



The Effects of Undervaluation and Cash Holdings on the Likelihood of a Share Repurchase Decision

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ABSTRACT

This study investigates the effects of undervaluation and cash holdings on the likelihood of a share repurchase decision using data from Indonesian listed companies for the period 2009–2015. In contrast to previous studies, this study measures undervaluation using residuals of the Ohlson (1995) model of valuation based on yearly and panel regressions. The results of this study show that undervaluation and cash holding increase the likelihood of a share repurchase decision. Furthermore, this study also finds that cash holding strengthens the effect of undervaluation on the likelihood of a share repurchase decision. The study suggests that future research should avoid direct application of the price-to-book ratio as the undervaluation proxy since it has measurement error. The findings of this research can be employed in investment strategies and supportive regulation development.

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INTRODUCTION

Besides dividend, share repurchase is an alternative policy for distributing cash to shareholders (Ross, 2013), with it currently experiencing a rising trend in the market. Ross (2013) found that share repurchase policy is currently accelerating in the USA – reaching a total transaction value of 75 billion USD during January 2011 compared to 139 billion USD for the whole of 2009. Dittmar and Dittmar (2002) state that in the USA share repurchase accounted for 44.42% of the total payout in 2000 compared to 11.82% in 1971. This increasing trend for share repurchase can also be seen in Indonesia. Share repurchase has become an attractive payout option when considering the global economic crisis in 2015 that affected the Jakarta Composite Index (JCI), which plunged 12.4% in the first half of 2015. Numerous companies listed on the Indonesia Stock Exchange (IDX) used this phenomenon to conduct a share repurchase since their share prices were perceived to be undervalued. The Indonesian Financial Services Authority (OJK) has also sought to stimulate repurchase by issuing new regulations, which, in such circumstances, limit the Annual General Meeting (AGM) approval of a company's share repurchase.

In order to explain the increasing trend for share repurchase, it is essential to understand the key drivers. There are two main factors that determine share repurchase decisions, namely undervaluation and cash holdings. The undervaluation of a company's share price leads the market to perceive that any share repurchase is an indicator of the company's undervaluation, commonly known as the signalling hypothesis. Previous research findings show that undervaluation has a significant effect on share repurchase decisions (Andriosopoulos and Hoque, 2013; Vermaelen, 1981; Stephens and Weisbach, 1998; Yarram, 2014). A share repurchase is affected by negative returns in previous periods since companies believe that, compared to the historical price, their share price is relatively undervalued. Hence, companies making share repurchase decisions are often perceived as sending out an 'undervalued signal' to the market. Ginglinger and Hamon's (2007) findings show that a company's declining share price is the main driver of a share repurchase decision. Their study also proves that the share price becomes more stable following the share repurchase decision.

The calculation methodology is important when determining undervaluation. Direct application of the price-to-book ratio (PBV) is the most common way of measuring undervaluation. Andriosopoulos and Hoque (2013) and Yarram (2014) employ PBV to measure the undervaluation of a company's share price. However, PBV is limited in terms of its ability to fully reflect undervaluation. As such, a low PBV should not immediately be taken as an indicator of undervaluation since a low PBV can also be indicative of a company's poor performance in organising their assets. Hence, when compared to the industry average, the stock market values a company with a lower PBV ratio. In this study, the measurement of undervaluation differs from that used in previous research. This study's measurement of undervaluation is based on the comparison of intrinsic and actual PBV. Intrinsic PBV is calculated using Ohlson's (1995) model that incorporates the company's profitability, risk and growth. When compared to actual PBV, a higher intrinsic value indicates an undervaluation of the company's share price.

Besides the undervaluation of its share price, the company also requires sufficient cash holdings in order to execute a share repurchase decision. This is called free cash flow theory and relates to a correlation between a share repurchase decision and the state of the company's cash holding. A higher cash holding drives the company to enact a share repurchase (Fenn and Liang, 1997; Oswald and Young, 2007; Frilander, 2013). Companies with higher cash holdings have greater capabilities, thus leading to a greater likelihood of them carrying out a share repurchase. For companies with low growth opportunities, the likelihood of a share repurchase is even higher since it is considered to be a good investment opportunity (Mitchell and Dharmawan, 2007).

This study notes that, based on the literature review, no previous study has looked at the interaction of cash holdings with undervaluation as a means of analysing the impact on share repurchase. This study proposes that, without sufficient cash holdings, a company is unlikely to repurchase its shares even if its share price is undervalued. In this regard, the company is not considered to have sufficient resources to take the necessary action. A company is most likely to carry out a share repurchase if it is supported by both undervalued stocks and sufficient cash holdings. In addition, from the investment hypothesis perspective, a share repurchase is one of the company's investment options, especially so when the share price is undervalued (Dixon *et al.*, 2008). High cash holdings are indicative of companies with limited investment opportunities, meaning they tend to hold on to their cash as opposed to distributing it across other investments. Consequently, when considering repurchase as a profitable investment, companies with an undervalued share price and high cash holdings are more likely to repurchase their shares. Therefore, based on the above explanation and using cash holding as a moderating variable, this study analyses the effect of undervaluation on the likelihood of a share repurchase decision.

