kramer et al. (2011) state that intangible assets are critical drivers for firm innovation and economic growth. Therefore, in this study, we use intangible assets to represent innovation.

As one of the emerging countries, Indonesia strives to compete in the global competition in the era of Industry 4.0. The Indonesian government issued the *Making Indonesia 4.0* roadmap (Ministry of Industry and Trade, 2020) to revitalize the national industrial sector through industrial technology and provide tax incentives that spending on research and development deducts taxable income. The Ministry of Finance of Indonesia also issues tax incentives related to R&D activities. The tax incentives are part of the government's effort to encourage the improvement of intellectual property rights through 1) exemption from import taxes on imports of goods for research and scientific development purposes; 2) firms that make donations for R&D purposes will receive tax benefits and 3) additional time of 2 years for compensation of losses, if they have R&D expenses in the context of product development or production efficiency (Minister of Finance Regulation, 2020). The support and incentives from the government have begun to steadily change the behaviour of top managers and lead to a greater allocation of investment for creating innovation (Zhan et al., 2020).

Indonesia has both a relatively low level of law enforcement (Leuz et al., 2003) and a firm disclosure level slightly above the average for emerging countries (Song, 2015). Indonesian Stock Exchange data, as of March 2021, indicates that the non-new economy still dominates the market capitalization of the 10 most prominent firms. Non-new economy firms operate in traditional durable and non-durable manufacturing industries (Barth et al., 2021; Ittner et al., 2003). This situation differs significantly between top firms in the U.S. and global firms. Based on our financial data of listed firms on the Indonesia Stock Exchange from 2016 to 2019, most firms have no intangible assets. Firms with intangible assets are only 48% of our total sample. In financial reporting, intangible assets usually comprise the value of the patent, copyright, brand name and goodwill. Moreover, most of the listed firms in the Indonesia Stock Exchange (IDX) are still categorized as low intellectual capital (IC) firms.

Through their research and development (R&D) budget, firms generate product and business innovations and develop intellectual property rights due to R&D activities. Intangible assets rapidly grow in importance compared to tangible assets. S&P 500 firms reached a value of intangible assets of \$21 trillion in 2018 (Ross, 2020).

According to *International Financial Reporting Standards*, prepared by the *International Accounting Standards Board*, intangible assets are identifiable as non-monetary assets without physical substance. International Accounting Standard (IAS) 38 sets out the criteria for recognizing and measuring intangible assets and requires disclosures. IAS 38 states that intangible assets should be presented in the statement of financial position after the costs are calculated reliably. Internally generated intangible assets cannot be reported because self-creation intangible assets do not have reliable costs to be estimated (IASB, 2014). To improve the comparability of

financial reporting between countries, Indonesian firms also adopt this regulation by providing financial accounting standard number 19 (IAI, 2020).

In producing self-creation assets, research and development accounting treatment also contribute to reporting issues on intangible assets. Research expenditures are not capitalized as assets, but recognized immediately as expenses in the current year. After the projects provide future economic benefits, developing expenses can be identified as assets. In short, IAS 38 provides strict guidelines to reduce the probability of listed firms reporting the overvaluation of intangible assets. This phenomenon is mentioned by Ross (2020), that intangible assets are hidden but have a significant stimulus.

The regulation of intangible assets by IAS 38 is quite different compared to the U.S. accounting standards. According to Financial Accounting Standard (FAS), no. 142, both research and development activities are immediately recorded as an expense in the United States (FASB, 2001). Firms cannot capitalize (or recognize them as assets) on those activities. It means that U.S. accounting practices enforce more conservative accounting rules. Intangible assets are presented in financial statements only for acquired or purchased assets. IAS 38 and FAS No. 142 are treated differently, which results in distinct key variables and leads to differences in financial analysis (Turlington et al., 2019).

Intangible assets are more difficult to measure than tangible assets. Referring to Whitwell et al. (2007), since investors rely more on their valuation of intangible assets, firms are motivated to boost their stock prices by presenting more intangible assets in their financial reports. Previous studies have shown that investors and security analysts overreact to information (DeBondt and Thaler, 1985, 1990). In line with these findings, Ho and An (2020) further find that intangible assets are information that causes overreaction among market participants in the Chinese Stock Market. Consequently, firms with intangible assets are vulnerable to crash risk in the future.

Crash risk is defined as the frequency of extreme negative returns (DeFond et al., 2015). According to Kim and Zhang (2014), the crash risk captures higher stock return distribution moments (the third-order moment). This feature is different from the return measures in previous studies, such as the average return (the first-order moment) and variance of returns (the second-order moment). Chen et al. (2001) emphasized the importance of skewness since returns are generally not normally distributed. Therefore, studies related to tail risk, a function of skewness, are critical because extreme adverse events can cause significant losses to investors.

Our study does not discuss the role of innovation in firm performance but focuses on evaluating the impact of the firm's innovation on stock market issues. We believe that presenting information about intangible assets is essential, but this stimulates investors to overreact while choosing firms with high levels of intangible assets as their investment targets. Investors assume that firms with intangible assets are associated with high levels of innovation, whereas business innovation is a very prominent issue today. Although innovation represented by intangible asset information is an important activity, some firms fail to implement it because they must adjust to new activities since innovation failure is too high (Nakata, 2020). Usually, it is not easy to be realized in a status quo situation (França et al., 2017).

Our research contributes to intangible asset studies by providing evidence from the Indonesian stock market, where non-new economy firms dominate the stock exchange. Our findings suggest that higher intangible assets increase the crash risk. This study also warns investors that the overvaluation of intangible assets can be highly harmful to their investment. Additionally, firms with intangible assets only experience a crash if they are operated in low intellectual capital industries. We also find that intangible assets accelerate crash risk for firms with low financial reporting quality.

Our paper also contributes to the studies on stock crashes by presenting intangible asset information as an essential catalyst. The findings also guide investors in anticipating future

crashes. This risk should be anticipated, especially for individual investors who tend to concentrate their funds on a small number of listed firms.

