Global Business and Management Research: An International Journal
Vol. 14, No. 3s (2022)

# Effect of Intangible Assets and Moderating Effect of COVID-19 Pandemic on Firm Performance & Value: Evidence from the Cross-Country Software Firms

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**Abstract**
**Purpose**: This study had two objectives. First, it examines the impact of intangible assets and the COVID-19 pandemic on the performance and value of software firms worldwide. Second, we examine whether there's a moderating effect of the COVID-19 pandemic on firm performance and the value of software firms around the world.
**Design/methodology/approach**: Using data from 303 software firms' data within five years (2016 to 2020), a panel data analysis was conducted to meet the study objectives.
**Findings**: This study had four main findings. First, advertising expenses harm the performance of software firms, and we found that in developed countries, this impact is more pronounced. Second, software companies' firm value is positively impacted by R&D and advertising expenses, which in developed countries yield a significant result (R&D). Third, COVID-19 as a dummy variable had a positive impact on the firm value of software firms. Lastly, we found a pure moderation effect of COVID-19 on the relationship between intangible assets (through R&D) and firm performance.
**Research limitations/implications**: Currently, 2021 is not yet ending, and we have only one year's worth of COVID-19 data to go within this study. Including the year 2021, the data could enhance the research results.
**Practical implications**: The practical implication of this study is that software firms can leverage their R&D and advertising activities to enhance their firm value.
**Originality/value**: The study on intangible assets of software firms is still highly scarce to be found, even though this industry has sizable intangible assets compared to others. The effect of the COVID-19 pandemic, which is currently emerging, and the moderating effect on the relationship between intangible assets and firm performance/value is yet to be found. Therefore, these can provide software firms' managers to strategize or anticipate such pandemics to protect/enhance firms' performance/value.

**Keywords**: Advertising expenses, COVID-19, Firm performance, Firm value, Intangible assets, R&D

## Introduction

Software permeates every aspect of our lives in the information age: individuals and companies rely on operating systems and applications to complete everyday tasks. It is not surprising that spending on enterprise software is growing fastest in the technology sector, with growth expected to continue in 2021, offsetting the decline caused by the COVID-19 pandemic in 2020. The software market represents the overall software market. Productivity software, business software, system infrastructure software, and application development software are important top-level software categories. Most software solutions are designed for use in a professional environment in this market segment but can also be used personally. (Statista, 2020).

Software companies worldwide were examined for three reasons. First, the software industry has an annual growth rate of 7.5% in revenue from 2021 to 2025 (Statista, 2020). Compared to other industries, such as the hardware and IT services industry, these two industries only have annual revenue growth rates of 2.7% and 4.3% for the same period (Statista, 2020). Second, the software enterprises have high intangible asset value, 87% of the total enterprise value, not to mention that Amazon has 96% of the total enterprise value. When compared to several other industries such as food, drinks, and media, these three industries have intangible asset values of 73%, 81%, and 84% (Lexology, 2021). Third, the core of the global competitive advantage of the United States (and even the world) is the digital economy which is increasingly dominated by non-physical outputs (e.g., service delivery, software, and computing) (Sun, 2019).

Intangible assets are one of the most valuable components in various industries and can be one of the companies' strategies for a competitive advantage. This intangible asset can be in the form of a strong brand image that makes companies like Nike, for example, have a powerful brand image with their swoosh logo, making it very easy to remember and identify by their customers or potential customers.

This research on intangible assets was conducted for three main reasons. First, the Organization for Economic Cooperation & Development (OECD, 2012), intangible assets are becoming more valuable because they are emerging as investments in contrast to tangible assets, this is based on the widespread acceptance that there has been a global shift towards value creation based on intangible assets. This trend has significant implications for the management of these assets type. Second, related to the relationship between intangible assets and company performance and value, the right intangible assets, considered the origin of company value formation, enable companies to achieve success (Garanina, T., & Pavlova, Y., 2011). In addition, intangible assets are one of the main drivers of business growth and value in most economic sectors (Wagenhofer, 2001). Therefore, Intangible Assets have an essential role in evaluating company performance (Garanina, T., & Pavlova, Y., 2011; Stewart, 1998; Wagenhofer, 2001). Third, related to the relationship between intangible assets, the company's goal in achieving competitive advantage - the results of a 2004 study conducted by Villalonga (2004) show that companies are increasingly investing in intangible assets than tangible assets because intangible assets are more effective in maintaining competitive advantage (Villalonga, 2004). Companies because they are challenging to imitate. This competitive advantage has a close relationship with the performance and value of a company.

