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Does Investment Portfolio Affect Insurance Failure? Evidence from Indonesia

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The high failure rate of insurers would reduce customer confidence in the insurance industry, especially in emerging and developing countries. This research analyzes the impact of various types of investments and the overall portfolio on the insurers' probability of failure. Using an actual sample of fail and non-fail insurers in Indonesia, this research provides robust evidence of the insurer investment portfolio on the insurers' probability of failure. In line with the prior studies, our research also confirms that risk-based capital, size, and profitability are significant factors that affect an insurer's failure. However, we cannot find an association between macroeconomic indicators and the insurers' failure in Indonesia. The outputs of this research have several policy implications for the stakeholders, especially for the insurance authorities in developing countries.

Keywords: insurance, investment, probability of default, Indonesia.

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1. Introduction

Slow growth and penetration of insurance business in emerging and developing countries, such as Indonesia (World Economic Forum, 2019), can be caused by the high level of insurers' failure and outstanding liability of failed insurers. Hence, Indonesia law number 40/2014 has mandated the establishment of a policy protection program. The program is expected to cover the failed insurers' outstanding obligation to policyholders, therefore increasing the insurance industry's trustworthiness. However, the program will not solve the issue completely if the insurers' probability of failure is still high. Furthermore, the high probability of failure insurance at the end will impact the program's performance and sustainability.

One factor that can affect insurers' probability of failure is their investment behavior. However, only a limited of studies focus on the impact of insurers' investment and its impact on insurers' probability of default (e.g., Chen & Wong, 2004; Sharpe & Stadnik, 2007; Moreno et al., 2020), and mainly the sample of their study focus on the developed countries. Therefore, there is still a research gap in the study of the investment portfolio and insurers' probability of failure, especially in emerging and developing countries. In addition, previous empirical studies focus on evaluating the impact of investment performance (e.g., Chen & Wong, 2004; Eling & Jia, 2008) and certain insurers' investments on insurers' failure probability (Sharpe & Stadnik, 2007). Therefore, we fill this gap by simultaneously evaluating each kind of insurers' investment in time deposit, mutual fund, government bond, property, stock, company bond, and investment portfolio. Thus, this research aims to evaluate the association between insurers' investment portfolios and insurers' failure probability.

In addition to the impact of insurer's failure on the industry trustworthiness, at the macro level, insurer failure can impact financial system stability and eventually the economic condition (e.g., Shim, 2017). Therefore, to identify and mitigate insurance failure early in the future, since Trieschmann and Pinches, 1973 several studies have evaluated insurers' specific factors that can impact insurers' probability of failure. General and life insurers' probability of failure has been impacted by Insurers' profitability, liquidity, leverage, product mix, and investment performance (Sharpe & Stadnik, 2007; Caporale et al., 2017, BarNiv & Hersbarger, 1990, Chen & Wong (2004). Nevertheless, prior studies only evaluate the impact of investment performance and specific types of investment individually. Hence, to our best knowledge, we are the first study that evaluates the impact of each type of investment portfolio on the insurers' probability of failure.

Furthermore, prior studies also show that insurers' probability of failure is affected by the macroeconomic condition, especially for insurers in developed countries. The macroeconomic indicators associated insurers' financial distress and failures, such as wholesale price, loan from financial institutions, inflation, unemployment rate, and stock market return. (Caporale et al., 2017, Zhang & Nielson, 2015; Chen & Wong, 2004; BarNiv & Hershbarger, 1990). Following those studies, this research incorporates several macroeconomic indicators: inflation, Gross Domestic Product (GDP) Growth, equity composite index growth, and time deposit interest rate.

Different from other insurance industries in developed countries object to the prior studies, insurance Indonesia has unique characteristics with relatively low penetration and with no policy protection holders. This makes the identification of factors that can impact insurers' probability of failure even more important. Our research uses real data of non-failure and failure insurers in Indonesia from 2008 to 2019. Using failure insurers' data, we can make a clear line of actual failure insurance and observe their condition before being declared as failed insurance.