Next, our research highlights the economic role of emerging markets that have increased in the last decade. Based on data from the Global Financial Stability Report, after the 2008 financial crisis, the role of emerging markets in global economic growth has increased (IMF, 2016). Based on Serletis & Azad's (2020) research, the prospect of economic growth in emerging markets is crucial for global economic growth. As one of the emerging markets, Indonesia has a relatively large market, so Indonesia's role in the global economy is significant.

The remainder of the article is structured as follows. Section 2 briefly discusses the impact of intangible assets on crash risk. The methodology is discussed in Section 3. The fourth section analyses the findings, and Section 5 is devoted to the conclusion and the opportunity for future studies.

Literature review

Firms with intangible assets represent more innovation-oriented firms than its counterpart. Professional investors also support this situation. They believe that intangible assets presented in financial information contain essential information about future benefit of the firms (Whitwell et al., 2007). Investors even overreact to information on intangible assets (Ho & An, 2020). This situation stimulates firms to report more intangible assets in their financial reporting. Investors may therefore react negatively if they learn that the intangible assets' future economic benefits fall short of their expectations. This increases the risk of crashes.

In producing innovation, the research (development) phase which meets the requirements of IAS 38 must be expensed (capitalized) and presented as an expense (intangible assets) in the profit loss statement (statement of financial position). Indonesia's accounting standard also adopts the same rule as the IAS 38. Using more conservative accounting treatment, U.S. regulation only capitalizes intangible assets from purchases. Research and development expenditures should be recognized immediately as expenses. It is stated in FAS 142 (FASB, 2001). This fact demonstrates that Indonesia's measurement of intangible assets is more aggressive than the U.S. accounting standard. Based on the World Bank, Indonesia was the seventh biggest GDP (PPP) in 2020, but listed firms are still dominated by non-new economy firms (IDX, 2021). The recognition of higher intangible assets in Indonesia tends to produce overvaluation because investors overreact to intangible asset information. Meanwhile, the future benefits of intangible assets are still not proven. This condition improves the probability of crash risk.

Several studies discussed crash risk (Hutton et al., 2009; Jia, 2018; Kim & Zhang, 2014; Wu & Lai, 2020). The management of firms with an advantage in information distribution delays bad news until it accumulates. At some point, the bad news can no longer be concealed. A bundle of bad news flooded the market and caused a stock crash.

Intangible assets contain a lot of information asymmetry due to several factors. First, accounting recognition and measurement complexity related to intangible assets are relatively high, especially for internally created intangible assets. Therefore, several studies show that intangible assets reduce the information content of financial statements. Lev and Zarowin (1999) presented the decreasing usefulness of accounting information to the stock market. The decline in value relevance is thought to be due to the difficulty of market participants in identifying information contained in intangible assets. Dantoh et al. (2004) showed a significant decrease in explanatory power (R^2) from financial statement information on market value, and this decline is especially apparent in firms with high intangible assets. Even 'traditional' intangible assets such as brand names and copyrights are presented in the annual financial report only if they fulfil strict recognition criteria. Therefore, those intellectual capital expenditures may not be reported as assets in

the financial statements (IAS 38). This condition obscures the importance of information on intangible assets and undermines the value of creating intangible assets, which are expected for future economic benefits.

Second, the uncertainty associated with the future economic benefits of intangible assets is higher than that of tangible assets (Kothari et al., 2002). This uncertainty makes it difficult for shareholders to estimate their next performance (Dehning et al., 2006). This condition indicates that the higher (lower) the firm's intangible assets proportion, the higher (lower) the risk.

Third, it is not easy to quantify intangible assets' value since they have no physical form. This situation gives greater discretion to management in reporting intangible assets (Wu & Lai, 2020). Based on March (1991), explorative firms have an asymmetric payoff (higher failure-to-success ratio), whereas exploitative firms refer to firms that implement aggressive innovations, involve disruptive changes and seek new opportunities. March (1991) also mentions that explorative firms have a high level of uncertainty. Therefore, explorative firms tend to have more bad news (Manso, 2011).

These three factors raise information asymmetry. The higher the intensity of intangible assets the firm owns, the higher the information asymmetry and the greater the possibility for managers to act opportunistically (Wu & Lai, 2020). Managers use their discretion in making and reporting policies for their interests (Ramanna, 2008), such as their career path, reputation and compensation reasons (Kothari et al., 2009). The complexity of intangible assets can be used as a cover for unsuccessful innovation, which puts their interests in danger. This condition raises information asymmetry for firms with high intangible assets and increases the probability of a stock crash.

Information asymmetry leads to stock mispricing by market participants. Investors overreact to intangible information, which causes the stocks to be overpriced (Ho & An, 2020). Nowadays, investors are exposed to the innovation hype of non-accounting information. Empirical research conducted by Habib and Hasan (2017) shows that the stocks of prospector firms experience overvaluation, which leads to a higher crash risk for these stocks. Prospectors in their research refer to innovation-oriented firms.

On the one hand, many economists and practitioners recognize that intangible assets have a significant role in firm valuation. However, management policy and deficiency of a universal standard of intangible assets adversely affect the firm's value (Wu & Lai, 2020). Drawing from the discussions, we state the following hypothesis:

H_{1a}: Firms with intangible assets are prone to crash risk.

A firm's strategy must be in harmony with its environment. Khan et al. (2020) state that the environment influences the innovation investment strategy (R&D investment). They find that high (low) uncertainty leads to low (high) investment in R&D. We predict that excessive innovation increases the risk of a crash for firms operating in low IC industries because it is not suitable for the business environment in which the firm operates. Thus, the following hypothesis is proposed:

H_{1b}: Firms with intangible assets are prone to crash risk, especially low IC firms.

