Impact of XBRL Technology Implementation on Information Asymmetry in Indonesia's Capital Market

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Abstract

This research aims to examine whether the publication of financial statements in XBRL format could reduce the level of information asymmetry, measured by the bid-ask spread, in Indonesia's capital market over eight years of its implementation. Furthermore, this research examines differences in the level of information asymmetry in two observation periods, which are the early stage and the advanced stage of the XBRL implementation. The population in this study are listed companies on the IDX80 index which were sampled using the purposive method. The analytical instrument used is a panel data regression test using a random effect model and the non-parametric Wilcoxon test of statistical differences. Consistent with similar studies, the results show that the publication of financial reports in XBRL format could reduce the level of information asymmetry by providing accurate, integrated, and universally accessible reporting. The difference test further reveals that the level of information asymmetry is lower in the advanced stages compared to the early stages. This suggests that XBRL implementation becomes more effective over time due to the positive developments in institutional readiness and stakeholder facilitation.

Keywords: financial reporting quality; information asymmetry; wilcoxon signed rank test; XBRL

1. Introduction

Financial information is the main information that can be used for various industry analysis needs. Indonesia ranks 29th out of 35 countries investigated in the country scores of financial reporting quality factor. The measurement is based on four factors of financial reporting quality related to governance and business management systems (factor-1); protection and development of capital markets (factor-2); transparency, accounting, and taxation (factor-3); and other socio-economic attributes of a business environment (factor-4). The low score for Indonesia indicates inadequate financial reporting quality. Indonesia's financial reporting quality factor score is minus 0.90, below the overall average of 0.0003 [1].

Technology has an important role in providing quality financial information that describes the economic reality of the business. The low quality of financial information can lead to increased risk and information asymmetry for users, which, in further implications,

could lead to errors in decision-making based on financial information. Actions that could be taken to minimize information asymmetry by addressing issues of system compatibility and data integration [2]. In 2012, the Indonesian Stock Exchange (IDX) began developing a reporting system using XBRL technology to be implemented with the main aim to make financial data easily exchanged, compared, and used without accounting standards and language barriers. This initiative aims to leverage technology to enhance the quality of reporting in Indonesia's capital market.

XBRL is fundamentally about the electronic tagging of data, similar to barcoding or the International Standard Book Number (ISBN) system used for books. It is an open standard built on XML technology. The XBRL architecture is composed of three main components, illustrated in Figure 1. The XBRL specification outlines the operational mechanisms and syntax rules; the XBRL taxonomy serves as a hierarchical dictionary specific to a reporting domain for interpreting tags (such as data items, attributes, or relationships); and the

XBRL instance document is the output-an electronic financial report generated according to the XBRL specification and taxonomy [3].
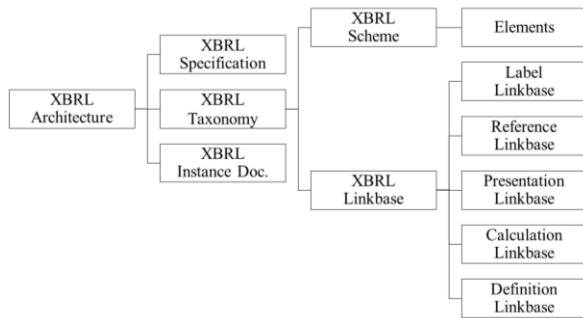

Figure 1. XBRL Architecture

In the economic context of Indonesia, the implementation of financial reporting technology like XBRL seems to have not resulted in a considerable overall positive impact on reducing the level of information asymmetry that can be approximated with earnings management [4]. In fact, in several cases and research areas, real earnings management has increased post-XBRL adoption [5]. Earnings management is closely related to information asymmetry because earnings management manifests asymmetric information transmission actions to stakeholders. There is no evidence showing that the adoption of XBRL technology could reduce the level of information asymmetry. The findings are explained with arguments regarding Indonesia still being in the early stages of XBRL technology adoption. It may take several years for stakeholders to reap the potential benefits of XBRL technology [6]. Consistent with that, other research outside Indonesia's capital market examines the unforeseen impact of the early stages of XBRL implementation on real earnings management using a set of suspicious companies for the period 1999 to 2013 on the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange [7]. This study found that real earnings management increased after the implementation of XBRL in China, particularly under the dual regulatory policy of XBRL from two regulators (the China Securities Regulatory Commission and the Ministry of Finance).