Our study first contributes to determining the impact of investment portfolio-specific factors on insurers' probability of failure. Unlike Stadnik and Sharpe (2007), we can evaluate the impact of each type of investment and investment portfolio on insurers' probability of failure. Hence, the study's outputs can give empirical evidence, which specific type of investment can contribute to insurers probability of failure. Next, this study also gives evidence of the impact of the specific insurers characteristic of actual solvability captured by Risk-Based Capital (RBC), size, profitability, and type of business on insurers probability of failure in an emerging and developing country. Furthermore, the outputs of this study also show whether the macroeconomic indicators affected insurers' probability of failure. For the regulator, our study can be the basis of existing and new regulations about the minimum or maximum investment in a specific type of investment. For the industry supervision and development policy, this research can contribute to the focus of supervision and development strategy to a specific type of insurance and size.

The rest of the paper is organized as follows. In Section 2, we provide the related literature, followed by the institutional setting in Section 3. In Section 4 and 5, we present and discuss the research method and empirical results, respectively. Finally, section 6 provides concluding remarks and policy implications.

2. Related Literature

Prior studies have widely analyzed insolvency and the probability of failure rates in the insurance industry (e.g., Trieschmann & Pinches, 1973, BarNiv Hershbarger 1990, Eling & Jia, 2018). At the macro and financial system stability level, a study of the insurance failure rate is important because the insurance industry also influences the financial system stability and the economic conditions (e.g., Shim, 2017). It becomes even more important in developed countries where insurance penetration is already high. On the other hand, by the nature of its business, the insurance industry provides a sense of security for individuals or business entities running their business. Trustworthiness is important for the emerging insurance industry in developing countries. However, studies of insurance failure rates in developing countries are still relatively limited.

Firm-specific factors affect insurance probability of failure. Using insurers in Australia, Sharpe and Stadnik (2007) showed that smaller insurance with lower profitability and cession rates are more likely to be distressed. They also showed that these insurers have more overseas business and long-tailed insurance lines. A more recent study from Caporale et al. (2017) found that liquidity, profitability, leverage are the significant factors of general insurance insolvency risk. BarNiv and Hershbarger (1990) show that change in product mix, asset mix, and gain/premium in the life insurance industry significantly affected insurances insolvency risk one year before. Furthermore, Chen and Wong (2004) found that firm size, asset mix, investment performance, and product mix affect life insurance financial health in Asia.

Specifically, Chen and Wong (2004) showed empirical evidence that investment performance affects insurers' financial distress. However, they did not elaborate on insurers' specific type of investment portfolio. Sharpe and Stadnik (2007), who used the logit model, found that insurers with financial distress are more likely to have a high insurance investment. On the other hand, they found that insurers with higher investment in listed and unlisted shares have low financial distress. A more recent study from Moreno et al. (2018) incorporated investment equity risk in determining insurers' solvency in Spain. They found that investment equity risk has an insignificant association with insurers' insolvency.

Previous studies also evaluate the association between insurers' probability of failure with macroeconomic indicators. Caporale et al. (2017) showed that macroeconomics factors such

as wholesale price and credit from the financial institutions are also important in determining general insurance survival risk. Their findings are in line with Zhang and Nielson (2013). They found that inflation and unemployment rates can contribute to general insurers' probability of default. Their study also incorporated financial market indicators. Therefore, it shows that the general insurance insolvency rate is positively and negatively related to stock market return and yield slope, respectively. On the other side, using insurance in Singapore as a sample, Chen and Wong (2004) only found a significant association between financially unstable insurance and interest rate level. Inline, BarNiv and Hershbarger (1990) found that Investment yield can predict insolvent insurers one year prior in the life insurance industry. Incorporated competition variable and stressed period in their sample, Moreno et al. (2018) found that concentrated market and economic crisis decreased insurers solvency margin. Rubio-Misas and Fernndez-Moreno (2017) showed that insurers' specific factors affect the regulatory solvency ratio in stressed and non-stressed periods. The factors are cost frontier efficiency, reinsurance utilization, premium growth, and form of stock insurers.

3. Institutional Settings: Insurance Exit Policy in Indonesia

In this study, we define insurer failure if the authority revokes the insurer's license. The revocation of insurers license refers to OJK regulation number 17/POJK.05/2017 concerning Procedures and Procedures for Imposing Administrative Sanctions in the Insurance Sector and Blocking Assets of Insurance Companies, Sharia Insurance Companies, Reinsurance Companies, and Sharia Reinsurance Companies. Insurers are subject to the license revocation sanction if they cannot solve the issue caused by the issuance of the administrative sanction, in the form of restrictions on business activities for a maximum period of three months for restrictions on all business activities.