Methodology

Sample selection

This study employs listed firms of the Indonesian stock market for the 2016–2019 period, except firms from the financial sector because those firms have different financial information characteristics. We select firms that have active trading days during the study period. A firm is

considered to have active trading days if its shares are traded at least equal to 90% of the maximum trading days for the year. In addition, we only analyze firms with financial reporting periods ending on December 31 to minimize the confounding effects.

Variable measurement

Adopting previous studies (Hutton et al., 2009; DeFond et al., 2015; Kim & Zhang, 2014; Kim & Zhang, 2016; Wu & Lai, 2020), the term crash risk (NegSkewt) refers to the negative skewness of firms' weekly returns in one period (a year). Negative skewness reflects that the stock has a frequency of extreme negative returns in that period (DeFond et al., 2015).

To calculate the skewness as a proxy for crash risk, we regress weekly individual stock returns with market returns and industry returns for each firm and each year (Kim & Zhang, 2016; Hutton et al., 2009; Jia, 2018)

$$r_{j,w} = \beta_0 + \beta_{1,j}r_{idx,w-1} + \beta_2r_{s,w-1} + \beta_{3,j}r_{idx,w} + \beta_{4,j}r_{s,w} + \beta_{5,j}r_{idx,w+1} + \beta_{6,j}r_{s,w+1} + \varepsilon_{j,w} \quad (1)$$

The symbol of $r_{j,w}$ represents the return of the firm j in the week w , r_{idx} is the weekly Indonesian stock exchange composite index representing the market return, and r_s is the weekly industrial return. We capture the factors of non-synchronous trading by considering leads and lags of the market and industrial return in the regression. The residual ($\varepsilon_{j,w}$) of the regression is transformed to $W_{j,w} = \ln(1 + \varepsilon_{j,w})$ so that the distribution becomes symmetrical (normally distributed). $W_{j,w}$ represents the firm's specific weekly return.

Equation (1) calculates firm-specific returns by estimating abnormal returns after controlling for market and weekly industrial returns. The residual ($\varepsilon_{j,w}$) from equation (1) represents factors that are not captured by the market and industry, so it refers to firm-specific returns.

Next, $NegSkew_t$ is calculated from the negative skewness of the firm's specific return ($W_{j,w}$), where the negative skewness for stock j in period t is calculated using the formula (Kim & Zhang, 2016; Jia, 2018)

$$NSKEW_{j,t} = - \left[n(n-1)^{3/2} \sum W_{j,w}^3 \right] / \left[(n-1)(n-2) \left(\sum W_{j,w}^2 \right)^{3/2} \right] \quad (2)$$

where n is the number of weekly returns during year t .

Negative skewness focuses on capturing extreme negative abnormal returns in a year. In one year, the accumulation of abnormal returns can be positive. Still, the company may experience a stock crash because there are one or more weeks in which the company has a substantial negative return, resulting in the mean weekly abnormal returns of the company being below the median. On the other hand, a company may experience negative abnormal returns for several weeks in one year. Nevertheless, the negative skewness is less because the weekly abnormal returns do not make the mean below the median. To provide a more accessible analysis, the skewness of each sample is multiplied by minus 1. The greater the value, the higher the risk of a stock crash ($NegSkew_t$).

We utilize a firm's ownership of intangible assets as a proxy for innovation. As mentioned in the previous section, only successful innovations and future economic benefits can be reported as intangible assets (IAS 38). We use a dummy variable for intangible assets. It equals one if the firm has intangible assets in year $t-1$ and zero otherwise. The presence of intangible assets in the previous period ($D_Intat-1$) affects the risk of crashes in the year t .

Following previous studies, firms' characteristics are included as control variables in testing the hypothesis. The first control variable is earnings management from the last period. We use Jones Model (Jones, 1991) ($DAJones_{t-1}$) and Modified Jones Model (Dechow et al., 1995)

(DAModJones_{t-1}) to measure earnings management. Earnings management estimation is defined as management flexibility to use their discretion in reporting earnings. We believe that the activity to boost earnings causes the probability of negative stock return to increase. Firms with higher earnings management report more net income than they should. Managed earnings lead to investors' overvaluation. This tactic increases the risk of a stock crash when investors realize the company's real situation. So, assuming that earnings fixate naïve investors, higher earnings management stimulates crash risk because of overvaluation (Neifar & Utz, 2019). Considering the idea, we presume earnings management is an important control variable for stock crash risk.

The second control variable is the firm's growth. This study uses growth at the beginning of the period (MBV_{t-1}). MBV_{t-1} represents a valuation factor in anticipating stock crash risk (Wu & Lai, 2020; Hutton et al., 2009). Higher MBV_{t-1} represents overvalued stocks with a higher probability of crashing. The current firm performance (ROA_t) is the third control variable. We use firm profitability as an indicator for firm performance. Current firm performance, (ROA_t) is used because we believe the performance negatively affects stock crashes. The fourth, fifth and sixth control variables are assets, leverage and institutional ownership. We use the percentage of net fixed assets to total assets at the beginning of the period (NPPE_{t-1}) as a controlling variable for the firms' assets. Leverage (LEV_{t-1}) is used as a control variable, as the higher leverage leads to more serious financial difficulty (Choi & Richardson, 2016), leading to a greater probability of crash risk. The last control variable is the level of ownership by institutional investors at the beginning of the period (INST_{t-1}). According to An and Zhang (2013), monitoring by institutional investors can reduce management's ability to hide the accumulation of bad news, so the higher the percentage of institutional ownership is expected to decrease crash risk.