This study contributes to the literature in two main original ways. Firstly, this study refines the undervaluation measurement to address the various drawbacks of the direct application of PBV, as commonly used in other studies. This study modifies the undervaluation measurement by comparing actual and intrinsic PBV based on Ohlson's (1995) valuation model. Secondly, this study is the first of its kind to examine the effect of undervaluation on share repurchase with cash holding as a moderating variable.

Further, in general, there continue to be few share repurchase studies in Indonesia. Hutapea (2015) investigated the relationship between cash holdings and share repurchase decisions, while Perdana (2014) examined the effect of the ownership structure on share repurchase, employing cash holdings as the control variable. Tanwira (2015) investigated the effect of capital structure and equity misvaluation on share repurchase by using undervaluation and cash holding as control variables. Thus, there is a need for a study that examines the more comprehensive determinants of share repurchase decisions in Indonesia.

The remainder of this paper is organised as follows. Section 2 discusses the relevant literature and develops the hypotheses. Section 3 presents the data, methodology and operationalisation of variables. Section 4 discusses the empirical results and Section 5 provides the conclusion.

REVIEW OF LITERATURE AND HYPOTHESES DEVELOPMENT

Efficiency of Capital Market in Indonesia

The efficiency level of the capital market in Indonesia has important implications for this study. Fama (1970) was the first to establish an efficient market theory. Based on the degree of efficiency and depending on the coverage of information reflected in security prices, the capital market's level of efficiency is categorised as being either weak, semi-strong or strong. In a strong and efficient market, the company's share price reflects all public and private information. There is no misvaluation of stocks and it is therefore irrelevant to use undervaluation in further analysis. Therefore, the basic assumption of undervalued stocks, as employed in this study, would be contrary to the Indonesian market conditions if the Indonesian market was already in a strong and efficient form. However, if the Indonesian capital market is either inefficient and weak or semi-strong, then the assumption of undervaluation is valid.

The findings from previous studies show that, even in weak form, the Indonesian capital market is still efficient (Nikita and Soekarno, 2012; Worthington and Higgs, 2005; Husnan, Hanafi, and Wibowo, 1996; Lesmana, 2001). Lesmana (2001) confirmed these results when he stated that the efficiency of the Indonesian market has not improved over time. Also, there is an indication of a worsening in the efficiency of the Indonesian capital market. Rizkianto and Surya (2014) performed a semi-strong form test of the Indonesian capital market in the period 2009–2013 using Multifactor Arbitrage Pricing Theory (Multifactor APT). Their findings revealed that the Indonesian capital market has not yet attained a semi-strong condition and continues to be categorised as an inefficient market. Therefore, it can be concluded that the Indonesian capital market is a weak and inefficient market and not a semi-strong efficient one. This leads to the possibility of the misvaluation of stocks, including undervaluation.

Undervaluation

The undervaluation hypothesis, often known as the signalling hypothesis, refers to a condition in which a company's management realises a profit from its share repurchase decisions. Based on information and their own deep knowledge of the company's undervaluation, the theory assumes that the company's management has non-public information that enables them to estimate the company's intrinsic value and to signal an undervaluation by conducting a share repurchase.

In line with the theory, an undervaluation of the company's share price is empirically found to be one of the determinants of a share repurchase (Vermaelen, 1981; Ikenberry *et al.*, 1995; Karhunen, 2002; Andriosopoulos and Hoque, 2013; De Cesari *et al.*, 2012; Brav *et al.*, 2005). Stephens and Weisbach (1998) and Comment and Jarrel (1991) also confirmed this undervaluation hypothesis with their findings on the correlation between share repurchase and negative excess returns in pre-share repurchase periods. This indicates the undervaluation of the company's share price. In Indonesia, Tanwira (2015) investigated 68 Indonesian companies and proved that equity misvaluation, such as undervaluation, is the main determinant factor of share repurchase.

From previous studies, it can be concluded that undervaluation indicates that the share price's market value is below the company's intrinsic value and drives the company to make a share repurchase decision. Therefore, the first hypothesis to be tested in this research is:

H₁: Undervaluation is positively associated with the likelihood of a share repurchase decision.

Andriosopoulos and Hoque (2013) and Yarram (2014) use PBV to measure the undervaluation of the company's share price. Based on the previous research, PBV is one indicator of undervaluation; as such, this study also employs PBV as a proxy to measure undervaluation. However, the drawback of using PBV to measure undervaluation is that a low PBV can be driven by the company's poor performance and leave the company with negative market sentiment being reflected in the low ratio. This study refines the measure of undervaluation by comparing intrinsic and actual PBV. Based on Ohlson's (1995) model, the intrinsic value is estimated as follows:

$$\frac{P_0}{BV_0} = 1 + \frac{1}{BV_0} \left(\sum_{n=1}^{m-1} \frac{ROE \times BV_{n-1} - k \times BV_n}{(1+k)^n} + \frac{\frac{RI_m}{k-g}}{(1+k)^{m-1}} \right)$$

Where:

P_0 = Intrinsic Price; BV_0 = Current Book Value; EPS = Earnings per Share; BV_{n-1} = Book Value at year $n-1$; ROE = Return on Equity; k = Discount rate - cost of equity; RI_m = Residual Income at year m ; g = Expected Growth Rate.