In contrast to those studies, despite having a similar analysis period and research area, which is Indonesia, the conclusions drawn from other contrary research are quite different [8]-[11]. Generally, their research findings indicate a positive relationship between XBRL adoption and a decrease in information asymmetry. Differential tests conducted in several studies also support the main finding that the level of information asymmetry changes and decreases after the implementation of reporting technology using XBRL.

These prior research findings inspire further exploration into the impact of XBRL implementation across the early and advanced periods of its implementation in Indonesia. There hasn't been recent research explicitly

measuring the difference in information asymmetry levels between the early and advanced stages of XBRL implementation. As highlighted before, XBRL is still in its early stages of implementation, and it may take several more years to fully gain the potential benefits of XBRL technology, particularly in reducing the level of information asymmetry conveyed through financial reports [6].

The generic objective of this research is to empirically demonstrate whether the publication of financial statements in XBRL format could reduce the level of information asymmetry in Indonesia's capital market over eight years of its implementation. Furthermore, this research examines differences in the level of information asymmetry in two observation periods, which are the early stage and the advanced stage of the XBRL implementation.

2. Research Methods

2.1 Scope, Sources, and Data Collection Techniques

Figure 2 provides a visual representation of the research methodology, detailing how companies were selected and how the observation periods align with the early and advanced stages of XBRL implementation in Indonesia.
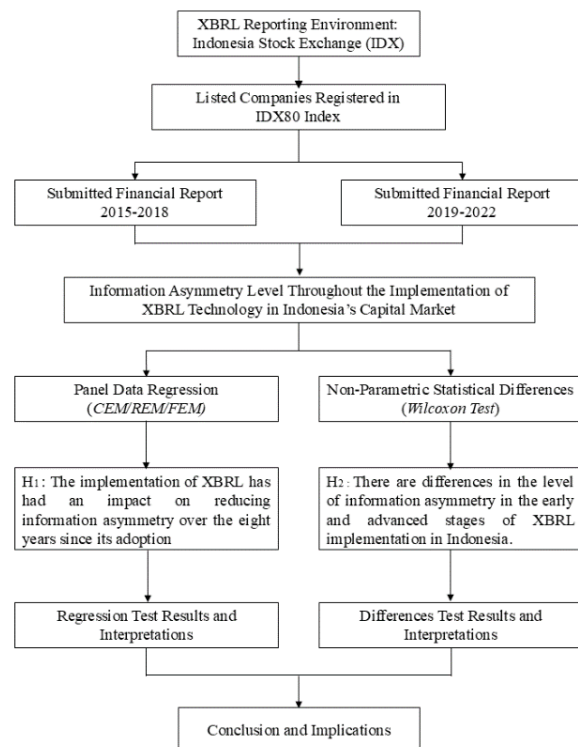

Figure 2. Research Design

The population in this study consists of publicly listed companies (issuers) listed on the IDX80 Index. The IDX80 Index measures the price performance of 80 stocks with high liquidity and large market capitalization, supported by strong company fundamentals. IDX80 is similar to IDX30 and LQ45 but with a larger number, specifically 80 stocks, which can

represent 80-90% of the stock market in terms of transaction value and volume. By using IDX80, it is assumed that it can represent companies listed on the IDX more generically based on backtesting results and free float index calculations compared to other official indices [12]. From the 80 companies listed in the population, research objects are selected through a purposive sampling method with criteria including companies not delisted during the specified observation period, having issued complete annual reports that are accessible, and having submitted financial reports in XBRL format during the observation years based on information recorded in annual reports. The chosen timeframe is divided into two observation periods referring to the research method used for measuring the impact of IFRS convergence on the relevance of financial information [13], namely the early stage of XBRL implementation in Indonesia covering the years 2015-2018 marked by the use of the first taxonomy in 2015, and the advanced stage of XBRL implementation covering the years 2019-2022 marked by XBRL reporting reaching 95% at the IDX in 2019 [14]. The unit of data used is secondary data sourced from company annual reports and historical stock data accessed from the official IDX website and validated financial platforms.