Model specification for H_{1a}

$$\begin{aligned} NegSkew_{j,t} = & \alpha + \beta_1 D_Inta_{j,t-1} + \beta_2 DA_{j,t-1} + \beta_3 MBV_{j,t-1} + \beta_4 ROA_{j,t} \\ & + \beta_5 NPPE_{j,t-1} + \beta_6 LEV_{j,t-1} + \beta_7 INST_{j,t-1} + \varepsilon_{j,t} \end{aligned} \quad (3)$$

Where NegSkew = negative skewness that represents stock price crash risk; D_Inta = dummy variable equals one if the firm has intangible assets, and zero otherwise. DA = discretionary accruals using Jones Model (DAJones) and Modified Jones

Model (DAModJones); MBV = market to book value; ROA = return on asset; NPPE = net fixed asset (property, plant, and equipment) as a proportion of total assets; LEV = debt to total assets; INST = proportion of institutional ownership = period tj = firm j

H_{1a} is supported when $\beta_1 > 0$. We use a dummy variable for intangible assets (D_Inta) because half our sample does not have intangible assets. However, in the additional analysis, we also use the continuous value of intangible assets in our investigation. We use intangible assets (Inta) as the proportion of intangible assets to the total assets of the firm (total intangible assets divided by total assets). To broaden the research, we divide the sample based on the firm category with low (high) intellectual capital and lower (higher) financial reporting quality. Further, we investigate this relation for loss firms. We still use the model specification of H_{1a} by adding D_Inta_{t-1} multiplied by DLoss_t. DLoss_t is a dummy variable that equals one for loss firms and zero otherwise.

Using the same estimation as H_{1a}, we use the low intellectual capital (IC) firm's sample for H_{1b}. We classify firms that are included in the high and low IC industries. In determining these categories, we refer to several references: Indonesian government classification (Ministry of Industry and Trade, 2020), Firer and Mitchell Williams (2003) and Woodcock and Whiting (2009). The category of high (low) intellectual capital represents more (less) innovation. We

believe that intangible assets have more added value if implemented in firms operating in industries classified as high intellectual capital.

Results and Discussion

Table 1 exhibits the descriptive statistics for a sample of listed firms on the Indonesian Stock Exchange from 2016 to 2019. The total sample used in this study is 880 firm years of observation. The mean value of $NegSkew_t$ is -0.253 . The average value of $DAJones_{t-1}$ and $DAModJones_{t-1}$ are 0.077 and 0 , respectively. Firms have an average MBV_{t-1} 2.868 , ROA_t of 0.042 , $NPPE_{t-1}$ of 0.385 , LEV_{t-1} of 0.474 and $INST_{t-1}$ of 0.131 .

Our sample consists of 426 firm-year observations with intangible assets (equal to 48% of the total) and 454 firms without intangible assets (equal to 52% of the total sample). Firms without intangible assets are dominating the stock market in Indonesia.

We apply Pearson and Spearman's correlation (untabulated). The correlation among independent variables is below 0.1, suggesting minor multicollinearity problems. **Table 2** gives evidence of our test using $NegSkew_t$ as a dependent variable. The findings present that D_Inta_{t-1} has a positive impact on $NegSkew_t$ at a 5% level (**Table 2** Panel A). Firms with intangible assets tend to generate higher crash risk. We analyze using pooled regression in columns (1) and (2). Fixed effect regression is also provided in columns (3) and (4). H_{1a} is supported.

These findings indicate that intangible assets – as a proxy for innovative activities – increase the risk of stock crashes. These results are supported by evidence from [Jia \(2018\)](#) and [Habib and Hasan \(2017\)](#) that innovation-oriented firms produce a lower success ratio, which causes the risk of stock crashes in these firms to increase.

Since most of our total sample ($N = 880$) do not have intangible assets, we perform a regression test with the Intangible assets (Inta) only for companies having intangible assets. In **Table 2** Panel B, we present the regression results. In this test, an intangible asset is a continuous variable obtained from the intangible assets divided by the company's total assets. **Table 2** Panel B Column (1) and (2) uses OLS regression, and Column (3) and (4) uses fixed effect regression. The results in **Table 2** Panel B also support H_{1a} that the number of intangible assets increases the risk of stock crashes for companies with intangible assets.

Analyzing the control variables, we find that higher earnings management increases the crash risk. Our findings support [Hutton et al. \(2009\)](#) and [Kim and Zhang \(2016\)](#), which show that

Table 1. Descriptive statistics.

	N	Minimum	Maximum	Mean	SD
$NegSkew_t$	880	-3.288	4.109	-0.253	1.046
$DAJones_{t-1}$	880	-1.901	1.618	0.000	0.147
$DAModJones_{t-1}$	880	-1.911	1.671	0.001	0.150
MBV_{t-1}	880	-2.370	91.810	2.868	6.926
ROA^t	880	-5.849	7.269	0.042	0.340
$NPPE_{t-1}$	880	0.000	6.868	0.385	0.487
LEV_{t-1}	880	0.006	2.340	0.474	0.228
$INST_{t-1}$	880	0.000	0.966	0.131	0.226

$NegSkew$ = negative skewness as a proxy of stock crash risk; $DAJones$ = Jones Model of discretionary accruals Model; $DAModJones$ = Modified Jones Model of discretionary accruals; MBV = market to book value; ROA = return on assets; $NPPE$ = proportion of net fixed assets (PPE) to total assets; LEV = debt to total assets; $INST$ = proportion of institutional ownership; t = period t .

Table 2. Firms with intangible assets and stock price crash risk.