Following the regulation, insurers are subject to administrative sanctions in first, second, and third warnings before being imposed with sanctions for limiting business activities. Insurers can be penalized with the first, second, and third warning letter by the authority if they cannot fulfill several regulations, including unable to maintain RBC above the threshold of 120%, unable to maintain Investment Adequacy ratio above the threshold of 100%, and maintain minimum equity which different based on the type of their business.

4. Methodology

4. 1. Data

To examine investment portfolio impacts on insurers' probability of failure. We use annual insurers data from 2009 to 2019 provided by Indonesia Financial Services Authority/Otoritas Jasa Keuangan (OJK). The insurers can be classified as domestic and foreign insurers as well as life and general insurers. The final sample comprises 131 insurers that consist of 16 failure insurers.

The variables of interest of insurers' investment portfolio are time deposit on total investment ratio, mutual fund on total investment ratio, Indonesia's government bond on total investment ratio, property on total investment ratio, stock on total investment ratio, and company bond on total investment ratio. Next, we use Risk-Based Capital reported by insurers to OJK, return on assets ratio, and the natural logarithm of total assets for the firm-specific characteristics. Domestic is a dummy variable, one for the insurer is a domestic insurer, and zero for the affiliated foreign insurer, while the general is a dummy variable for the type of insurer. One for the insurer is general insurance and zero for the life insurer. In addition, we use macroeconomic factors such as inflation, gross domestic product growth, Jakarta Stock Exchange composite index growth, and one-month time deposit interest as control variables.

Tabel 1 List of Variables

Variable	Definition	Source	Expected Sign
rbc	Risk-Based Capital (%)	OJK	-
rdep	Time Deposit Investment on Total Investment	OJK, Authors' calculation	-
rreksa	Mutual Fund Investment on Total Investment	OJK, Authors' calculation	-
rsbn	Government Bond Investment on Total Investment	OJK, Authors' calculation	-
rprop	Property Investment on Total Investment	OJK, Authors' calculation	+
rsi	Stock Investment on Total Investment	OJK, Authors' calculation	-
robli	Company Bond Investment on Total Investment	OJK, Authors' calculation	-
lnTA	Natural Logarithm of Total Assets	OJK, manually calculated	-
roa	Return on Assets	OJK, Authors' calculation	-
national	Domestic Insurance (Dummy)	OJK	-
general	General Insurance (Dummy)	OJK	-
inflation	Customer Price Index Growth	BPS	-
gdp	Gross Domestic Product Growth	BPS	-
grihsg	JSE Composite Index Growth (%)	JSE	-
tdint	One Month Time Deposit Interest	OJK	-

OJK: Indonesia Financial Services Authority
BPS: Badan Pusat Statistik (BPS) or Indonesia Statistics
JSE: Jakarta Stock Exchange

4. 2. Empirical Strategy

To examine investment portfolio impacts to insurers probability of default, following BarNiv and Hershbarger (1990), BarNiv and McDonald (1992), Lee and Uruttia (1996), Brockett et al. (1994), Cummins et al. (1999), and Chen and Wong (2004), Sharpe and Stadnik (2007), this research uses the logistic regression model. The logistic regression model is an econometric model suitable when the dependent variable is not a continuous variable but a binary variable. The logistic regression model in this research is as follows:

Model 1

$$Y_{i,t} = \alpha + \beta 0 \text{ rdep}_{i,t} \text{ or rreksa}_{i,t} \text{ or rsbn}_{i,t} \text{ or rprop}_{i,t} \text{ or rsi}_{i,t} \text{ or robli}_{i,t} \text{ or rbc}_{i,t} \text{ or lnTA}_{i,t} \text{ or roa}_{i,t}$$

$$+ \beta 10 \text{ inflation}_{t} + \beta 7 \text{ gdp}_{t} + \beta 7 \text{ grihsg}_{t} + \beta 7 \text{ tdint}_{t} + \varepsilon_{i,}$$