2.2 Variables

Proxies of the Bid-Ask Spread ratio are commonly used in research to measure the level of information asymmetry within a given analysis period. The mathematical definition of Bid-Ask Spread is quite straightforward, representing the difference between the highest bid price and the lowest ask price of a stock traded on a specific date [14]. In this study, the specific date refers to the date of financial report publication.

The value of the Bid-Ask Spread can be interpreted in various ways. The smaller the difference (spread) between the two prices, the more liquid the stock, thus attracting market interest and ultimately increasing the stock price in subsequent periods [15]. Conversely, this difference is interpreted as economic compensation given to market makers for their services obtained from this difference because bid prices are generally lower than the actual price [14]. This study refers to the interpretation that Bid-Ask Spread is an indicator of information asymmetry [16]. The higher the calculated difference, the greater the information gap between management and investor-held information. Each party has a different perspective on a stock reflected in bid and ask prices due to the disparity of information held.

The implementation of XBRL technology in the Indonesian capital market is designated as the main independent variable in this study to be measured for its influence on the level of information asymmetry. Analysis of this variable is also expanded to assess the differences in the impact of XBRL technology in the early and advanced periods of its implementation to

shed light on the argument put forth by prior research, stating that Indonesia is still in the early stages of XBRL development and requires time to realize one of its optimal benefits, which is reducing the level of information asymmetry [6].

The XBRL implementation variable is categorized as a dummy or binary variable, which is useful for representing categorical data in numeric form and only has two dichotomous values, 0 or 1 [17]. The use of dummy variables allows the study to incorporate categorical information into the statistical model without altering the fundamental nature of the model itself. Dummy variables also enable the study to compare the relative effects of different groups or categories in statistical analysis. Both in panel data regression analysis and paired sample t-test difference tests, the early stage of XBRL implementation (2015-2018) is coded as 0, while the advanced stage (2018-2022) is coded as 1.

In the study, control variables are used to minimize the confounding effects or nuisance variables that can obscure the relationship between the independent variable and the dependent variable [17]. Control variables are selected based on their relationship with the level of information asymmetry variable [6], [7], [8], [9]. The four variables include company size, stock turnover, stock volatility, and stock price. Table 1 is a complete table of each proxy variable in this research.

Table 1. Measurement of Variables

Variables	Measurement
Information Asymmetry [18]	$\dfrac{(Ask\ Price_{it} - Bid\ Price_{it})}{\dfrac{(Ask\ Price_{it} + Bid\ Price_{it})}{2}} \times 100$
XBRL Implementation [9]	Dummy variable: early-stage = 0; advanced-stage: 1
Company Size [7]	Total assets
Stock Turnover [6]	$\dfrac{Number\ of\ shares\ traded}{Average\ number\ of\ shares\ oustanding}$
Stock Volatility [8]	$\dfrac{Highest\ price - Lowest\ price\ t}{\dfrac{Highest\ price + Lowes\ price\ t}{2}}$
Stock Price [8]	Average closing price t

2.3 Analysis Method

The analysis instruments used in this study consist of panel data regression and difference test using the non-parametric statistical method (Wilcoxon test). Panel data regression analysis is used to determine the impact of XBRL reporting technology implementation during the observation period (2015-2022) on the level of information asymmetry. Meanwhile, the difference test is utilized to ascertain the difference in the level of information asymmetry between the early period (2015-2018) and the advanced period (2019-2022) of XBRL implementation in Indonesia. The analytical procedures in this study encompass descriptive statistics, classical assumption tests, and hypothesis tests conducted using the Eviews statistical software.