Also, this era of The Novel Coronavirus (COVID-19) pandemic creates a tremendous amount of uncertainty and has far-reaching consequences for healthcare, population movements, and economic growth (Baker et al., 2020). Stock market volatility (Baek et al., 2020; Phan &

Narayan, 2020), liquidity (Just & Echaust, 2020), riskiness (Rizwan et al., 2020), and companies' returns (Narayan et al., 2021; Shen et al., 2020), are still the focus of the majority of COVID-19 research on the impact of the pandemic on financial markets. Meanwhile, not many have been found for firm-level research, so researching the impact of the COVID-19 pandemic on company performance is considered valuable (Hu & Zhang, 2021).

Therefore, because these intangible assets are closely related to the software industry and these two things are also considered emerging and play an essential role in the performance and value of a company, this research is considered essential and valuable for software companies in the world, which is currently growing and is still little researched by researchers in the world. Moreover, there is still a research gap in the current situation where COVID-19 in 2020 was announced as a pandemic. There is also very scarce research related to intangible assets for software companies in the world.

There are three main objectives in this research. The first is to examine the impact of intangible assets on firm performance & firm value of software firms. The second is to examine the impact of the COVID-19 pandemic on firm performance & firm value. Lastly, we examine whether there is a moderating effect from the COVID-19 pandemic on the relationship between intangible assets and firm performance and firm value.

**Literature Review**

Resources and capabilities create core competencies that drive company activities and lead to competitive advantage in the resource-based view. There are two types of resources: tangible and intangible. Tangible resources are visible and have physical characteristics. Capital, labor, land, buildings, equipment, factories, and supplies are examples of tangible resources. Intangible resources are invisible because they have no physical characteristics. Culture, knowledge, brand equity, reputation, and intellectual property are examples of intangible resources. Intangible resources rather than tangible resources are more likely to provide a competitive advantage. Anyone with the necessary funds can buy tangible assets such as buildings or computer servers on the open market. On the other hand, a brand name has to be developed over time. (Frank T. Rothaermel, 2021).

Intangible assets such as trademarks have no physical existence but can be valuable. Like tangible fixed assets, they usually will not be converted into cash and are generally considered illiquid (Ross et al., 2015). These intangible assets have a significant future contribution to business success; they provide knowledge, information, intellectual property, and experience (Moskow, 2001). Rodrigues (2007) explains that Intangible Assets can be divided into two types. The first type includes an independently distinguishable legacy, such as copyright. The second type includes assets that cannot be distinguished from one company, from each other, and other assets, such as skilled and experienced employees and an efficient administrative system (Lopes, 2007).

One of the intangible asset proxies used in this study is research and development (RD). This proxy was chosen based on research previously conducted by Tahat and colleagues (2017) which examined the impact of intangible assets on the financial and market performance of non-financial companies in the UK. The results of the research conducted by them stated that, in general, the findings of this examination report strong evidence about the role of intangible assets in improving company performance. In particular, the results show that R&D is related

to the firm's future performance. (Tahat et al., 2017).

Based on a study conducted by Gamayuni and colleagues (2015) also stated the same thing. It was found that intangible assets positively and significantly affect financial performance (ROA) (Gamayuni, 2015). In addition, Denicolai and colleagues' (2015) research confirms that intangible assets are vital in driving company performance (Denicolai et al., 2015). Research conducted by Amadieu and colleagues (2010) also stated things that support these studies. A high level of intangible expenses positively impacts performance by increasing the expected profit and reducing the risk of variance (Amadieu & Viviani, 2011). In addition, based on study conducted in 2008 using data on public companies in Japan - it was found that intangibles are positively related to firm value (R&D, human capital, and advertising). Also, the study data implies that investment in human capital above industry norms increases the chances of becoming a better-performing organization (Ramirez & Hachiya, 2008). Similarly, some studies have found that advertising expenses increase the market value more than other types of investment (Chauvin & Hirschey, 1993; Graham & Frankenberger, 2000).