Model 2

$$Y_{i,t} = \alpha + \beta 1 \text{ rdep}_{i,t} + \beta 2 \text{ rreksa}_{i,t} + \beta 3 \text{ rsbn}_{i,t} + \beta 4 \text{ rprop}_{i,t} + \beta 5 \text{ rsi}_{i,t} + \beta 6 \text{ robli}_{i,t} + \beta 7 \text{ rbc}_{i,t} + \beta 8 \text{ lnTA}_{i,t} + \beta 9 \text{ roa}_{i,t} + \beta 10 \text{ inflation}_{t} + \beta 7 \text{ gdp}_{t} + \beta 7 \text{ grihsg}_{t} + \beta 7 \text{ tdint}_{t} + \varepsilon_{i,t}$$

$Y_{i,t}$ is a dummy variable of insurers i in time t. It takes a value of one for the failed insurer and zero otherwise. In Model 1, each type of investment is examined individually, while in Model

2, all type of investment is examined simultaneously. A positive sign of the coefficients, $\beta 0$ to $\beta 7$ means that the variable increases the odds ratio or the probability of failure divided by the probability of the non-failure.

5. Results

5.1 Descriptive Statistics and Correlation Matrix

Table 2 shows the descriptive statistics of all the insurers, the treatment group, and the control groups. The treatment group compromises failure insurers, while the control group includes the non-failure insurers. In the sample period, the average insurers' RBC is 939,33%%, relatively high compared to the regulatory threshold of 120%. It showed that, in general, the Indonesian insurance industry has higher solvency. However, the data show there is no significant difference between the treatment and the control group RBC. For the variables of interest, investment ratio in time deposit, mutual fund, government bond, property, stock, and company bond, the significant differences between the treatment group and control group only appear in time deposit, mutual fund, government bond, and property. Although time deposit is relatively safe investment, a higher ratio in the treatment group can be interpreted as distress insurers tend to maintain their liquidity and prioritize investing in a more liquid instrument such as a time deposit. Investment and mutual funds and government bonds are relatively safe investments as the control group chooses them. On the other side, property investment is higher in the treatment group. The descriptive statistics also show that the domestic insurers significantly have more observations in the treatment group.

Table 3 provides the correlation matrix of variables. *Rdep* is negatively correlated with *lnTA*. It could imply that relatively bigger insurer tends to diversify their investment to other than time deposit. Inline, *rdep* is also negatively correlated with *rreksa* and *rsbn*. However, *rdep* has a higher and positive correlation with the *general* insurer. It means that *general* insurer tends to invest in a time deposit and relatively has a lower investment in a mutual fund, as is shown by the negative relation between *rreksa* and general insurers.

Table 2 Description Statistics

	(1) Full sample mean	(2) Treatment mean	(3) Control mean	(4) Difference (3)-(2) b	p
rbc (%)	939.33	147.11	972.60	825.48	0.6469
rdep	0.48	0.64	0.48	-0.17	0.0001
rreksa	0.16	0.02	0.17	0.14	0.0000
rsbn	0.11	0.02	0.12	0.10	0.0000
rprop	0.02	0.06	0.02	-0.04	0.0000
rsi	0.08	0.11	0.08	-0.02	0.2340
robli	0.08	0.08	0.08	0.00	0.9688
lnTA	13.48	11.42	13.57	2.15	0.0000
roa	0.02	-0.10	0.02	0.12	0.0000
domestic	0.67	0.97	0.65	-0.32	0.0000
general	0.64	0.73	0.64	-0.09	0.1379
inflation (%)	4.29	3.73	4.31	0.58	0.0105
gdp (%)	5.40	5.61	5.39	-0.22	0.0018
grihsg (%)	12.46	12.37	12.46	0.09	0.9827
tdint (%)	7.17	7.83	7.14	-0.69	0.0001

	(1) Full sample mean	(2) Treatment mean	(3) Control mean	(4) Difference (3)-(2) b	p
N	1563	63	1500	1563	

Rbc is risk-based capital, *rdep* is time deposit on total investment, *rreksa* is mutual fund on total investment, *rsbn* is government bond on total investment, *rprop* is property on total investment, *rsi* is stock on total investment, *robli* is company bond on total investment, *lnTA* is natural logarithm on total assets, *roa* in return on assets, *domestic* is a dummy variable, one for domestic insurers and zero for foreign affiliated insurers, *general* is a dummy variable, one for general insurance and zero for life insurance, *inflation* is inflation, *gdp* is gross domestic product growth, *grihsg* is stock equity composite index growth, and *tdint* is one month time deposit interest.