In panel data regression analysis, estimating the most suitable panel data model is necessary to understand the relationship between dependent and independent variables over time and across different units. This allows for an analysis of how certain factors affect these units over time. Three approaches to estimating regression models are the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). CEM is the simplest method for estimating panel data regression, as it merely combines cross-sectional and time-series data. It does not take into account heterogeneity across units or potential correlations within a single unit's observations over time. The estimation of panel data regression models using FEM involves the inclusion of dummy variables, which is why this approach is often referred to as the Least Squares Dummy Variable (LSDV) model. Estimation can be performed either with weighting, such as cross-sectional weights or Generalized Least Squares (GLS), to address heterogeneity across cross-sectional units, or without weighting, relying solely on the Least Squares Dummy Variable (LSDV) method. The last approach, REM, considers random individual effects by treating the coefficients of these effects as random variables. In essence, this approach accounts for the unique, unobserved characteristics of each unit that may influence the observed outcomes.
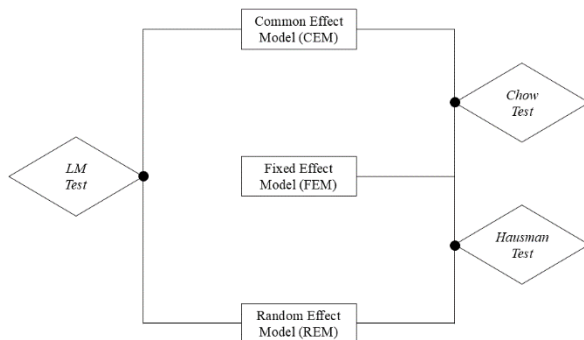

Figure 3. Three Approaches of Regression Models Estimation

From the three available model approaches, only one appropriate model is required for use in the study. Determination is based on the results of formal testing, including the Chow Test, Hausman Test, and Lagrange Multiplier (LM) Test, conducted step by step as described in Figure 3.

Wilcoxon Test is one of several alternative difference test methods. which is a statistical procedure for comparing the means or proportions of two or more groups or treatments (can also mean periods) to see if there are significant differences between the groups or treatments [19]. The primary objective of such tests is to assess whether the observed differences are attributable to the factors and variables under investigation or influenced by other unobserved factors.

The Wilcoxon signed-rank test does not require the assumption of normality or the absence of outliers, meaning that the data does not need to follow a normal distribution [19]. The criteria in the Wilcoxon Test is

based on the mean difference derived from the test results. Specifically, it evaluates whether there is a significant increase or decrease in the mean value attributed to the variable measuring the level of information asymmetry (SPREAD), while also taking into account the probability value generated by the Wilcoxon test.

3. Results and Discussions

3.1 Selected Models: REM

Cross-section probability value F in the redundant fixed effects test is less than the significance level (α=0.05), then the FEM is preferred over the CEM.

Table 2. Chow Test Result

Redundant Fixed Effect Tests			
Equation: Untitled			
Test cross-section fixed effects			
Effects Test	Statistic	d.f.	Prob.
Cross-section F	1,7423	-51,3590	0,0021

Once FEM is identified as the appropriate model, further comparison between FEM and REM must be conducted using the Hausman test.

Table 3. Hausman Test Result

Correlated Random Effects - Hausman Test			
Equation: Untitled			
Test cross-section random effects			
Test Summary	Chi-Sq. Sta.	Chi-Sq. d.f.	Prob.
Cross-section random	7,1490	5	0,2098

The probability value for the random cross-section is 0.2098. High P-value >0.05 indicates that the REM is preferred, as it suggests no correlation between the fixed effects in the FEM and the independent variables. This aligns with the assumption of REM, which considers individual effects as arising from a random distribution. Based on the results of the Chow and Hausman tests in Tables 2 and 3, the best panel data regression model in this study that fits the characteristics and structure of the data is the Random Effects Model (REM).

Therefore, the mathematical equation for the REM model for this research is as follows.

$$\text{SPREAD} = 2{,}03_0 - 3{,}18_1 \text{XBRL}_{it} + 2{,}36_2 \text{SIZE}_{it} + 30{,}57_3 \text{TURNOVER}_{it} + 26{,}65_4 \text{VOLATILITY}_{it} - 3{,}76_5 \text{STOCKPRICE}_{it} + \varepsilon_{it}$$

3.2 Simultaneous Statistical F-Test

The simultaneous F test is conducted to determine how the independent variables collectively or simultaneously influence the dependent variable. What needs to be observed in the results of the simultaneous F statistic test in Table 4 is the probability value, whether it is smaller or larger than the significance level set at 0.05.

Therefore, it can be concluded that the independent variables included in the model collectively have a significant simultaneous effect on the dependent

variable of information asymmetry level, under the assumption of ceteris paribus.