Dependent Variable: NegSkew _t				
PANEL A: full sample N = 880				
	(1) OLS	(2) OLS	(3) Fixed effect	(4) Fixed effect
	Coef. (t-stat)	Coef. (t-stat)	Coef. (t-stat)	Coef. (t-stat)
Constant	-0.353*** (3.711)	-0.354*** (-3.722)	-0.361*** (-3.912)	-0.362*** (-3.919)
D_Inta _{t-1}	0.139** (1.978)	0.139*** (1.974)	0.148** (2.173)	0.148** (2.170)
DAJones _{t-1}	0.393* (1.639)	-	0.315* (1.353)	-
DAModJones _{t-1}	-	0.401** (1.708)	-	0.317* (1.390)
MBV _{t-1}	0.016*** (3.221)	0.016*** (3.221)	0.015** (2.995)	0.015*** (2.995)
ROA _t	0.187** (1.806)	0.188** (1.809)	0.226** (2.241)	0.226** (2.243)
NPPE _{t-1}	0.026 (0.359)	0.025 (0.350)	-0.012 (-0.178)	-0.013 (-0.186)
LEV _{t-1}	-0.033 (-0.212)	-0.031 (-0.201)	0.002 (0.015)	0.003 (0.021)
INST _{t-1}	-0.125 (-0.804)	-0.125 (-0.803)	-0.087 (-0.579)	-0.088 (-0.580)
F-test	3.197***	3.231***	8.481***	8.492***
Adj. R ²	0.017	0.017	0.079	0.079
N	880	880	880	880
PANEL B: Firms with intangible assets N = 426				
	(1) OLS	(2) OLS	(3) Fixed effect	(4) Fixed effect
	Coef. (t-stat)	Coef. (t-stat)	Coef. (t-stat)	Coef. (t-stat)
Constant	-0.137 (-0.862)	-0.138 (-0.86)	-0.201* (-1.285)	-0.201 (-1.283)
Inta _{t-1}	0.691 (1.118)	0.687 (1.112)	0.794* (1.313)	0.789* (1.305)
DAJones _{t-1}	0.277 (0.950)	-	0.283*** (0.994)	-
DAModJones _{t-1}	-	0.269 (0.943)	-	0.267 (0.959)
MBV _{t-1}	0.021*** (2.675)	0.021*** (2.671)	0.020*** (2.591)	0.020** (2.586)
ROA _t	-0.088 (-0.175)	-0.089 (-0.175)	0.068 (0.138)	0.068 (0.137)
NPPE _{t-1}	0.032 (0.254)	0.031 (0.251)	-0.012 (-0.098)	-0.013 (-0.103)
LEV _{t-1}	-0.233 (-0.875)	-0.232 (-0.873)	-0.102 (-0.391)	-0.103 (-0.392)
INST _{t-1}	-0.251 (-1.144)	-0.251 (-1.144)	-0.190 (-0.884)	-0.191 (-0.885)
F-test	1.813*	1.811*	3.667***	3.660***
Adj. R ²	0.013	0.013	0.059054	0.059
N	426	426	426	426

One-tailed test. ***, ** and * represent the significance at 1%, 5% and 10%, respectively.

earnings opacity increases the risk of crashes. MTB_{t-1} positively affects crash risk; the higher the MTB_{t-1} , the higher the crash risk. Our evidence also supports overvaluation studies where stock prices that are already too expensive tend to experience price revisions in the following year (DeBondt and Thaler, 1985, 1990). These stocks are potentially crashing. Profitability also positively affects crash risk. It reflects that the higher the profitability, the greater the crash risk.

To enhance the discussion, we also conducted a sub-sample analysis. To investigate H_{1b} , we divided the sample based on intellectual capital. We investigate the relationship between innovation and crash risk in low intellectual capital firms, which categorization is based on

Indonesian government classification (Ministry of Industry and Trade, 2020), Firer and Mitchell Williams (2003) and Woodcock and Whiting (2009).

Firms with intangible assets (D_Inta_{t-1}) exacerbate crash risk ($NegSkew_t$) for the low intellectual capital (low IC) firms and non-big four samples. Overall, our findings conclude that H_{1b} is

Table 3. Firms with intangible assets and stock price crash risk: Sub-sample analysis.

Dependent Variable: $NegSkew_t$				
PANEL A: Low IC and High IC firms				
	(1) Low IC industry sample	(2) Low IC industry sample	(3) High IC industry sample	(4) High IC industry sample
	Coef. (t-stat)	Coef. (t-stat)	Coef. (t-stat)	Coef. (t-stat)
Constant	-0.309*** (-3.066)	-0.310*** (-3.071)	-0.751 (-2.868)	-0.751** (-2.868)
D_Inta_{t-1}	0.183*** (2.416)	0.183*** (2.413)	0.032 (0.175)	0.032015 (0.174)
$DAJones_{t-1}$	0.270 (1.077)	-	0.458 (0.652)	-
$DAModJones_{t-1}$	-	0.275 (1.120)	-	0.432 (0.638)
MBV_{t-1}	0.014*** (2.795)	0.014*** (2.796)	0.026 (1.300)	0.026* (1.301)
ROA_t	0.230** (1.774)	0.230** (1.775)	0.263 (1.632)	0.263* (1.639)
$NPPE_{t-1}$	-0.045 (-0.598)	-0.045 (-0.604)	0.343 (1.469)	0.344* (1.478)
LEV_{t-1}	-0.106 (-0.636)	-0.106 (-0.631)	0.641 (1.769)	0.639** (1.764)
$INST_{t-1}$	-0.040 (-0.236)	-0.041 (-0.238)	-0.391 (-1.177)	-0.390 (-1.173)
F-test	6.930***	6.940***	2.407**	2.409**
Adj. R ²	0.074	0.074	0.092	0.092
Fixed effect	Yes	Yes	Yes	Yes
N	740	740	140	140
PANEL B: Non-big-four and big-four accounting firms' sample				
	(1) Non-big four sample	(2) Non-big four sample	(3) Big-four sample	(4) Big-four sample
	Coef. (t-stat)	Coef. (t-stat)	Coef. (t-stat)	Coef. (t-stat)
Constant	-0.468*** (-3.832)	-0.469*** (-3.837)	-0.102 (-0.786)	-0.103 (-0.786935)
D_Inta_{t-1}	0.208** (2.230)	0.207** (2.224)	-0.004 (-0.046)	-0.004 (-0.043)
$DAJones_{t-1}$	0.299 (1.062)	-	0.301 (0.704)	-
$DAModJones_{t-1}$	-	0.303 (1.097)	-	0.263 (0.626)
MBV_{t-1}	0.020*** (3.346)	0.020*** (3.344)	-0.013* (-1.426)	-0.013* (-1.425)
ROA_t	0.218* (1.510)	0.218* (1.509)	0.338*** (2.654)	0.338*** (2.659)
$NPPE_{t-1}$	-0.010 (-0.113)	-0.011 (-0.120)	-0.002 (-0.023)	-0.004 (-0.038)
LEV_{t-1}	0.200 (0.984)	0.201 (0.993)	-0.314* (-1.548)	-0.314* (-1.550)
$INST_{t-1}$	-0.265* (-1.302)	-0.265* (-1.304)	0.188 (0.921)	0.188368 (0.923)
F-test	7.779***	7.787***	2.504***	2.492***
Adj. R ²	0.107	0.107	0.04626	0.046
Fixed effect	Yes	Yes	Yes	Yes
N	569	569	311	311