Table 3 Correlation Matrix

	ciu	rbc	rdep	rreksa	rsbn	rprop	rsi	robli	lnTA	roa	domestic	general	Inflasi	gdp	grihsg
ciu	1														
rbc	-0.0116	1													
rdep	0.101***	0.0257	1												
rreksa	-0.129***	-0.0181	-0.585***	1											
rsbn	-0.137***	0.0210	-0.392***	0.0337	1										
rprop	0.122***	-0.0141	-0.0933***	-0.0520*	-0.0870***	1									
rsi	0.0300	-0.0189	-0.429***	-0.0300	-0.0836***	-0.0482	1								
robli	-0.00107	-0.0107	-0.304***	-0.0760**	0.0607*	-0.0611*	-0.0232	1							
lnTA	-0.239***	-0.0253	-0.611***	0.436***	0.255***	-0.00331	0.258***	0.137***	1						
roa	-0.166***	-0.137***	0.0176	-0.0335	-0.0494	-0.0509*	0.00433	0.0594*	0.178***	1					
domestic	0.132***	-0.0400	0.157***	-0.196***	-0.390***	0.115***	0.0595*	0.116***	-0.277***	0.0797**	1				
general	0.0375	-0.0513*	0.488***	-0.470***	-0.155***	-0.0257	-0.264***	-0.0116	-0.365***	0.195***	0.134***	1			
inflation	-0.0650*	0.0296	0.111***	-0.0491	-0.139***	-0.0386	0.0339	0.0309	0.0694**	0.0399	0.0161	0.00139	1		
gdp	0.0786**	-0.0193	0.0931***	-0.0531*	-0.0845***	-0.0264	0.00661	-0.0335	-0.185***	0.0103	0.0362	0.0355	-0.157***	1	
grihsg	-0.000646	0.00278	0.0100	-0.00257	-0.0209	-0.00425	0.00762	-0.0183	-0.0378	0.0126	0.0113	-0.000337	0.385***	-0.354***	1
tdint	0.0973***	0.0309	0.134***	-0.116***	-0.124***	-0.00117	-0.0295	-0.0302	-0.189***	-0.0170	0.0357	0.0207	-0.258***	0.128***	-0.507***

Ciu is a dumy variable, one for a failure insurer, zero for a non-failure insurer. *rbc* is risk-based capital, *rdep* is time deposit on total investment, *rreksa* is mutual fund on total investment, *rsbn* is government bond on total investment, *rprop* is property on total investment, *rsi* is stock on total investment, *robli* is company bond on total investment, *lnTA* is natural logarithm on total assets, *roa* in return on assets, *domestic* is a dummy variable, one for domestic insurers and zero for foreign affiliated insurers, *general* is a dummy variable, one for general insurance and zero for life insurance, *inflation* is inflation, *gdp* is gross domestic product growth, *grihsg* is stock equity composite index growth, and *tdint* is one month time deposit interest.

5.2 Empirical Results

Our research analyzes the impact of insurers' investment portfolio on insurers' probability of failure with logistic regression. The variables of interest are insurers' investment in time deposit, mutual fund, government bond, property, stock, and company bond, captured by the variables of *rdep, rreksa, rsbn, rprop, rsi*, and *robli*, respectively.