Based on the above equation, PBV is affected by the company's profitability (ROE), risk (cost of equity) and expected growth (g). Based on those factors, this study estimates the intrinsic value of PBV.

Cash Holdings

Cash constitutes a company's most liquid assets. Frilander (2013) finds that the ideal level of liquidity is one at which the company is able to cover its short-term expenses such as interest expenses, operating expenses and capital expenditure and also retain a small buffer for unforeseeable expenses. Thus, ideally, a company should not hold excess cash.

If companies have excess cash, a better option is to return it to shareholders as a means of reducing agency costs (Jensen, 1986; Easterbrook, 1984). According to Amihud and Li (2006), the flexibility afforded by a share repurchase is one advantage of this payout method since a share repurchase is not a firm commitment. Guay and Harford (2000) state that a share repurchase is executed by using less permanent cash flow.

Consistent with the above arguments, previous studies have stated that there is a positive correlation between share repurchase and cash holdings (Fenn and Liang, 1997; Jensen, 1986; Dittmar and Dittmar, 2007; Mitchell and Dharmawan, 2007; Stephens and Weisbach, 1998; Frilander, 2013; Brailsford *et al.*, 2016). Companies with high cash holdings tend to repurchase their shares in larger quantities. However, this also leaves the company at greater risk of overinvesting and giving higher profitability to its shareholders in terms of the distribution of cash.

While the above studies employed the company's cash position, other studies have used cash flow as an alternative measure of cash holding. Oswald and Young's (2007) findings show that a company's liquidity and cash flow performance are the main determinant factors of share repurchase. Their research also proves that higher and abnormal cash flow boosts the likelihood of a share repurchase and increases the funds available to execute one. Brailsford *et al.* (2016) findings show similar results when analysing free cash flow as a determinant of the decision to conduct a share repurchase.

In conclusion, existing studies posit and find that, if companies have a high cash holding, they are motivated to repurchase their shares. Therefore, the next hypothesis to be tested is as follows:

H₂: Cash holding is positively associated with the likelihood of a share repurchase decision.

Interaction of Undervaluation and Cash Holdings

To date, there has been no prior research that has used cash holdings as a moderating variable to investigate the effects of undervaluation on the likelihood of a share repurchase decision. The interaction between these variables represents this study's contribution to the literature. The following three reasons are proposed as arguments for this interaction: sufficient resources are needed for repurchase; costly signalling; and the investment hypothesis.

Without sufficient cash holdings, a company will tend to not make share repurchase decisions; thus, despite the undervaluation of its share price, there is no cash available to take the necessary action. Therefore, the decision to conduct a share repurchase due to undervaluation depends on whether or not the company has an adequate cash holding. This suggests that cash holding moderates the impact of undervaluation on the likelihood of a share repurchase.

Mitchell and Dharmawan's (2007) findings show that, in order to carry out a share repurchase, the company incurs extra costs, which are often quite high. In alignment with signalling theory, information regarding the company's prospects induces the management to make a share repurchase decision. This is because the management perceives the recent share price to be undervalued when compared to the company's more encouraging prospects. When considering the high cost that would be incurred, only a company that found its stock to be significantly undervalued would implement a share repurchase. In line with Myers and Majluf (1984), the costs of a share repurchase increase when a company uses external financing to execute its action. Therefore, since it serves as a relatively low-cost source of financing the repurchase, a company's higher cash holding boosts the likelihood of a share repurchase decision. The correlation between undervaluation and share repurchase is strengthened if the company is supported by a higher cash holding.

From the investment hypothesis perspective, Dixon *et al.* (2008) state that share repurchase is one of the company's investment options, especially when the share price is undervalued. In these circumstances, a share repurchase becomes a profitable option that leads to an increase in both the share price and shareholder wealth. On the other hand, however, a high cash holding is indicative of a company with limited investment opportunities since the company is electing to hold on to its cash rather than spread it across other investments. Consequently, this can provide a lower return than the company's required rate of return. Therefore, a company which has an undervalued share price supported by a high cash holding will tend to repurchase its shares since the share repurchase is perceived to be a profitable investment.

Based on these arguments, cash holding is an important variable that strengthens the impact of undervaluation on the share repurchase decision. The likelihood of a share repurchase decision increases if the company experiences both undervaluation in its stock and has a sufficient cash holding. Therefore, the next hypothesis to be tested is:

H₃: Cash holding strengthens the influence of undervaluation on the likelihood of a share repurchase decision.

RESEARCH METHODOLOGY

Sample Selection

This study's population comprises companies listed on the IDX between 2009 and 2015. The sample was selected using the non-probability purposive sampling method. The following criteria were used for the sample: companies listed on the IDX before 2009 which had not gone private by 2015, with positive PBV values and complete financial data for the period of study.

This study uses balanced panel data to obtain more accurate conclusions and reduce disturbance within the research. This is because unbalanced panel data has more errors in comparison to balanced panel data (Baltagi, 2005). The research period begins in 2009 in order to avoid bias from the 2008 global economic crisis that affected companies' financial conditions and the condition of the Indonesian market. Companies with a negative PBV were removed from the sample since this indicates companies which are experiencing negative equity. This is difficult to interpret since it reflects the company's financial distress condition and a high degree of risk (Brown *et al.*, 2007).