One-tailed test. ***, ** and * represent the significance at 1%, 5% and 10%, respectively.

supported. Table 3 Panel A Columns (1) and (2) show that intangible assets escalate the risk of crashes for listed firms operating in low IC industries. Khan et al. (2020) state that the environment influences the innovation investment strategy (R&D investment). It implies that the environment plays a role in its innovation strategy. Therefore, we also examine innovation-oriented firms in the environmental setting in which they operate based on the intellectual capital industry. To enhance the outcomes, we use a sample of low intellectual capital (IC) firms. If intangible assets are not suitable for low IC firms, then markets negatively respond to the presentation of intangible assets. Our examination in Table 3 Panel A demonstrates that D_Inta_{t-1} significantly increases $NegSkew_t$ at a 1% level using a low IC firm sample. However, the presentation of intangible assets cannot explain $NegSkew_t$ for the high IC firms' sample.

In this study, we also split our sample based on the financial reporting quality using auditor accounting firms as a proxy. Auditors are independent parties who maintain the quality and credibility of financial reports. In carrying out their profession, auditors adhere to professional ethics and standards. With increasingly stringent audit quality, the credibility of financial reporting will be higher to reduce information asymmetry between companies and users of financial statements. Based on previous studies, auditors from big-four accounting firms are believed to have higher audit quality than their counterparts (DeAngelo, 1981). Big-four accounting firms have a greater incentive to produce or maintain their audit quality concerning various matters, especially reputational considerations that they must maintain (Caneghem, 2004; Chung et al., 2005). Therefore, we believe that listed firms audited by non-big-four accounting firms are expected to have lower accounting information quality than those audited by the big four (Berglund & Eshleman, 2019; El-Dyasty & Elamer, 2020). The results of this investigation are depicted in Table 3, Panel B.

Lower (higher) financial reporting quality corresponds to greater (lower) information asymmetry, which increases (decreases) the risk of a crash. Considering agency theory, management teams are motivated to keep the bad news and produce more good news to attract investors. As a result, the probability of stock crash risk increases in the future.

Our examination in Table 3 Panel B Columns (1) and (2) present empirical evidence using a sample of firms audited by non-big-four accounting firms. D_Inta_{t-1} positively affects $NegSkew_t$. Non-big four accounting firms represent lower accounting information quality. If the quality of accounting information is low, managers tend to hide bad news, which is the antecedent to a stock crash. However, D_Inta_{t-1} cannot explain $NegSkew_t$ for the big-four accounting firms' sample (Table 3 Panel B Column (3) and (4)). This means that intangible assets cannot affect future crash risk for better financial reporting quality. Regarding the relationship between intangible assets and crashes, the big-four accounting firms will reduce the impact of intangible assets on crashes because they are more conservative and reputable. On the other hand, for companies audited by non-big four, usually audited with limited resources, intangible assets become more aggressive, stimulating stock crash risk.

Table 4 presents the analysis of loss firms because loss firms have different characteristics than profit firms (Darrough & Ye, 2007). We test the full sample of loss firms in Columns (1) and (2). The role of the existence of intangible assets on the crash risk in loss firms can be derived from the $D_Inta_{t-1} * DLoss_t$. In Columns (3) and (4), we only investigate firms with intangible assets. Our tests utilize the proportion of intangible assets to total assets ($Inta_{t-1}$) in observing firms with intangible assets.

As reported in models (1) and (2) in Table 4, the relation between firms with intangible assets that experience loss ($D_Inta_{t-1} * Dloss_t$) positively affects crash risk. We find that the magnitude of $D_Inta_{t-1} * Dloss_t$ is more extensive than the total sample. This indicates that firms with intangible assets contribute positively to the risk of crashes in firms that experience losses. We also test a profit firm sample (untabulated), but the impact of intangible assets is not significant.

Table 4. Loss firms with intangible assets.

	Dependent Variable: NegSkew _t			
	(1)	(2)	(3)	(4)
	Coef. (t-stat)	Coef. (t-stat)	Coef. (t-stat)	Coef. (t-stat)
	Full sample		Firms with intangible assets sample	
Constant	-0.349*** (-3.773)	-0.349*** (-3.780)	-0.254*** (-1.656)	-0.254*** (-1.656)
D_Inta _{t-1}	0.097* (1.331)	0.096* (1.325)	—	—
Inta _{t-1}	—	—	-0.336 (-0.522)	-0.342 (-0.532)
DAJones _{t-1}	0.356* (1.527)	—	0.417* (1.490)	—
DAModJones _{t-1}	—	0.359* (1.570)	—	0.401* (1.463)
MBV _{t-1}	0.015*** (3.04)	0.015*** (3.040)	0.020*** (2.674)	0.020*** (2.667)
ROA _t	0.249*** (2.453)	0.249*** (2.456)	0.879*** (1.701)	0.878*** (1.700)
NPPE _{t-1}	-0.008 (-0.114)	-0.009 (-0.122)	-0.040 (-0.338)	-0.041 (-0.343)
LEV _{t-1}	-0.034 (-0.228)	-0.033 (-0.222)	-0.074 (-0.289)	-0.074 (-0.288)
INST _{t-1}	-0.078 (-0.515)	-0.078 (-0.515)	-0.216 (-1.026)	-0.216 (-1.028)
D_Inta _{t-1} *Dloss _t	0.250** (2.041)	0.251** (2.049)	—	—
Inta _{t-1} *Dloss _t	—	—	6.001*** (4.507)	6.001*** (4.506)
F-test	8.117***	8.130***	5.336***	5.328***
Adj. R ²	0.082	0.082	0.101	0.101
Fixed effect	Yes	Yes	Yes	Yes
N	880	880	426	426