Table 4 Estimation of Logistic Regression for Insurers' Failure

	Model 1 Time Deposit	Model 1 Mutual Fund	Model 1 G.Bond	Model 1 Property	Model 1 Stock	Model 1 C.Bond	Model 2 All Variables
rbc	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
	(-4.46)	(-4.09)	(-4.35)	(-4.38)	(-4.40)	(-4.26)	(-3.93)
rdep	-0.240						0.089
	(-0.42)						(0.09)
rreksa		-5.155**					-4.437*
		(-2.21)					(-1.85)
rsbn			-7.234***				-6.334**
			(-3.18)				(-2.53)
rprop				2.932**			3.149*
				(2.18)			(1.63)
rsi					1.701**		1.437
					(1.92)		(0.97)
robli						0.160	0.777
						(0.15)	(0.59)
lnTA	-0.956***	-0.798***	-0.810***	-0.917***	-0.951***	-0.936***	-0.709***
	(-6.14)	(-5.42)	(-5.90)	(-6.63)	(-6.62)	(-6.53)	(-4.75)
roa	-1.522*	-1.773**	-1.978**	-1.564**	-1.485*	-1.578**	-1.826*
	(-1.87)	(-2.20)	(-2.14)	(-2.00)	(-1.89)	(-1.99)	(-1.82)
domestic	2.703***	2.727***	2.401**	2.593***	2.617***	2.708***	2.165**
	(3.52)	(3.56)	(3.12)	(3.39)	(3.37)	(3.49)	(2.95)
general	-0.049	-0.331	-0.116	-0.028	0.102	-0.087	-0.049
	(-0.12)	(-0.88)	(-0.31)	(-0.07)	(0.24)	(-0.23)	(-0.11)
inflasi	0.055	0.009	-0.030	0.061	0.041	0.047	-0.045
	(0.51)	(0.08)	(-0.27)	(0.56)	(0.38)	(0.44)	(-0.40)
gdp	0.254	0.224	0.108	0.250	0.234	0.252	0.091
	(0.87)	(0.77)	(0.35)	(0.84)	(0.81)	(0.87)	(0.29)
grihsg	0.002	0.003	0.001	0.003	0.002	0.002	0.001
	(0.39)	(0.42)	(0.11)	(0.47)	(0.35)	(0.40)	(0.15)
tdint	0.097	0.065	-0.011	0.119	0.093	0.091	0.003
	(0.68)	(0.46)	(-0.08)	(0.80)	(0.67)	(0.64)	(0.02)
constant	4.827	3.781	5.497	3.989	4.661	4.534	4.304
	(1.49)	(1.17)	(1.70)	(1.21)	(1.46)	(1.39)	(1.27)
R-sqr	0.3416	0.3546	0.3574	0.3486	0.3483	0.3413	0.3807
N	1561	1561	1561	1561	1561	1561	1561

The dependent variable is *ciu*, a dumy variable, one for a failure insurer, zero for a non-failure insurer. *rbc* is risk-based capital, *rdep* is time deposit on total investment, *rreksa* is mutual fund on total investment, *rsbn* is government bond on total investment, *rprop* is property on total investment, *rsi* is stock on total investment, *robli* is company bond on total investment, *lnTA* is natural logarithm on total assets, *roa* in return on assets, *domestic* is a dummy variable, one for domestic insurers and zero for foreign affiliated insurers, *general* is a dummy variable, one for general insurance and zero for life insurance, *inflation* is inflation, *gdp* is gross domestic product growth, *grihsg* is stock equity composite index growth, and *tdint* is one month time deposit interest. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table 4 shows that in model 1 and model 2, investment in mutual funds and a government bond is negatively associated with insurers' probability of failure. In contrast, investment in property and stock is positively associated with insurers' probability of failure. However, the association of investment in stock and probability of failure does not hold in model 2. The result is in line with the descriptive statistics. There is no significant difference in stock investment between the failure and non-failure insurers. Our result is inconsistent with Sharpe and Stadnik (2007). This inconsistency might be caused by the different behavior between the stock market in Australia and Indonesia, or while our result only focuses on the listed shares, Sharpe and Stadnik (2007) include listed and unlisted shares. Regarding property investment, our result is consistent with Sharpe and Stadnik (2007). Since property investments are relatively illiquid, the result implies that insurers with a bigger portion of investment in illiquid assets have a higher probability of failure.

Regarding the insurer characteristic factors, in line with prior studies, Pottier and Sommer (2002), Cheng and Weiss (2012), and Rubio-Misas and Fernndez-Moreno (2017), we also found that insurers with higher RBC, total assets, and return on assets have a higher probability of failure have. In addition, the domestic insurers have a higher probability of default than the affiliated foreign insurers. The findings suggest that the affiliated foreign insurers have better performance in Indonesia, consistent with Suryanto et al. (2020). Furthermore, we also find no significant difference in the probability of failure if the insurer is a life insurer or general insurer. The results are consistent in model 1 and model 2. On the other side, inconsistent with Zhang and Nielson (2015), we found that macroeconomics factors, inflation, gdp, equity composite index, and time deposit interest rate have an insignificant association with insurers' probability of failure. The different results could be caused by the penetration of the insurance industry in Indonesia's economy and financial market that is relatively low.

5.3 Robustness Check

Following Eling and Jia (2018), since our treatment observations are relatively smaller than our total observations, our first robustness check employs rare event logistic regression from King and Zeng 2001. The rare event logistic regression is expected to tackle the maximum likelihood estimation of the logistic model that could suffer from small-sample bias. Table 5 shows that the result of rare event logistic regression is consistent with the conventional logistic regression, except for the investment in property in model 2 that does not correlate with insurers' probability of failure.