Based on information from the official IDX website, there was a total of 526 listed companies in 2015 versus 110 listed companies in 2009. A total of 31 companies had a negative PBV, while 49 companies had incomplete financial data. Therefore, following the sample selection process, the total sample for this research is 336 companies, or 2,352 observations, for the seven periods of the study.

Research Model

In order to test the first and second hypotheses, the following empirical logit regression model is employed:

$$LOGIT (SR = 1) = \alpha + \beta_0 UVL_{it} + \beta_1 CH_{it} + \beta_2 LEV_{it} + \beta_3 SIZE_{it} + \beta_4 DPR_{it} + \beta_5 DIV_YIELD_{it} + \varepsilon \dots \dots \dots (1)$$

Where:

SR = Likelihood of share repurchase; UVL = Undervaluation; measured by UV, UV1 and PBV; CH = Cash holding; measured by CASH, CF and CF_ADJ; LEV = Leverage; SIZE = firm size; DPR = Dividend payout ratio; DIV_YIELD = Dividend yield; e = Error; i for firm I and t for year t.

The logit regression model to test the third hypothesis is as follows:

$$LOGIT (SR = 1) = \alpha + \beta_0UVL_{it} + \beta_1CH_{it} + \beta_2UVLxCH_{it} + \beta_3LEV_{it} + \beta_4SIZE_{it} + \beta_5DPR_{it} + \beta_6DIV_YIELD_{it} + \varepsilon \dots \dots \dots (2)$$

Shown as $\beta_2UVLxCH$ in the model, the impact of undervaluation on the likelihood of share repurchase, moderated by cash holdings, is reflected by multiplying the two variables.

In line with Andriosopoulos and Hoque (2013), this study uses the logit regression method since the dependent variable is the dummy variable. SR is the dummy variable, with companies that conduct a share repurchase indicated by one, and companies that do not perform a repurchase share indicated by zero.

Measurement of Variables

The model’s dependent variable is a dummy variable that measures the share repurchase decision. A value of one is given for companies that implement a share repurchase, and zero for companies not implementing a share repurchase.

Undervaluation is measured using the three proxies of PBV, UV and UV1. Consistent with previous studies, PBV is the value of the actual price-to-book ratio prior to the share repurchase period (Dittmar, 2000; Mitchell and Dharmawan, 2007; Andriosopoulos and Hoque, 2013). As explained earlier, the actual value of PBV is limited in terms of its ability to measure undervaluation. Therefore, this study compares actual and intrinsic PBV to reflect undervaluation. The following two approaches are taken to measuring the level of undervaluation: 1. Residuals of the following annual regression (equation (3)), noted as UV, in order to address and adjust the market condition in each period and to investigate undervaluation relative to other companies’ share value; and 2. Residuals of a panel regression of equation (3), noted as UV1, to detect relative undervaluation over time.

Based on Ohlson’s (1995) valuation model, undervalued stocks are identified by the negative error value generated by a regression as follows:

$$PBV_{it} = \alpha_{it} + \beta_0ROE_{it} + \beta_1RISK_{it} + \beta_2EG_{it} + \varepsilon \dots \dots \dots (3)$$

Where:

PBV = Actual price-to-book ratio; ROE = Return on equity; RISK = Company risk; EG = Company expected growth; e = Error.

Ideally, the Return On Equity (ROE) and Expected Growth (EG) measurements should employ forecast value. However, the limitation of Indonesian forecast data makes it difficult to apply the forecast measurement. In this study, assuming that ROE is relatively stationary, future ROE is measured as actual ROE in the fiscal year-end prior to the share repurchase. Concino’s (2011) findings show that the changes in the company’s net income are the best proxy for measuring the company’s growth. Therefore, EG is measured using average net income growth for the last three years.

RISK is measured using the cost of equity. The cost of equity calculation is based on the Capital Asset Pricing Model (CAPM), with the yield of 10-year government bonds used as a proxy for the risk-free rate. The beta value follows the company’s beta relative to the JCI. Beta is calculated using a yearly regression of daily returns. The study uses 5.5% as the proxy for the risk premium of the Indonesian market, which is based on research findings from PricewaterhouseCoopers (PwC, 2013) stating that the market risk premium for developing countries, including Indonesia, is around 5.5%.

Intrinsic values are measured by the predicted value of PBV generated from the results of the regression. Based on the regression model, undervaluation occurs when the actual PBV is either lower than the intrinsic value or, simply, the residual is negative. The residual value is multiplied by negative 1 (-1) to reflect the degree of undervaluation and employed as the value of UV and UV1.

Cash holding is measured using the three proxies of CASH, CF and CF_ADJ. CASH is calculated by dividing the cash balance by the company’s total assets (Dittmar, 2000; Hutapea, 2015). Following Andriosopoulos and Hoque’s (2013) lead, this study employs Cash Flow (CF) as another proxy for cash holding by dividing the company’s Earnings Before Interest, Tax, Depreciation and Amortization (EBITDA) by total assets. This study

constructs CF_ADJ, which is also a proxy for cash holding. CF_ADJ is a dummy variable that takes one as its value if the company has a higher CF compared to the industry average, and zero otherwise.