***, ** and * represent the significance at 1%, 5% and 10%, respectively (one-tailed tests).

Table 4 Columns (3) and (4) indicate that listed firms with higher intangible assets (Inta_{t-1}) do not affect stock price crash risk, but for firms experiencing loss (Inta_{t-1} *Dloss_t), higher intangible assets positively affect NegSkew_t at a 1% level. The results indicate that lower intangible assets do not produce crash risk. Only loss firms with higher intangible assets have the probability of crashing.

In analyzing loss firms, market participants change their awareness of earnings to other financial statement components. The method of valuing profit firms differs from the firms that experience loss (Darrough & Ye, 2007). In a profit situation, investors' attention is on the net income. Conversely, in loss firms, the focus of investors is on the book value of equity and cash flow information to evaluate firms' ability to avoid default or financial difficulty. Investors prefer to sell their investments in loss firms at the market value of net assets (Ciftci & Darrough, 2015). However, it is challenging for market participants to estimate a firm's value, particularly for businesses that have a high proportion of intangible assets and experiencing losses, due to the complexity of reporting and valuation intangible assets.

We believe that loss firms suffer from higher information asymmetry than profit firms. This condition is inseparable from the fact that loss firms provide lower levels of disclosures (Miller, 2002). Research by Barth et al. (2021) find that the valuation of loss firms is challenging. The complexity of their intangible assets and increased information asymmetry in loss firms led to an increase in crash risk over the ensuing period. Our findings, by predicting the phenomenon, show that higher intangible assets increase the risk of a stock price crash in a loss scenario. Investors may also believe that higher intangibles are becoming less reliable for firms presenting negative net income.

Overall, our findings indicate that firms with intangible assets are explorative firms in Indonesia. They are still finding a new way to generate future economic benefits from their intangible assets. Firms tend to implement aggressive innovations and seek new opportunities followed by a high level of uncertainty. Although they legally have the right to use their intangible assets, the actual usefulness in generating future profit is still questioned. They should explore more to create value for the stockholders.

We also run independent sample t-tests of the average stock crash risk between the sub-samples (untabulated). The higher (lower) the $NegSkew_t$, the higher (lower) the crash risk. The findings show that firms with intangible assets are more at risk of experiencing stock crashes than firms without intangible assets.

Benefiting from the overreacting investors, the stock price of firms with higher intangible assets is overvalued. Valuation of internally generated intangible assets is the source of mispricing. In presenting financial statements, listed firms tend to show a higher value of assets to boost market participants' perception of their value. Our additional test gives insight that the role of intangible assets only affects stock price crash risk when listed firms are audited by non-big four (as the representation of low financial reporting quality).

The new economic environment also affects intangible assets' impact on crash risk when firms are categorized as low intellectual capital firms. Innovation policies not in line with the business's environment may cause this condition. In low IC industry environment, standout innovation is not expected. We hope that our findings from the additional tests also stimulate new opportunities for future research.

Conclusions

During the last four decades, the value of intangible assets of the five largest global firms has significantly increased the proportion of intangible assets compared to their tangible assets. This fact shows that investment in intangible assets – as a reflection of innovation activities – is increasingly intensely today. However, innovation carries a high risk of uncertainty. Several firms suffer huge losses after recognizing their failed innovation and, in turn, causing their share price to crash.

This research contributes to further enriching research related to innovation and intangible assets from the capital market. Our research focuses on how intangible assets, which are proxies of the firm's innovation, affect the risk of stock crashes, given that innovation has a high failure-to-success ratio. Our findings present evidence that Indonesian firms with intangible assets are more prone to stock crash risk. More than 80% of our sample operates in the low intellectual capital industry, and these findings should be analyzed with more caution. After a more in-depth analysis, we find that higher intangible assets increase the risk of stock crashes for: (1) firms that operate in a low intellectual capital industry, (2) firms with low financial reporting quality and (3) loss firms. In the first case, we suspect that the unpreparedness of the industrial infrastructure and the mismatch between the business environment and the firm's innovation strategy causes the risk of crashes for firms in the low intellectual capital industry. However, more research is still needed in this area. In the second and third cases (low financial reporting quality and loss firms), highly intangible assets exacerbate the information asymmetry in these firms.

There are some limitations in our study, which we hope will open up a line of inquiry for future research. First, intangible asset components must be explored to detail specific intangible assets that stimulate crash risk. Second, expanding the scope by comparing the impact of intangible assets between countries. Countries with higher financial reporting quality and higher intellectual capital firms should risk more future stock price crashes.