Although according to the literature, intangible assets are generally reported to have a significant positive relationship with diverse evidence of value. While some studies report a positive market value effect of R&D investment (Chauvin & Hirschey, 1993; Huselid, 1995; Lev & Sougiannis, 1996), some report a negative effect (Anandhi S. Bharadwaj et al., 1999). In addition, a study conducted by Merkley (2013) shows that intangible assets (through R&D) negatively impacted the business performance (Merkley, 2013). A study conducted by Srivasta (2014) also shows that intangibles negatively affect the firm’s earnings (Srivastava, 2014). Similarly, others find that advertising expenses do not increase the market value more than other types of investment (Erickson & Jacobson, 1992). However, there is a likelihood that the positive impact of intangibles will not be present in the short to medium term (Stam & Wennberg, 2009).

A study on the effect of the COVID-19 pandemic on firm performance shows that COVID-19 harms business performance (Hu & Zhang, 2021). In addition, the first ever study on the impact of COVID-19 on firm performance also shows that, COVID-19 negatively impacted firm performance (Shen et al., 2020). Not to mention, with all the lockdowns happening worldwide, this policy also hurts the business performance (Ren et al., 2021). In such environmental turbulence, it could moderate the relationship between intangibles and business performance (Stefano Zambon et al., 2020).

**Hypothesis Development**

Based on previous studies mentioned in the literature review, six hypotheses were developed for this particular study. However, due to the scarcity of studies on COVID-19, the hypotheses related to COVID-19 are based on the generalization of the commonly recognized effect of COVID-19 on businesses.

**H1**: Intangible assets have a positive impact on firm performance
**H1a**: R&D positively impact on firm performance
**H1b**: ADV positively impact on firm performance
**H2**: Intangible assets have a positive impact on firm value
**H2a**: R&D has a positive impact on firm value
**H2b**: ADV has a positive impact on firm value
**H3**: COVID-19 pandemic harms firm performance
**H4**: COVID-19 pandemic harms firm value
**H5**: COVID-19 pandemic has a moderating effect on the relationship between intangible

assets and firm performance
**H6**: COVID-19 pandemic has a moderating effect on the relationship between intangible assets and firm value

## Methods

The secondary data used in this study were obtained from the Capital IQ, the Global Innovation Index Organization website, and the World Bank website. The data used in this study is panel data because the data used is a combination of time series and cross-section data (Brooks, 2014). Regarding the data period used in this research, annual data from 2016 to 2020 is used, consisting of 303 software companies globally. Thus, the total observations in this study were 1515 observations.

There are four types of variables used in this paper. First, the independent variable consists of intangible assets (using R&D and Advertising expenses (ADV) as proxy) and the dummy variable of COVID-19. Second, control variables – which consist of firm size (SIZE), leverage (LEV), liquidity (LIQ), total computer software spending in a country (TSS), and GDP annual growth in each country. Thirdly, the dependent variables are the firm performance (ROA) and the firm value (Tobin's Q as proxy). The proposed empirical models used in this paper can be written as:

$$ROA_{iit} = \alpha_0 + \beta_1 RD_{iit} + \beta_2 COV_{iit} + \beta_3 RDRRCOV_{iit} + \beta_4 SIZE_{iit} + \beta_5 LEV_{iit} + \beta_6 LILL_{iit} + \beta_7 TSS_{iit} + \beta_8 GDP_{iit} + \varepsilon\varepsilon_{iit} \quad (1)$$

$$ROA_{iit} = \alpha_0 + \beta_1 ADV_{iit} + \beta_2 COV_{iit} + \beta_3 ADVRRCOV_{iit} + \beta_4 SIZE_{iit} + \beta_5 LEV_{iit} + \beta_6 LILL_{iit} + \beta_7 TSS_{iit} + \beta_8 GDP_{iit} + \varepsilon\varepsilon_{iit} \quad (2)$$

$$TLL_{iit} = \alpha_0 + \beta_1 RD_{iit} + \beta_2 COV_{iit} + \beta_3 RDRRCOV_{iit} + \beta_4 SIZE_{iit} + \beta_5 LEV_{iit} + \beta_6 LILL_{iit} + \beta_7 TSS_{iit} + \beta_8 GDP_{iit} + \varepsilon\varepsilon_{iit} \quad (3)$$

$$TLL_{iit} = \alpha_0 + \beta_1 ADV_{iit} + \beta_2 COV_{iit} + \beta_3 ADVRRCOV_{iit} + \beta_4 SIZE_{iit} + \beta_5 LEV_{iit} + \beta_6 LILL_{iit} + \beta_7 TSS_{iit} + \beta_8 GDP_{iit} + \varepsilon\varepsilon_{iit} \quad (4)$$

Also, Table 1 shows the details of the variables used in this paper, some of them are based on previous studies.