For the second robustness check, we use one, two, and three years lag estimation for the logistic regression. The result is consistent with the investment in government bond one-year lag and for investment in property in one year, two and three years lag. Regarding the significance of the lag RBC, our result is consistent with Rauch and Wende (2015).

Table 5 Estimation of Rare Event Logistic Regression for Insurers' Failure

	Model 1 Time Deposit	Model 1 Mutual Fund	Model 1 G.Bond	Model 1 Property	Model 1 Stock	Model 1 C.Bond	Model 2 All Variables
rbc	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
	(-4.27)	(-3.91)	(-4.15)	(-4.19)	(-4.23)	(-4.07)	(-3.68)
rdep	-0.256						-0.052
	(-0.45)						(-0.06)
rreksa		-4.472*					-3.935*

	Model 1 Time Deposit	Model 1 Mutual Fund	Model 1 G.Bond	Model 1 Property	Model 1 Stock	Model 1 C.Bond	Model 2 All Variables
		(-1.93)					(-1.66)
rsbn			-6.196**				-5.441*
			(-2.74)				(-2.19)
rprop				2.937**			2.910
				(2.20)			(1.52)
rsi					1.729**		1.343
					(1.96)		(0.92)
robli						0.113	0.530
						(0.11)	(0.40)
lnTA	-0.927***	-0.776***	-0.790***	-0.884***	-0.920***	-0.905***	-0.685***
	(-6.00)	(-5.31)	(-5.80)	(-6.43)	(-6.44)	(-6.35)	(-4.64)
roa	-1.461*	-1.702**	-1.872*	-1.527**	-1.431	-1.510*	-1.605*
	(-1.80)	(-2.12)	(-2.04)	(-1.97)	(-1.83)	(-1.92)	(-1.62)
domestic	2.390***	2.401***	2.107**	2.285***	2.309***	2.391***	1.819**
	(3.14)	(3.15)	(2.76)	(3.01)	(2.99)	(3.10)	(2.51)
general	-0.083	-0.359	-0.156	-0.067	0.061	-0.127	-0.093
	(-0.21)	(-0.96)	(-0.42)	(-0.17)	(0.14)	(-0.33)	(-0.21)
inflasi	0.055	0.010	-0.026	0.058	0.040	0.047	-0.040
	(0.51)	(0.10)	(-0.24)	(0.54)	(0.38)	(0.44)	(-0.36)
gdp	0.241	0.208	0.100	0.233	0.224	0.234	0.078
	(0.84)	(0.72)	(0.33)	(0.79)	(0.78)	(0.81)	(0.25)
grihsg	0.002	0.002	0.001	0.003	0.002	0.002	0.001
	(0.41)	(0.41)	(0.12)	(0.48)	(0.36)	(0.40)	(0.15)
tdint	0.100	0.065	-0.005	0.121	0.096	0.093	0.010
	(0.70)	(0.47)	(-0.04)	(0.82)	(0.70)	(0.66)	(0.07)
constant	4.916	3.968	5.584	4.051	4.694	4.633	4.546
	(1.53)	(1.24)	(1.74)	(1.23)	(1.48)	(1.43)	(1.35)
N	1561	1561	1561	1561	1561	1561	1561

Ciu is a dumy variable, one for a failure insurer, zero for a non-failure insurer. *rbc* is risk-based capital, *rdep* is time deposit on total investment, *rreksa* is mutual fund on total investment, *rsbn* is government bond on total investment, *rprop* is property on total investment, *rsi* is stock on total investment, *robli* is company bond on total investment, *lnTA* is natural logarithm on total assets, *roa* in return on assets, *domestic* is a dummy variable, one for domestic insurers and zero for foreign affiliated insurers, *general* is a dummy variable, one for general insurance and zero for life insurance, *inflation* is inflation, *gdp* is gross domestic product growth, *grihsg* is stock equity composite index growth, and *tdint* is one month time deposit interest. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table 6 Lag Estimation of Logistic Regression for Insurers' Failure (Model 2)