The control variables for regression in equations one and two are as follows. Frilander (2013) states that the company uses share repurchase to adjust its capital structure in order to achieve the optimal level. In this study, LEV is measured by the company's debt-to-equity ratio, where it is believed that companies with lower ratios are more likely to repurchase their shares. Debt is defined as all interest-bearing debt. SIZE affects the company's undervaluation because firm size reflects the degree of information asymmetry. Vermaelen (1981) found information asymmetry to usually occur in small-sized companies. However, Dittmar (2000) states that, because of information, misvaluation asymmetry can also occur in large-size companies. Such companies tend to take the opportunity of share repurchase in order to gain profits. Related studies have found that SIZE has both a significant and positive correlation with share repurchase (Dittmar, 2000; Grullon and Michaely, 2002; Jagannathan and Stephens, 2003; Andriosopoulos and Hoque, 2013). Therefore, this study predicts that there is a positive correlation between SIZE and share repurchase decisions. SIZE is defined as the natural logarithm of total asset.

Previous studies have proved that dividends have a substitution function with share repurchase (Yarram, 2014; Henry, 2011). However, DeAngelo *et al.* (2000), Dittmar (2000) and Dennis and Osobov (2008) found no statistical proof of the substitution function between dividends and share repurchase. Other related studies, meanwhile, have proved the existence of a complementary function between dividends and share repurchase (Jain *et al.*, 2009; Mitchell and Dharmawan, 2007). Therefore, it can be concluded that dividends can have either a complementary (positive correlation) or substitution (negative correlation) function in relation to share repurchase. DPR is calculated by dividing dividend by net income. As employed by McNally (1999) and Andriosopoulos and Hoque (2013), this study also controls for dividend yield (DIV_YIELD); thus DIV_YIELD is measured by dividing the dividend per share by the share price.

RESULTS AND DISCUSSION

Descriptive Statistic Analysis

Table 1 provides the descriptive statistics of the variables employed in this study. The mean PBV for Indonesian companies is 2.58, which is quite high, while the means of ROE and EG are relatively low. This may occur because, as the denominator of PBV, the measurement of the equity's book value uses historical cost rather than replacement cost. Consequently, it generates a lower book value and higher PBV. By comparison, the mean of Indonesia's PBV is significantly higher than in other countries. Based on Wang *et al.* (2013), the mean of Taiwan's PBV is 0.97.

Table 1 Descriptive Statistics

Variable	Observation (N)	Value 1 (N=2,352)	Value 1 Percentage	Value 0 (N=2,352)	Value 0 Percentage
SR	2,352	81	3.44%	2,271	96.56%
CF_ADJ	2,352	747	31.76%	1,605	68.24%
Variable	Observation	Mean	Standard Deviation	Minimum Value	Maximum Value
PBV	2,352	2.583251	4.268489	0.07	37.39
ROE (%)	2,352	12.76055	21.60408	-62.3875	88.77712
RISK	2,352	0.1149646	0.0399985	-0.00083	0.251062
EG (%)	2,352	12.703	50.40004	-203.403	234.8356
UV	2,352	0.0000021	3.682079	-35.1345	14.9621
UV1	2,352	-0.0000002	4.141639	-34.8547	10.90289
CASH	1,953	0.0561635***	0.0708617	0.000018	0.513372
CF	2,352	0.1557023***	0.2136487	-0.530014	0.96212
LEV (%)	2,352	31.15678***	32.0638	0	209.7072
SIZE	2,352	21.28002***	1.913085	14.1052	27.4695
DPR (%)	2,352	15.64464***	21.46396	0	84.10181
DIV_YIELD (%)	2,352	1.601079***	2.575305	0	12.066

Note: *** significantly different from zero (0) at 1% level. SR = dummy variable of repurchase decision; 1 for repurchase firms; 0 for non-repurchase firms; PBV = actual price-to-book value at period t-1; ROE = return on equity for period t-1; RISK = Beta estimated based on the Capital Asset Pricing Model (CAPM); EG = expected growth, measured by average net income growth for the period t-1 to t-3; UV = undervaluation measured by residual of periodic regression of equation (3); UV1 = undervaluation measured by residual of panel regression of equation (3); CASH = total cash balance divided by total assets at period t-1; CF = EBITDA divided by total assets at period t-1; CF_ADJ = dummy variable of cash flow, 1 for firm with higher cash flow than industry, 0 otherwise; LEV = total debt divided by total equity at period t-1; SIZE = natural logarithm of total assets at period t-1; DPR = dividend payment divided by net income at period t-1; DIV_YIELD = dividend per share divided by share price at period t-1.

The mean ROE is 12.76%, which is slightly higher than the RISK (Cost of Equity) mean of 11.49%. This indicates that, in general, Indonesian companies have marginal performance in creating company value since the return generated is only slightly higher than their cost of equity. The EG mean is 12.7%; this indicates quite high growth in Indonesia's net income. However, the growth is very volatile when considering the high standard deviation and extreme values of the maximum and minimum data.

UV is a proxy for undervaluation based on the residual of periodic regression. UV1 is a proxy of undervaluation based on the residual of panel regression; this incorporates the error of fixed-effect components. The high standard deviations of UV and UV1 reflect that some companies are either severely overvalued or undervalued.