Because the data in this study are panel data, the data processing method used is the selection between three types of models, namely common effect models (PLS), fixed-effect models, and random effect models. In choosing one of the three types of models for each regression equation, it is necessary to use three types of tests: the Chow test, the Hausman test, and the Lagrange test. If the models do not comply with the BLUE characteristics (Best Linear Unbiased Estimator), a fully robust standard error will be applied – using a clustering method.

Clustering is a technique that can be used to achieve a reliable standard error value (Wooldridge, 2012). This clustering method assumes that each cross-section belongs to the same cluster, allowing serial correlation and non-constant error values to occur in the same cluster. Assuming the number of cross-sections is more than the amount of time series data, this method can overcome the problem of heteroscedasticity and autocorrelation. No one ruled out the possibility of a regression model containing heteroscedasticity and serial correlation (Wooldridge, 2012). Therefore, all the regression models will be treated using this method to control for these statistical issues.

*Table 1. Variable measurements*

| Category | Variable | Formula | Unit | Reference |
|---|---|---|---|---|
| Independent variable | Reseach & Development (RD) | Net amounts reported | $ million | (Tahat et al., 2017) |
| | Advertising Expenses (ADV) | Net amounts reported | $ million | (Chauvin & Hirschey, 1993; Graham & Frankenberger, 2000) |
| Dummy Variable | COVID-19 pandemic (COV) | 0: not pandemic year; 1: pandemic year | - | - |
| Dependent Variable | Return on Assets (ROA) | Net income/ Total Assets | - | (Tahat et al., 2017) |
| | Tobin'sQ (TQ) | (Market Value of, equity + Book value of total debt)/ Book of value total assets | - | (Tahat et al., 2017) |
| Control Variable | Firm Size (SIZE) | Log natural of total assets | - | (Ocak & Fındık, 2019) |
| | Leverage (LEV) | Total Debt/ Total equity | - | (Tahat et al., 2017) |
| | Liquidity (LIQ) | Current Assets/ Current liabilities | - | (Tahat et al., 2017) |
| | Total Computer Software Spending (TSS) | Net amounts reported | % | (GII, 2021) |
| | Gross Domesti Product Annual Growth (GDP) | Net amounts reported | % | (World Bank, 2021) |
| Moderating Variable | COV interaction with RD and ADV | COV*RD; ADV*COV | - | - |

**Findings**

This section consists of three main parts—first, descriptive statistics. Second, correlation matrix. Third and last, the regression results.

*Table 2. Descriptive statistics result*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| ROA | 1515 | 0.4745 | 13.179 | -193.7 | 40.6 |
| TQ | 1515 | 3.0277 | 2.8499 | 0.1981 | 27.3717 |
| RD | 1515 | 167.78 | 1001.8 | 0.001 | 19269 |
| ADV | 1515 | 14.5 | 103.49 | 0 | 1600 |
| COV | 1515 | 0.2 | 0.4001 | 0 | 1 |
| SIZE | 1515 | 5.4472 | 1.8762 | 0.5481 | 12.6159 |
| LEV | 1515 | 0.6851 | 11.301 | -36.077 | 432.2 |
| LIQ | 1515 | 2.2006 | 1.756 | 0.11 | 25.1 |
| TSS | 1515 | 59.665 | 27.843 | 14.1 | 100 |
| GDP | 1515 | 1.5463 | 3.3521 | -9.7902 | 8.25631 |
| RDXCOV | 1515 | 42.653 | 559.57 | 0 | 19269 |
| ADVXCOV | 1515 | 3.4991 | 51.047 | 0 | 1600 |