Table 4. F-Test

Effects Specification	
Cross-section fixed (dummy variables)	
F-Statistic	10,1948
Prob(F-Statistic)	0,0000

3.3 Partial Statistical t-Test

Having the same criteria as the F-statistic test, the partial testing also uses the significance level set at 0.05. Table 5 presents the computed results of this test.

Table 5. t-Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2,0311	0,1822	11,1507	0,0000
XBRL_X1	-3,1826	0,1557	-20,4396	0,0000
SIZE_X2	2,3615	9,7816	2,4171	0,0161
TURNOVER_X3	30,5670	15,9442	1,9171	0,0560
VOLATILITY_X4	26,6519	2,6480	10,0649	0,0000
STOCKPRICE_X5	-3,7606	1,9205	-0,1964	0,8444

The t-statistic value for the XBRL technology adoption variable is -20.4396 with a probability value of 0.0000,

which is smaller than 0.05. This means that the significance value does not exceed the threshold of the predetermined level of causality relationship (5%), indicating that the XBRL adoption variable has a negative impact on the level of information asymmetry. Meanwhile, among the four control variables, only company size (SIZE) and stock volatility (VOLATILITY) both have a positive influence on the level of information asymmetry.

3.4 Wilcoxon Difference Test Results

This research also conducted a difference test to fulfill the second research objective, which is to find out and provide further interpretation of whether there are differences in the level of information asymmetry in the two periods of XBRL technology adoption. The difference test was carried out using the alternative Wilcoxon test method to determine differences in stock spread levels at the early and advanced stages of XBRL technology implementation as a medium for issuers to deliver financial reporting to the IDX.

Table 6. Wilcoxon Test Result

Test for Equality of Medians of *SIZE, TURNOVER, VOLATILITY, STOCKPRICE*
Categorized by values of XBRL
Sample: 2015 2022
Included observations: 416

	XBRL	Count	> Overall Median	Median	Mean Rank	Mean Score	Wilcoxon Prob.
SPREAD	POST0	208	2,7146	191	298,9736	0,6640	
	POST1	208	0,4255	17	118,0264	-0,6577	
	All	416	0,8697	208	208,5000	0,0031	0,0000
SIZE	POST0	208	2,3900	94	192,7500	-0,1409	
	POST1	208	3,1400	114	224,2500	0,1409	
	All	416	2,7600	208	208,5000	-3,4200	0,0076
TURNOVER	POST0	208	0,0012	97	194,4038	-0,1246	
	POST1	208	0,0013	111	222,5962	0,1247	
	All	416	0,0012	208	208,5000	2,0800	0,0168
VOLATILITY	POST0	208	0,0271	88	181,3918	-0,2347	
	POST1	208	0,0352	120	235,6082	0,2391	
	All	416	0,0305	208	208,5000	0,0022	0,0000
STOCKPRICE	POST0	208	1500,0000	101	200,5625	-0,0608	
	POST1	208	1700,0000	106	216,4375	0,0609	
	All	416	1600,0000	207	208,5000	4,0500	0,1783

Based on Table 6, the significant probability of the difference in the average spread value is 0.0000 (less than 0.05), indicating a significant influence on the differences in treatment given to each variable, essentially, there is a difference in the level of information asymmetry between the early and advanced stages of XBRL implementation. The Wilcoxon test results reveal a reduction in the average spread value. In the early stage of XBRL implementation (2015–2018), the mean rank value was 298.9736 with a mean score of 0.6640, which decreased to 118.0264 followed by a mean score of -0.6577 in the advanced stage (2019–2022) as illustrated by the bar chart in Figures 4 and 5.
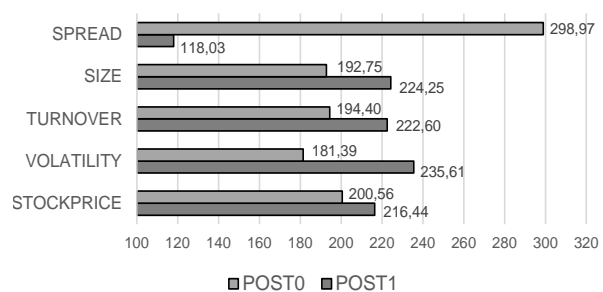