	Lag One Year	Lag Two Years	Lag Three Years
Rbc	-0.002***	-0.002***	-0.002**
	(-4.43)	(-4.02)	(-3.23)
rdep	0.269	0.932	4.441
	(0.24)	(0.61)	(1.06)
rreksa	-3.305	-1.340	2.782
	(-1.42)	(-0.55)	(0.64)
rsbn	-6.034*	-3.593	2.989
	(-1.95)	(-1.04)	(0.58)
rprop	5.162**	7.375***	11.094**
	(2.42)	(2.79)	(2.02)
rsi	1.361	2.567	7.306
	(0.77)	(1.18)	(1.50)
robli	1.548	2.561	6.339
	(0.96)	(1.23)	(1.29)
lnTA	-0.663***	-0.712***	-0.767***
	(-4.23)	(-4.06)	(-3.55)
roa	-0.638	-0.792	-1.533
	(-0.55)	(-0.63)	(-0.97)
domestic	2.341**	2.236*	1.979
	(2.18)	(1.93)	(1.76)
general	-0.287	-0.034	0.860
	(-0.60)	(-0.07)	(1.29)
inflation	0.253	0.111	0.297
	(0.65)	(0.28)	(0.88)
gdp	-0.042	0.052	-0.525
	(-0.11)	(0.09)	(-0.75)
grihsg	0.004	0.006	0.002
	(0.56)	(0.51)	(0.11)
tdint	-0.258	0.049	-0.332
	(-0.55)	(0.10)	(-0.70)
constant	4.257	1.796	2.994
	(0.98)	(0.35)	(0.45)
R-sqr	0.3168	0.2912	0.2778
N	1386	1228	1077

Ciu is a dumy variable, one for a failure insurer, zero for a non-failure insurer. *rbc* is risk-based capital, *rdep* is time deposit on total investment, *rreksa* is mutual fund on total investment, *rsbn* is government bond on total investment, *rprop* is property on total investment, *rsi* is stock on total investment, *robli* is company bond on total investment, *lnTA* is natural logarithm on total assets, *roa* in return on assets, *domestic* is a dummy variable, one for domestic insurers and zero for foreign affiliated insurers, *general* is a dummy variable, one for general insurance and zero for life insurance, *inflation* is inflation, *gdp* is gross domestic product growth, *grihsg* is stock equity composite index growth, and *tdint* is one month time deposit interest. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

6. Conclusion and Policy Implication

We empirically analyze insurers' investment portfolio association with insurers' probability of failure. By using a treatment group and control group, including non-failure and failure, we use logistic regression and rare event logistic regression to investigate insurers' investment portfolios' impact on the probability of failure. Using the insurance industry's panel data in Indonesia from 2009 to 2019, we show robust evidence that insurers' investment share affects their probability of default. In line with prior studies (Pottier & Sommer, 2002; Rubio-Misas & Fernndez-Moreno, 2017), we also find that insurers' specific characteristics, RBC, total assets, and profitability are negatively associated with insurers probability of failure. In addition, our results show that domestic insurers have a higher probability of default than affiliated foreign insurers.

Specifically, we find that insurers' investment in mutual funds and government bonds is negatively associated with insurers' probability of failure. On the other side, investment in property and stock increase insurers' probability of failure. Our result in property investment, in line with Sharpe and Stadnik (2007). However, we find different findings regarding stock investment. However, we find different findings regarding stock investment. This inconsistency can be caused we only focusing on listed shares, while Sharpe and Stadnik (2007) focus on both listed and unlisted shares or because of the different behavior of the stock market in Australia and Indonesia. In the context of profitability of failure in our sample, these findings imply that investment in mutual funds and government bonds tends to be safer than investing in property and stock. Furthermore, our findings also show that an increase in RBC, total assets, return on assets, investment in government bonds and property can be an early sign of insurers' probability of failure in the future.

Our findings implied several policy implications. First, our study supports Indonesia Financial Services Authority/Otoritas Jasa Keuangan's (OJK) effort to enforce the supervision of insurers' investment strategy, especially in illiquid assets. Next, this study supports PJK's policy that required insurers to maintain a minimum investment in government bonds of their total investment. The findings also implied that the regulator and industry need to focus more on developing domestic insurers since they have a higher probability of default than the affiliated foreign insurers. Furthermore, since our study shows no significant association of macroeconomic indicators with insurers' probability of default, our study also implies that insurance domestic in Indonesia needs to increase their size and penetration, including through various literation efforts that the authority has done.

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