Table 2 provides descriptive statistics results on the variables used in this paper. The first proxy for intangible assets, RD, has an average value of US$ 167 million (SD = US$ 1.001 million) in the sample of software companies. Then, there is a significant gap in the value of research & development expenses between the two companies in the sample, about 19 million times. This gap is indicated by a min value of US$ 0.001 million and a max value of US$ 19.269 million in the sample data. The ADV variable or advertising expenses, which is also a proxy for intangible assets, has an average value of US$ 14.5 million with a standard deviation of US$ 103 million. It can be seen that there is a gap of US$ 1,600 million in the minimum and maximum data samples for software companies in the data sample. The firm performance proxy, ROA, has a value that is assessed as spread out. This spread is due to the SD value (13.17) or about 27.77 times the mean value (0.47). Then, there is a 234-unit gap between the min (-193.7) and max (40.6) values. A positive mean value indicates that the average software company in the data sample has a positive performance and can use its assets to generate profits well. The firm value proxy, TQ, has a positive mean (3.02) and more than one, meaning that, on average, the software companies in this data sample are considered overvalued. Then, if we look at the SD value (2.84) or 94% of the mean value, it shows that the data in this sample is clustered around the mean value. That is, there is stability in the firm value of the sample. The min value (0.19) indicates that there are companies whose TQ value is below one, which means that there are undervalued companies in the sample. The max value (27.37) shows a number far from one, which means that there are companies in the sample that are highly overvalued.

*Table 3 Correlation matrix*

| Variables | ROA | TQ | RD | ADV | COV | SIZE | LEV | LIQ | TSS | GDP | RDXCOV | ADVXCOV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ROA | 1 | | | | | | | | | | | |
| TQ | -0.052** | 1 | | | | | | | | | | |
| RD | 0.071*** | 0.058** | 1 | | | | | | | | | |
| ADV | 0.073*** | 0.090*** | 0.844*** | 1 | | | | | | | | |
| COV | 0.029 | 0.112*** | 0.023 | 0.014 | 1 | | | | | | | |
| SIZE | 0.305*** | 0.148*** | 0.415*** | 0.346*** | 0.065** | 1 | | | | | | |
| LEV | -0.003 | -0.013 | 0.011 | 0.085*** | 0.067*** | 0.062** | 1 | | | | | |
| LIQ | -0.012 | 0.001 | -0.009 | -0.014 | -0.024 | -0.059** | -0.027 | 1 | | | | |
| TSS | -0.092*** | 0.217*** | 0.142*** | 0.145*** | -0.003 | 0.254*** | 0.048** | -0.145*** | 1 | | | |
| GDP | -0.009 | -0.063** | -0.034 | -0.019 | -0.748*** | 0.064** | -0.052** | 0.130*** | -0.178*** | 1 | | |
| RDXCOV | 0.036 | 0.060** | 0.549*** | 0.405*** | 0.153*** | 0.195*** | 0.02 | -0.008 | 0.075*** | -0.116*** | 1 | |
| ADVXCOV | 0.036 | 0.077*** | 0.459*** | 0.486*** | 0.137*** | 0.175*** | 0.172*** | -0.009 | 0.088*** | -0.099*** | 0.838*** | 1 |

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3 reports the Pearson correlation matrix o the variables used in this paper. There are two highly correlations in the variables (RD & ADV and RDXCOV & ADVXCOV) because the correlation value is higher than 0.8 (colored in red). However, since those four variables are used in different equations, there will be no collinearity.

*Table 4 The impact of intangible assets on firm performance & firm value and the moderating effect of COVID-19 pandemic*

| VARIABLES | ROA | ROA | TQ | TQ |
|---|---|---|---|---|
| RD | -0.00194 | | 0.000644* | |
| | -0.00152 | | -0.000357 | |
| COV | 0.183 | 0.245 | 1.149*** | 1.144*** |
| | -0.791 | -0.784 | -0.289 | -0.29 |
| RDXCOV | 0.000469* | | -7.48E-05 | |
| | -0.000284 | | -7.05E-05 | |
| SIZE | 6.029** | 6.007** | -0.33 | -0.329 |
| | -2.812 | -2.8 | -0.245 | -0.246 |
| LEV | 0.0142** | 0.0190** | -0.00269 | -0.00457* |
| | -0.00636 | -0.00788 | -0.00238 | -0.00256 |
| LIQ | 0.249 | 0.251 | -0.109 | -0.11 |
| | -0.197 | -0.197 | -0.0684 | -0.0686 |
| TSS | 0.00367 | 0.00385 | 0.0202*** | 0.0202*** |
| | -0.0358 | -0.0359 | -0.00557 | -0.00555 |
| GDP | 0.172* | 0.174* | 0.0435 | 0.0431 |
| | -0.0986 | -0.099 | -0.0331 | -0.0332 |
| ADV | | -0.0147* | | 0.00616* |
| | | -0.00767 | | -0.00325 |