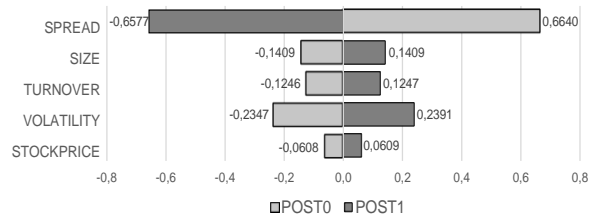Figure 4. Mean Rank of Wilcoxon Test Results

Figure 5. Mean Score of Wilcoxon Test Results

Table 6 also presents the results of the Wilcoxon test for the difference in the average values of control variables, which are not further interpreted in this study. Based on the table, the company size variable and the stock volatility variable experienced an increase in the average values in the advanced stage of the research period, with significance probabilities of 0.0076 and 0.0000, respectively. Companies with bigger sizes generally possess greater resources to deliver transparent and relevant information to stakeholders, including more comprehensive financial reports and enhanced communication with investors. Some bigger companies attract more analyst coverage, which helps to mitigate information asymmetry. As a result, when adopting XBRL, companies are likely to experience a greater reduction in information asymmetry compared to smaller firms, owing to their capacity to leverage XBRL more effectively. The adoption of XBRL in financial reporting holds significant potential for enhancing transparency, particularly in highly volatile markets. Companies experiencing high stock volatility may derive greater benefits from implementing XBRL, as the format enhances the quality and accessibility of information in such environments. This study contextualizes the issue within the setting of developing markets, such as Indonesia, which typically exhibit higher levels of volatility compared to developed markets. Consequently, reducing information asymmetry through XBRL technology becomes not only more critical but also highly impactful in these regions.

The other control variables, stock turnover, and stock price, do not significantly influence the differences in treatment given to each variable, with significance probabilities of 0.0168 and 0.1783 respectively.

3.5 Discussions

The use of the panel data regression method has been adjusted to the purpose of this research, wherein this method can provide empirical evidence regarding the relationship between XBRL technology implementation and the dependent variable of information asymmetry over time and across individual units (sample companies). Based on the statistical estimation results of panel data regression in Table 5, the t-statistic value for the XBRL technology adoption variable is notably high, at -20.4396 with a probability value of 0.0000. The results indicate that the relationship between the XBRL technology adoption variable and the level of information asymmetry is

inversely proportional with a high coefficient. Unlike linear regression, which does not account for unit and time variations, the panel data regression method focuses on the observation period. This means that over the eight-year observation period, XBRL technology played a significant role in reducing information asymmetry, approximated by the stock spread value.

The findings of this research confirm the majority of similar studies [8]-[11], which concludes that there is a positive relationship between XBRL adoption and the reduction of information asymmetry. XBRL technology provides transparency and fair distribution of financial data as an integral part of good corporate governance that the Indonesia Stock Exchange (IDX) has been trying to implement since 2015 [3]. As a result, by observing the implementation of XBRL technology over an eight-year observation period among the listed companies in the IDX80 index, it concludes that the publication of financial reports in XBRL format could reduce the level of information asymmetry.

Essentially, the decrease in information asymmetry is a consequential effect of the benefits brought by XBRL, such as a universal reporting scheme that is accurate, integral, deliverable, and accessible. For investors who do not internally utilize XBRL-formatted financial reports, the presence of XBRL technology may not have significant impacts from their principal perspective. However, the adoption of XBRL at certain levels has indeed provided significant benefits for regulators in supervising and monitoring listed companies, thereby resulting in the reduction of information asymmetry due to the disparity in quality information ownership between principals (investors) and agents (listed companies's management).

The XBRL reporting technology enables data to be readily available and processed into financial ratios and indicators for monitoring a company's financial performance. The XBRL reporting system is linked with the regulator's monitoring system, in this case, the Indonesia Stock Exchange (IDX), which provides indicators to oversee the performance of listed companies. The XBRL reporting system provides warning notifications for companies or indicators that need to be monitored closely. Starting from this premise, the level of information asymmetry can be reduced with the utilization of the XBRL reporting system by listed companies.