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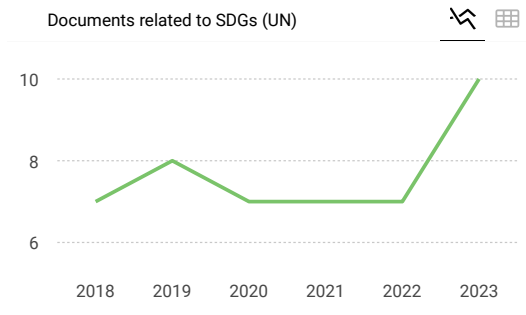
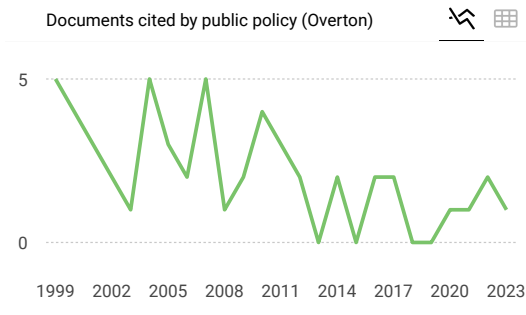
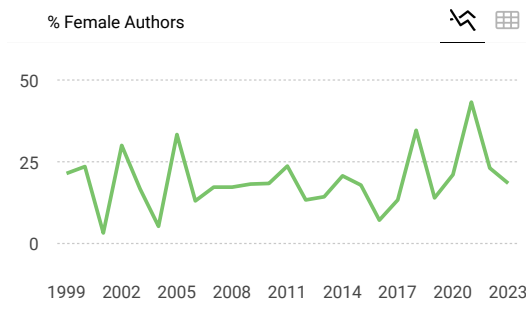
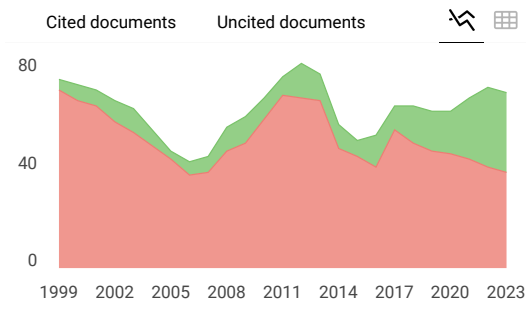
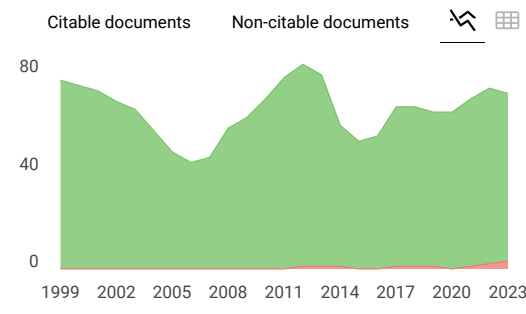
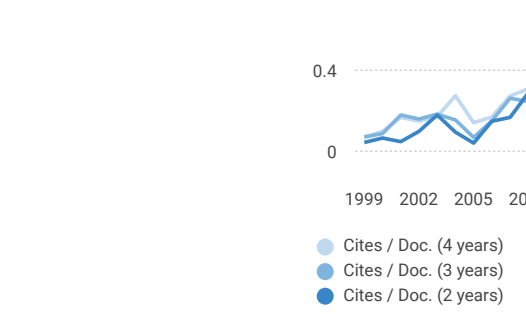
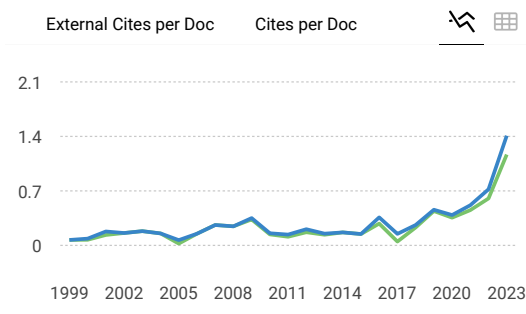
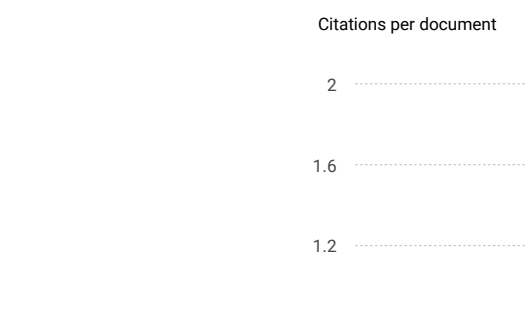
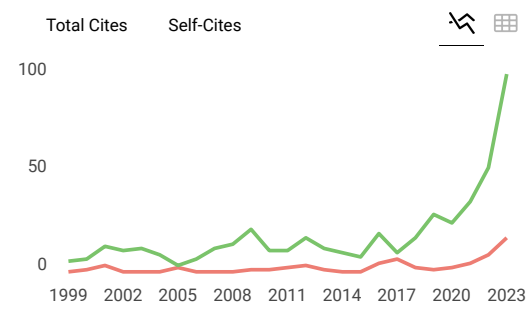
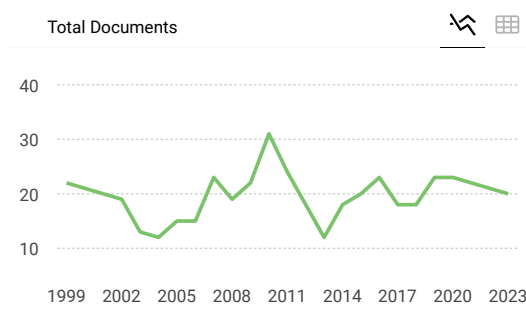
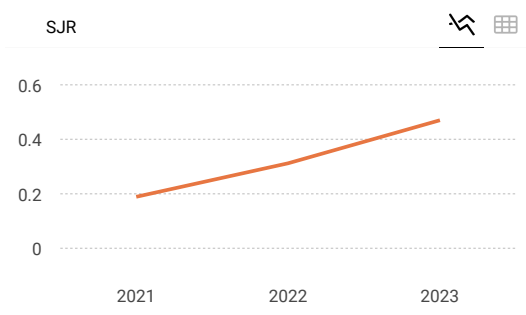
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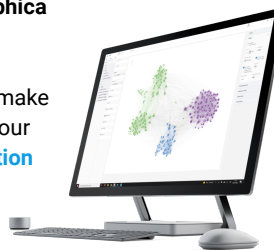
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