| | | | | |
|---|---|---|---|---|
| ADVXCOV | | -0.000373 | | 0.000209 |
| | | -0.00199 | | -0.000638 |
| Constant | -33.14** | -33.15** | 3.457*** | 3.477*** |
| | -13.56 | -13.55 | -1.329 | -1.335 |
| Observations | 1,515 | 1,515 | 1,515 | 1,515 |
| R-squared | 0.085 | 0.085 | 0.076 | 0.077 |
| Number of id | 303 | 303 | 303 | 303 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4 outlines the results of examining the effects of RD and ADV on firm performance. The result indicates that R&D does not significantly impact the firm performance of software firms. However, it turned out that advertising expenses (ADV) negatively impact firm performance at a 10% significance level. Contrary to most study results of the previous studies, which yielded a positive impact, the result in this paper says otherwise. Several previous studies showed a negative or no impact as well of intangible assets on firm performance (Anandhi S. Bharadwaj et al., 1999; Erickson & Jacobson, 1992; Merkley, 2013; Srivastava, 2014).

Table 4 outlines the results of examining the effects of RD and ADV on firm value as well. The result indicates that research & development positively impacts the firm value of the software firms at the 10% significance level. Same thing as well for ADV; it also impacts the firm value of the software firms positively at the same significance level. This result supported the previous studies on the impact of intangible assets on firm value.

Based on Table 4, which also outlines the moderating effect of the COVID-19 pandemic. The results indicate that the COVID-19 pandemic as a dummy variable has a positive and significant impact on the firm value of the software firms.

In addition to that, when assessing the moderating effect of the COVID-19 pandemic, we found no evidence of moderating effect on the relationship between intangible assets and firm performance or firm value when using advertising expenses as the proxy for the intangible assets. However, when using the research & development as the proxy, we found a positive and significant (at 10% level) value of the parameter of the RDXCOV variable.

In addition, we also conducted a sub-sample analysis between developed and developing countries, which these two categories are based on the grouping from United Nations data (United Nations, 2021). The two tables below, show the regression results based on the two categories.

*Table 5 Regression result in developed countries*

| VARIABLES | ROA | ROA | TQ | TQ |
|---|---|---|---|---|
| RD | -0.00202 | | 0.000625* | |
| | -0.00163 | | -0.000329 | |
| COV | 0.997 | 1.108 | 1.634*** | 1.619*** |
| | -1.079 | -1.07 | -0.431 | -0.432 |
| RDXCOV | 0.000471 | | -9.75E-05 | |
| | -0.000309 | | -7.61E-05 | |
| SIZE | 6.963** | 6.940** | -0.232 | -0.228 |
| | -3.503 | -3.485 | -0.305 | -0.306 |
| LEV | 0.0157** | 0.0211** | -0.00297 | -0.00461* |
| | -0.00781 | -0.00942 | -0.00247 | -0.00265 |

| | | | | |
|---|---|---|---|---|
| LIQ | 0.415 | 0.427 | -0.254* | -0.258* |
| | -0.414 | -0.414 | -0.133 | -0.133 |
| TSS | -0.0118 | -0.0115 | 0.0153** | 0.0152** |
| | -0.0483 | -0.0485 | -0.0065 | -0.00647 |
| GDP | 0.303** | 0.309** | 0.0924* | 0.0913* |
| | -0.153 | -0.155 | -0.0507 | -0.0509 |
| ADV | | -0.0175** | | 0.00607* |
| | | -0.00833 | | -0.00333 |
| ADVXCOV | | -0.000424 | | -6.15E-05 |
| | | -0.00214 | | -0.000746 |
| Constant | -37.96** | -37.99** | 3.453** | 3.467** |
| | -15.98 | -15.96 | -1.542 | -1.548 |
| Observations | 1,170 | 1,170 | 1,170 | 1,170 |
| R-squared | 0.1 | 0.101 | 0.09 | 0.09 |
| Number of id | 234 | 234 | 234 | 234 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