Before the implementation of XBRL technology, the reporting mechanism required regulator staff to manually input company financial information into spreadsheets to support the monitoring process, which was time-consuming and prone to errors. Prioritizing efficiency and providing optimal service to the market. The adoption of XBRL significantly reduce information processing costs. This impact is particularly pronounced in contexts where XBRL implementation is mandatory, as it minimizes filing delays and enhances the timeliness of financial reporting [20]. A decrease in

information processing costs may lead analyst to get more coverage and mitigate information asymmetry, which subsequently reduce the cost of equity capital [21].

The availability of XBRL-formatted reports for the public is likely to support further technology dissemination, and increasing engagement levels with other stakeholders is the next goal of efforts to reap the benefits of XBRL technology implementation [22]. It is worth emphasizing that the benefits of XBRL technology implementation in Indonesia are currently being felt primarily at the regulatory level, indicating that Indonesia's capital market implements the conversion strategy at the listed firms' level in the context of mandatory but unenforced XBRL filing regulation [23].

Empirical evidence regarding the difference in the level of asymmetry between the early and advanced stages of XBRL technology implementation has been presented in Table 6 through the Wilcoxon test. The results show a decrease in the mean rank value by 180.9472 from 298.9736 in the early stage of XBRL adoption (2015-2018) to 118.0264 in the advanced stage (2019-2022). These findings support the conclusion of the main reference that XBRL implementation in Indonesia throughout their observation period in 2018 was still in the early stages, and it would take several more years to fully realize the potential benefits of XBRL technology, one of which is the reduction of information asymmetry contained in financial reports [6].

The regulator's ability to enhance supervision and monitoring of financial reports submitted in XBRL format is supported by the positive development of several factors, including but not limited to institutional readiness and stakeholder facilitation support [24]. These factors collectively or partially drive the level of participation in XBRL-format financial reporting by listed companies, which, over time, could improve the ability to implement XBRL so that the financial report of listed companies becomes integrated and reduce the level of information asymmetry much better throughout advanced stages of XBRL implementation in Indonesia's Capital Market.

In terms of institutional readiness to submit agency documents that align with regulatory requirements, the introduction of the Service Guide by the Indonesia Stock Exchange (IDX) for listed companies, along with the launch of an integrated portal called IDXnet in 2017, marked a significant development. This portal enables listed companies to directly disclose information to the public, enhancing transparency and compliance with disclosure obligations. This facility aims to reduce asymmetric information and increase efficiency in reporting. All Listed Companies are required to submit information disclosure through IDXnet. IDXnet is connected to other applications such as IDX-XBRL, and IDX-SISCA.

IDXnet was developed to address the growing demand for an integrated and efficient reporting system, driven by the increasing number of issuers and the rising complexity of financial statements and corporate actions. This initiative aligns with international standards by adopting the XBRL format. IDXnet offers several key features. *First*, Automatic Data Validation, which minimizes human error during the reporting process while ensuring the accuracy and reliability of submitted information. *Second*, Standardization of Reporting Formats, achieved by adopting a taxonomy based on PSAK and IFRS standards, covering financial position, profit and loss, changes in equity, and cash flow reports, thereby ensuring uniformity across issuers. *Third*, Global Accessibility, which provides reports in multiple formats and languages to accommodate international investors. *Fourth*, Centralized Data Management, which enables efficient monitoring by regulators, issuers, and other stakeholders through an integrated system. This portal is designed to streamline the adoption and submission of financial reports in the XBRL format during the advanced stages of its implementation. This suggests that the IDX has made the adoption of XBRL by listed companies mandatory. The integration of business reporting has been developed in various countries in developed markets, such as the Netherlands, Australia, and the European Union. This approach aims to enhance reporting efficiency, improve transparency, and foster an environment encourages investment.

Secondly, stakeholder engagement was found to significantly influence the XBRL project success, led by IDX [23]. The Indonesia Financial Service Authority (IFSA), the Institute of Indonesia Chartered Accountants (IICA), vendors, and listed firms were identified as key stakeholders in the XBRL development for financial reporting. Close collaboration and interaction with the stakeholders were maintained to develop the XBRL reporting system and taxonomy. Notably, accounting professionals play a critical role as agents of digital innovation and transformation [25]. Participation in the system design process is likely to enhance compliance, particularly when supported by regulators' responsiveness in facilitating firm involvement and reviews [23]. It indicates that the regulators have optimized stakeholder involvement in the process to promote XBRL reporting acceptance and compliance.