Based on the descriptive statistical analysis, there are 81 share repurchase actions, which equates to 3.44% of the total observations. This demonstrates that in Indonesia it is not a common policy to repurchase shares and then distribute cash to shareholders, and this result is in contrast to other countries. For example, Wang *et al.* (2013) state that between 2000 and 2010 a total of 275 Taiwanese companies, equal to 23% of the total listed companies, repurchased shares. However, Korea has the same characteristic as Indonesia, where only 38 companies, equal to 5% of total listed companies, repurchased shares.

Further analysis of the descriptive statistics is required in order to compare the characteristics of repurchase companies (SR=1) with those of non-repurchase companies (SR=0). The comparison of the descriptive statistics proves only the different characteristics of the companies conducting/not conducting a share repurchase. In order to obtain more valid and powerful results, regression models are used to test the impact of the repurchase determinants on share repurchase.

Table 2 provides a comparison of the means of variables between repurchase and non-repurchase companies. When compared to those of non-repurchase companies, repurchase companies have significantly higher UV1 means. This indicates that those companies undertaking a repurchase tend to undervalue their share prices more, especially when undervaluation is measured relatively across time and other companies' share prices. Repurchase companies also have higher cash holdings and, more specifically, they have higher industry-adjusted cash flows.

Table 2 Comparison of the Means of Variables between Repurchase Firms and Non-Repurchase Firms

	Mean			Mean	
	SR=1	SR=0		SR=1	SR=0
UV	0.296	-0.011	CF_ADJ	0.543***	0.309
UV1	0.799*	-0.028	LEV (%)	24.863*	31.381
PBV	2.286	2.594	SIZE	22.283***	21.244
CASH	0.068	0.056	DPR (%)	26.135***	15.270
CF	0.185	0.155	DIV_YIELD (%)	1.913	1.589

Note:*** significantly different from the mean of non-repurchase companies at the 1% level.

** significantly different from the mean of non-repurchase companies at the 5% level.

* significantly different from the mean of non-repurchase companies at the 10% level.

When compared to non-repurchase companies, repurchase companies have significantly lower LEV means. The means of SIZE and DPR of repurchase companies are also significantly higher than those of non-repurchase companies. This therefore suggests that repurchase companies are larger in size, have lower percentages of debt and higher dividend payouts.

Regression Analysis

In equation (3), the regressions are performed annually and pooled between 2009 and 2015. Table 3 provides the results. The panel regression operates by using the fixed-effect method based on the Hausman and Breusch-Pagan tests. In general, in all the models all of the variables have similar significant effects on share repurchase. This is proved by the significant value of the F-stat. R^2 has an average value of 13%. The R^2 value is comparatively high in contrast to the 1% value in Vazquez, Valdes and Herrera's (2007) study of Mexican service companies. However, the R^2 value is significantly lower when compared to Dechow, Hutton and Sloan's (1998) research on American companies, with a value of 60%. A potential cause of the lower R^2 is due to the application of historical as opposed to forecast data for ROE and EG.

Table 3 Regression Results of Equation (3)

	Predicted Results	Cross-section							Panel
		2009	2010	2011	2012	2013	2014	2015	
ROE	+	0.06***	0.02**	0.01**	0.03***	0.01	0.03***	0.01	0.02***
RISK	-	-11.95*	-8.59**	-9.89*	-6.43*	-5.56*	-5.26	-8.49**	-2.30
EG	+	0.06***	0.02***	0.03***	0.01***	0.04***	0.002	0.001	0.03***
Observation		336	336	336	336	336	336	336	336
Prob. (F-Stat)		0.000	0.000	0.000	0.000	0.016	0.047	0.050	0.000
Adj R-squared		0.404	0.262	0.184	0.088	0.0219	0.0149	0.0143	0.076

Dependent variable = PBV. *** statistically significant at the 1% level ** statistically significant at the 5% level * statistically significant at the 10% level

Based on the regression result, in general, ROE and EG both have a significant and positive influence on PBV. On the other hand, RISK has both a significant and negative impact on PBV. The regression results are consistent with the predicted relationship based on Ohlson's (1995) model.

Table 4 summarises the regression results used to test hypotheses 1 and 2. All models have significant F-stat values, thus proving that all of the variables have significant stimulant effects on share repurchase.

Consistent with the hypothesis, the results show that, at the 10% significance level, UV has both a marginally significant and positive influence on share repurchase. High undervaluation thus increases the likelihood of share repurchase. The UV value is generated from the annual regression of equation (3). Hence, it suggests that the management's decision to repurchase is affected by an undervaluation of the company's share price relative to the values in other companies. Therefore, the regression results support the first hypothesis which states that undervaluation has a positive impact on the likelihood of share repurchase.

Also, at the 5% significance level, the UV and UV1 results have both a significant and positive correlation with share repurchase. The results suggest that the management considers undervaluation of the share price across time and relative to the values of other companies. This proves the first hypothesis since there is statistical evidence of both a significant and positive relationship between undervaluation and the likelihood of a share repurchase.