*Table 6 Regression result in developing countries*

| VARIABLES | ROA | ROA | TQ | TQ |
|---|---|---|---|---|
| RD | -0.0122 | | 0.00275 | |
| | -0.00894 | | -0.00683 | |
| COV | -0.897 | -0.507 | -0.0239 | 0.156 |
| | -0.595 | -0.573 | -0.208 | -0.218 |
| RDXCOV | 0.00544 | | 0.00926* | |
| | -0.00387 | | -0.00472 | |
| SIZE | 1.453* | 1.304 | -0.769*** | -0.624** |
| | -0.822 | -0.804 | -0.235 | -0.243 |
| LEV | -1.863*** | -1.872*** | -0.238 | -0.245 |
| | -0.304 | -0.302 | -0.165 | -0.174 |
| LIQ | 0.034 | 0.0525 | -0.0353 | -0.0400* |
| | -0.108 | -0.11 | -0.0218 | -0.0237 |
| TSS | -0.00619 | -0.00309 | 0.0285*** | 0.0299*** |
| | -0.0404 | -0.0402 | -0.00698 | -0.00679 |
| GDP | 0.0698 | 0.0951 | -0.00837 | -0.00533 |
| | -0.0964 | -0.0972 | -0.0296 | -0.0308 |
| ADV | | 0.0267 | | -0.00629 |
| | | -0.0173 | | -0.0104 |
| ADVXCOV | | -0.0418 | | 0.0737 |
| | | -0.0406 | | -0.0502 |
| Constant | -4.36 | -4.241 | 5.681*** | 4.918*** |
| | -5.276 | -5.235 | -1.254 | -1.419 |
| Observations | 345 | 345 | 345 | 345 |
| R-squared | 0.071 | 0.071 | 0.184 | 0.186 |
| Number of id | 69 | 69 | 69 | 69 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Comparing the results from Table 5 (developed countries) and Table 6 (developing countries), we can see four key findings. Firstly, R&D in developed countries showed a significant and slightly similar result with the result in Table 4 (all data sets), where R&D had a positive and significant (at 10% level) impact on firm value. However, we did not see this in the developing country, where R&D did not significantly impact firm value. Secondly, the COVID-19 dummy variable had a significant (at 1% level) and positive impact on firm value in the software firms in developed countries. However, we did not see this result in the developing countries because no COVID-19 dummy variable had a significant parameter value. Thirdly, advertising expenses (ADV) had a significant (at 5%) and negative impact on firm performance. In addition, ADV also positively impacted firm value (at 10% significance level) for developed countries' data sets. Again, we did not see the same result in the developing countries. Lastly, we found no moderating effect present in the developed countries. Meanwhile, we found that RDXCOV had a positive and significant impact at a 10% significance level.

**Discussion and Conclusion**

There are four key findings in this study, and let us discuss them one by one. Firstly, advertising expenses harm software firms' performance. Thus, this result is rejected the H1b, while H1a is still inconclusive due to R&D parameter is not significant. Most of the previous research listed in the literature review shows that intangible assets are supposed to positively impact firms' performance (Amadieu & Viviani, 2011; Denicolai et al., 2015; Gamayuni, 2015; O'Connell et al., 2017; Tahat et al., 2017). In comparison, the result found in this study showed otherwise. However, we also found that a few studies showed a negative or no effect of intangible assets on firms' performance (Anandhi S. Bharadwaj et al., 1999; Erickson & Jacobson, 1992; Merkley, 2013; Srivastava, 2014). There is a possibility that the intangible assets might take some time to enhance the firm performance of the software firms in this case (Stam & Wennberg, 2009). This result indicates that there is a need for further study to check this possibility. The implication of these findings for software firms' managers is to look out for this possibility of the negative impact of incurring advertising expenses, which could harm their firm performance instead of enhancing it in the short to medium term. In addition, we also found that intangible assets (advertising expenses) had a significant and negative impact on firm performance. Meanwhile, in developing countries, we did not see a significant impact. The negative impact of advertising expenses on the firm performance is more pronounced in developed countries than in developing countries, based on its more negative parameter value. Second, R&D and advertising expenses positively impact the firm value of the software firms. Thus, this result is supported H2a and H2b. This result fully supports most of the results listed in the literature review that shows similar results (Amadieu & Viviani, 2011; Chauvin & Hirschey, 1993; Denicolai et al., 2015; Gamayuni, 2015; Graham & Frankenberger, 2000; Li et al., 2019; Ocak & Fındık, 2019; O'Connell et al., 2017; Ramirez & Hachiya, 2008; Tahat et al., 2017). The managers of the software firms could realize the implication of these findings to help the firms gain value – they could leverage it by using R&D and advertising initiatives. In addition, we found that intangible assets (R&D and advertising expenses) in developed countries positively impact on firm value as well. Meanwhile, we did not see this in developing countries. The positive impact of R&D on firm value in developed countries is less pronounced than in developing countries based on its lower parameter value.