The implementation levels of XBRL are categorized into non-adoption, low adoption, moderate adoption, and high adoption, based on the extent of XBRL usage for both internal and external purposes from the company's perspective [26]. Non-adoption typically occurs when regulators do not mandate XBRL reporting. In a low adoption strategy, organizations may choose to outsource XBRL conversion and filing, driven by efficiency concerns and a lack of internal expertise. Despite outsourcing, managers remain accountable for ensuring the accuracy and

completeness of the XBRL-converted financial reports. A moderate adoption strategy involves organizations adopting XBRL primarily to meet regulatory requirements by converting their financial statements. In this case, organizations should invest in XBRL mapping tools and provide training for employees to use the software. The most advanced approach is high adoption, a sophisticated strategy that utilizes XBRL for internal purposes.

Indonesia has already reached the advanced stage of XBRL technology implementation and has reaped benefits from its application, including reducing information asymmetry. However, a deeper mapping based on the classification above reveals that the implementation of XBRL by the IDX has only reached a moderate adoption level, as companies primarily use XBRL to convert their financial statements to meet regulatory requirements. The use of XBRL in Indonesia has not reached a high adoption level, where XBRL would be leveraged for internal company purposes [23]. This has become a concern for regulators in the Indonesian capital market to pay attention to the readiness and expertise of listed companies in developing XBRL internally as a further implementation strategy that companies must also undertake.

After empirically demonstrating that the level of information asymmetry decreases at the advanced stage of XBRL technology implementation in Indonesia compared to the early adoption stages, this research suggests that regulators should update their focus to explore the potential benefits of XBRL further. In the subsequent stages, regulators should encourage companies to utilize XBRL not only for compliance reporting but also for internal purposes, thereby enhancing the quality of the financial reporting environment in Indonesia and achieving the benefits of reduced reporting costs. As a result, Indonesia's score in the financial reporting quality factor will improve, reflecting the successful use of technology to enhance the quality of business reporting. This improvement can further increase the investment value of companies listed on Indonesia's Capital Market.

4. Conclusions

The study concludes that the adoption of XBRL technology significantly reduces information asymmetry, particularly in its advanced stages, due to its ability to standardize, integrate, and improve the accessibility of financial reporting. Enhanced supervision and monitoring by regulators, supported by institutional readiness and stakeholder facilitation, have driven greater adoption of XBRL among listed companies. Over time, this adoption has strengthened the quality and integration of financial reports, further minimizing information asymmetry in Indonesia's capital market. The implementation of XBRL by the IDX has only achieved a moderate level of adoption. This has raised concerns among regulators and listed

companies, prompting them to focus on the readiness and expertise in developing XBRL internally as part of a further implementation strategy. Companies can leverage XBRL beyond mandatory reporting purposes by utilizing its flexible features and interoperability to support various operational and strategic aspects, supposing, for internal data analysis. XBRL can be used to integrate financial reports with other internal company data like operational reports to support in-depth analysis. Its standardized format makes data easier to process and compare for data-driven decision-making. Moreover, data in XBRL format can be compared with data from other companies using the same standard for benchmarking and competitive analysis. Companies can analyze their competitive position in the market and identify opportunities for improvement. Regarding the variables, the bid-ask spread is commonly used to measure the level of information asymmetry in financial markets, but it has several weaknesses. Bid-ask spread reflects not only information asymmetry but also other factors such as market liquidity, price volatility, and transaction costs. This can obscure its interpretation regarding information asymmetry. In markets with low liquidity, the bid-ask spread tends to widen due to limited trading activity, not necessarily due to information asymmetry. Future researchers could use alternative information asymmetry proxies that are more measurable than stock spread values, such as the difference between asset prices and intrinsic values. If the price of an asset significantly differs from its intrinsic value (the value is based on fundamental factors), it could indicate information asymmetry. Those with better access to information can identify more accurate intrinsic values and make decisions based on that knowledge.

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