Based on the regression results, PBV does not have a significant effect on the likelihood of a share repurchase. The findings from Andriosopoulos and Hoque's (2013) UK study also show an insignificant effect. As explained in the previous section, theoretically, PBV does not fully reflect undervaluation since the variation in PBV is determined by the company's own underlying factors (i.e. expected profitability, risk and growth). Consequently, PBV as a proxy for undervaluation contains measurement error and thus lacks the ability to detect any significant influence of undervaluation on the likelihood of a repurchase.

In summary, when the study controls for the effect of underlying factors on PBV by using UV and UV1, undervaluation has a significant effect on the likelihood of a share repurchase. Thus, in order to improve the power of the study, future studies need to control for the effect of these factors on PBV.

Table 4 Regression Results of Undervaluation on the Likelihood of a Repurchase

	Predicted Results	UV	UV	UV	UV1	UV1	UV1	PBV	PBV	PBV
		CASH	CF	CF_ADJ	CASH	CF	CF_ADJ	CASH	CF	CF_ADJ
UV	+	0.09*	0.08*	0.09*						
UV1	+				0.11**	0.12**	0.13**			
PBV	-							-0.04	-0.04	
CASH	+	3.51**			3.48**			3.54*		
CF	+		0.07			0.24			0.01	
CF_ADJ	+			0.89***			0.92***			0.89***
LEV	-	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**	-0.01*	-0.01*
SIZE	+	0.55***	0.43***	0.44***	0.52***	0.41***	0.42***	0.52***	0.42***	0.42***
DPR	+/-	0.01*	0.02**	0.01**	0.01**	0.02***	0.01**	0.01	0.0174**	0.01
DIV_YIELD	-	-0.05	-0.05	-0.06	-0.06	-0.05	-0.06	-0.06	-0.05	-0.06
Observation		1,953	2,336	2,336	1,953	2,336	2,336	1,953	2,336	2,336
Prob. (F-Stat)		0.000	0.000	0.000	0.000	0.000	0.000	0.0004	0.001	0.000
Log likelihood		-277	-297	-293	-277	-296	-292	-279	-298	-294

Dependent variable = SR. *** statistically significant at the 1% level ** statistically significant at the 5% level * statistically significant at the 10% level.

CASH is proved to have both a significant and positive impact on the likelihood of a share repurchase. However, CF does not have a significant effect on the likelihood of a share repurchase. The findings from Andriosopoulos and Hoque's (2013) German study show that CF has an insignificant effect. However, the level of CF varies with the industry and thus does not fully reflect the excess cash flow. After CF is adjusted by the effect of the industry, the study finds that industry-adjusted cash flow (CF_ADJ) has both a significant and positive influence on the likelihood

of share repurchase decisions. Companies with greater cash flow relative to the industry are more likely to implement a share repurchase. In summary, with regard to CASH and CF_ADJ, the results are consistent with the prior studies mentioned in the previous section, i.e. companies with excess cash are more likely to conduct a share repurchase than companies with no excess cash.

Table 5 summarises the regression results of the interaction between undervaluation and cash holdings; this is the contribution made by this study. For the sake of brevity, only the results of the interaction variables are provided. With regard to the other variables, the results are consistent in substance with the results in Table 4.

Aligned with the third hypothesis, cash holding strengthens the effect of undervaluation on share repurchase if the measurements of the interaction variables are based on UV, UV1, CASH and CF_ADJ. When the interaction variables incorporate PBV and CF, the results provide no empirical evidence of a significant effect on the likelihood of a share repurchase. However, as explained earlier, both PBV and CF contain measurement errors and thus cannot be relied upon when testing the hypothesis.

To the best of our knowledge, this study is the first of its kind to document empirically that the impact of undervaluation on the share repurchase decision depends on the level of cash holding. The study's findings are consistent with Spence's (1973) proposed signalling theory and Myers and Majluf's (1984) pecking order theory. Since a share repurchase is costly, only firms with adequate levels of funding are able to conduct one to signal that their shares are undervalued. In addition, in line with the pecking order theory, companies prefer to use their own internal funding (excess cash) to finance their repurchase programmes.

Table 5 Regression Results of the Interaction between Undervaluation and Cash Holding on the Likelihood of a Repurchase

	Predicted Results	Coefficient		Predicted Results	Coefficient		Predicted Results	Coefficient
UVCASH	+	1.5827*	UVICASH	+	1.6279**	PBVCASH	-	-0.6221
UVCF	+	0.0270	UVICF	+	0.0477	PBVCF	-	-0.0517
UVCF_ADJ	+	0.3367**	UVICF_ADJ	+	0.1819**	PBVCF_ADJ	-	-0.0293

The results for the control variables are explained as follows. LEV has both a significant and negative influence on share repurchase in all regression models. This indicates that, given that they have relatively low levels of current debt, Indonesian companies repurchase shares in order to increase their levels of debt to their optimal levels. SIZE has both a significant and positive relationship with repurchase. This suggests that large companies have greater abilities to execute repurchase transactions. In general, DPR has both a significant and positive relationship with share repurchase. A positive coefficient shows that the dividend payment has a complementary function for share repurchase in Indonesia. There is an insignificant correlation of DIV_YIELD; this means that when taking action on share repurchase, Indonesian companies do not consider dividend yield.