Third, COVID-19 as a dummy variable showed a positive impact on the firm value of the software firms. Thus, this result is rejected H4, while H3 is still inconclusive due to COVID-19 parameter is not significant. This results is not supported the previous study which investigated the relationship between COVID-19 and firm/market performance (Hu & Zhang, 2021; Ren et al., 2021; Shen et al., 2020). However, practically speaking – based on the data

from CB insights, regarding the active users of Microsoft Teams (as a product of software firm, Microsoft), experienced a 62 million jump in the number of active users during this pandemic, from July 2019 to April 2020 (CB Insights, 2021). In addition, we saw that in the developed countries, the COVID-19 dummy variable also had a positive and significant impact on firm value. Meanwhile, in the developing countries, we did not see any significant results.

Lastly, we found a moderating effect of COVID-19 on the relationship of intangible assets (through R&D) and firm performance. Thus, this result is supported H5, while H6 is still inconclusive due to no significant parameter of moderating variable, which supposedly moderates the relationship between intangible assets and firm value. This finding means that this pandemic strengthens intangible assets' effect through R&D on a firm's performance. This result is fully support the idea from an academic report by Stefano and colleagues (2020), environmental turbulence (such as this pandemic) will moderate the relationship between intangibles and firm performance (Stefano Zambon et al., 2020). In addition, we also found a significant moderating effect of the COVID-19 pandemic on the relationship between R&D and firm value in developing countries. Meanwhile, there is no significant result in the developed countries.

***Theoretical Implications***

Since there was no similar previous study on the moderating effect of COVID-19 on the relationship between intangible assets and firm performance/value, this study could potentially be a reference point for future study. In addition, since little to no study was previously conducted on intangible assets in software firms (which has a relatively sizeable intangible asset compared to other industries), this study can also be used as a point of reference for future studies related to intangible assets-rich industries.

***Practical and Social Implications***

There are two practical and social implications of this study. Firstly, based on the result, investing in intangible assets (through advertising expenses) can negatively affect the ROA indicator. So, it is necessary to think first for company managers which indicators are the most important. However, investing in R&D and advertising expenses could help software firms to enhance their firm value. For advertising expenses, it might be challenging to decide whether invest or not to invest because it harms ROA but has a positive impact on firm value. However, for R&D, it might be a better option than advertising expenses for software firms' managers to focus on enhancing the firm value. Secondly, A health-related crisis such as the COVID-19 pandemic can strengthen the influence of intangible assets on a company's firm performance. So, this can be used as a strategy for software companies to improve their performance during a pandemic.

***Limitations and Suggestions for Future Research***

There are at least two limitations of this study. Firstly, identifying a specific proxy that is more suitable for intangible assets in software firms is a challenge due to data constraints. Although these proxies are commonly acknowledged in the literature, factors such as patent rights, patent applications, perceived product quality, customer loyalty/satisfaction would increase the usefulness of this study. Secondly, once 2021 is finished, the COVID-19 data would be worth at least two years, which would be more beneficial than only one year worth of COVID-19 data.

**Acknowledgement**
Alief Rizky Ramadhan: Data collection, data analysis, methodology, writing, review, and editing. Ruslan Prijadi, Ph.D: Supervising and advising.

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