Predicted Probabilities Test

A further test on predicted probabilities is required in order to evaluate the predicted probabilities of a share repurchase given the value of the independent variables. The independent variables tested are UV, UV1, CASH and CF_ADJ since these variables have significant effects on the regression tests.

Table 6 provides the results of the tests. For undervaluation, a value of zero signifies that the stock is fairly priced and is indexed to 100. The result shows that if the companies' stocks are undervalued, i.e. the value is greater than zero, the probability of a share repurchase is 26–98% higher relative to companies that are fairly valued, and 1.5–4 times higher relative to overvalued companies. Thus, the probability of a share repurchase increases as the level of undervaluation increases.

Table 6 Predicted Probabilities Test Results

Undervaluation		Cash Holding	
UV and UV1 Value	Index Probabilities SR=1	CASH Value	Index Probabilities SR=1
-6	49	0.1	100
-4	62	0.2	139
-2	79	0.3	193
0	100		
2	126		
4	158	CF_ADJ Value	Index Probabilities SR=1
6	198	0	100
		1	240

For cash holding, which is measured by CASH, a value of 0.1 is indexed to be 100. Table 4.6 shows that a higher CASH value results in a greater probability of a share repurchase. For example, the repurchase probability of a company with a CASH value of 0.3 is 93% higher than that for a company with a CASH value of 0.1. For cash holding, as measured by CF_ADJ, an index of 100 is assigned to companies that have lower cash flows relative to the industry average. Companies generating higher cash flows relative to the industry average (CF_ADJ equals to 1) have a 140% higher share repurchase probability than companies with lower cash flows relative to the industry average (CF_ADJ equals to 0). In conclusion, the test results indicate that companies with large cash holdings and whose shares are undervalued have a much greater probability of conducting a share repurchase than other companies.

CONCLUSION

This study has investigated the effect of undervaluation and cash holding on the likelihood of a share repurchase decision. The study has also examined whether the level of cash holding strengthens the positive impact of an undervaluation on the repurchase decision. Based on the test results, the study concludes that undervaluation has both a significant and positive influence on the likelihood of a share repurchase. This result supports the findings of previous studies and shows that Indonesian companies consider undervaluation relatively across time and across companies in terms of committing to taking action on share repurchase. In line with the findings of previous studies, this study also finds evidence that cash holding has both a significant and positive impact on the likelihood of a share repurchase. Furthermore, this study contributes to the research on the determinants of the repurchase decision by proposing and documenting that cash holding strengthens the positive effect of undervaluation on the likelihood of a share repurchase. This finding indicates that the rationale for a company's decision to conduct a share repurchase can be explained by signalling theory and pecking order theory. The study also contributes to the literature by proposing and demonstrating empirically that the more powerful and less demonstrative measure of undervaluation is PBV, which takes into account the effect of a company's underlying determinants on firm value (expected profitability, risk and growth).

The theoretical implication of this study for share repurchase is that the decision to conduct a share repurchase is determined jointly by the level of undervaluation and cash holding. In line with signalling theory, a signal must be costly to be credible. Since a share repurchase is quite a costly undertaking, only companies with adequate cash balances are able to conduct a share repurchase as a means of signalling the undervaluation of their stocks. Consistent with the pecking order theory, an ample cash balance is required in order to undertake a share repurchase, which is relatively more efficient than acquiring external funding.

This study has also generated a methodological implication. With regard to the use of PBV to measure the extent of undervaluation, studies need to adjust PBV by taking out the variations in PBV owing to its fundamental, underlying factors of predicted profitability, risk and growth. In order to use cash flow as a measure of cash holding, studies may need to control for the industry effect on the company's cash flow.

The practical implications of this study are as follows. Investors are able to detect companies with a high likelihood of a share repurchase by identifying undervalued companies with high cash holdings. They can thus manage their investment strategies to make a profit by entering into a long position in the stock before the company announces a share repurchase. For the company's management, they need to evaluate the degree of undervaluation and the level of cash holding in order to determine whether or not a share repurchase is warranted. Also, they are able to leverage the signalling hypothesis to further boost their company's value since the stock market will perceive the company to be undervalued in the event that a share repurchase is conducted.

The limitations of this study are as follows. The first limitation is the use of historical data as a proxy for future profitability and growth. Ideally, ROE and EG would be forecast; however, such forecast data is unavailable for the majority of Indonesian companies. Historical data contain measurement errors, thereby rendering those tests that employ it less efficient. The second limitation is that, when compared to Europe and the USA, there is a relatively low number of share repurchases in Indonesia. This results in a relatively small number of companies to sample that have repurchased shares. Sekaran and Bougie (2013) state that a relatively small sample size tends to result in an insignificant conclusion when testing a hypothesis. Both of these limitations tend to bias the results against supporting the hypothesis; however, they have only a relatively minor impact on the study since all of the hypotheses are statistically significant and supported.

In order to increase the total observations of share repurchase, further research needs to use a broader sample by including, for example, samples from various countries. In addition, the use of a cross-country study would enable a researcher to examine the impact of country-level factors on share repurchase decisions and would moderate the effect of undervaluation and cash holding on share repurchase decisions. In order to improve the accuracy of undervaluation, future studies need to employ forecast profit and growth.

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