**Idiosyncratic Tail Risk and Stock Return in Indonesia**

**Abstract**

Idiosyncratic tail risk explains about the financial crisis which happened due to idiosyncratic risk. It could also be used as a factor for asset pricing, making it necessary to be further studied since it could help protect investors from extreme incidents that could bring loss. We investigate the effect of idiosyncratic tail risk to the stock return in Indonesia. The data of daily stock price of 662 public companies in Indonesia that was registered in Indonesia stock exchange (IDX) are used during the period of 2006-2018. The results show that idiosyncratic tail risk has negative effects on the stock return in portfolio level, but not in individual level.

**Keywords** : Asset Pricing, Generalized Extreme Value Distribution, Idiosyncratic tail risk.

**JEL Classification**: G120

1. **Introduction**

After Ang et al., (2006; 2009) showed negative effects of idiosyncratic risk to the stock return, so many evidences of effects of idiosyncratic risk and returns was found. Ang et al., (2006) showed that this idiosyncratic volatility strong negative effects on the stock return after controlling momentum, size, liquidity, short term reversal etc. Furthermore, as Hou and Loh (2016) showed that all most all the research results support the idiosyncratic volatility puzzles and tried to explain the idiosyncratic volatility with various types of firm specific and behavioral related factors.

Simultaneously, some researchers, such as Bali et al., (2011), try to find a proxy of idiosyncratic volatility that can show the main components of idiosyncratic volatility. Bali et al., (2011) proposed highest daily return in one month (MAX) as the proxy for the idiosyncratic volatility. They showed that the MAX could be reduced the negative effects of idiosyncratic volatility to the stock return.

On the other hand, even if Ang et al., (2009) showed the strong evidences that the positive effects of idiosyncratic volatility to the stock return using international market, contradictive results, Idiosyncratic volatility (IV) has positive effects to stock return, have been found. Fu (2009) estimated idiosyncratic volatility using Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) showed that stocks with higher idiosyncratic risk have positive effects on expected return in Spanish stock market. Higher IV stocks compensate for 1% greater return in a month.

Miralles-Marcelo et al., (2012) also showed positive effects of IV to the stock return. They mentioned their controversary results were produced because they apply different asset pricing model to estimate idiosyncratic volatility with Ang et al (2006; 2009). Fu (2009) and Miralles-Marcelo et al., (2012) showed that if we change the method to estimate idiosyncratic risk, relation between idiosyncratic risk and stock return can be change.

Furthermore, Long et al., (2018) proposed idiosyncratic tail risk (ITR) as a alternative measure of idiosyncratic risk. They showed that ITR had negative effects on stock return. However, ITR can not weaken the negative relationship between IV and stock return in Chinese stock market. Instead, the negative effects of the ITR are weakened in the Fama-MacBeth regression when they included IV as one of the control variables.

On the other hand, some emerging markets did not show idiosyncratic volatility puzzle. Nartea et al., (2011) found that IV had positive effects on stock return in Malaysia, Singapore, Thailand, and Indonesia stock market. Pudjianto &Wibowo (2019) also found the same result in Indonesia stock market. Even if their findings could be explained the results based on risk-return trade-off based on under-diversification (Levy, 1978; Merton, 1987; and Xu and Malkiel, 2002), they did not show reasons why investors always under-diversify their portfolio than other markets.

The developments of different methodology to estimate idiosyncratic risks gives opportunities to review the effects of idiosyncratic risk to the stock return, especially for the market that did not show idiosyncratic volatility puzzle. Then, we try to apply different method that used by Long et al., (2018) using ITR to re-exam effects of the idiosyncratic risk to the stock return in Indonesia stock market. It is more interesting just because Indonesia stock market fail to show ‘idiosyncratic volatility puzzle (Nartea et al., 2011, Pudjianto & Wibowo, 2019), ITR may show the relative effects of ITR as alternative measurement of idiosyncratic risks to the stock return.

The main result shows that idiosyncratic risks which is estimated using ITR has negative effects on the stock return in portfolio level. On the other hand, the firm level regression results using Fama-MacBeth have negative coefficient but statistically insignificant. However, our research results clearly show that when we estimate idiosyncratic risk using different method, puzzle that was originally raised by Ang et al., (2006) can be found also in Indonesia.

The following part of the papers will be written as follows. We will develop the hypothesis based on the idiosyncratic risk which is estimated using ITR has negative effects on stock return. Then we explain the data and methodology. After that we show the empirical results based on time series and cross-sectional regression.

1. **Hypothesis Development: ITR and Stock Return**

Tail risk is defined as the risk of price of an asset or portfolio can fluctuates more than three times the standard deviation. Conceptually, tail risk shows in events with very small possibility since it is located at the right or left end of the distribution. Tail risk is different from common volatility which is focuses on total risk and focuses extreme changes that appears higher moments. Then tail risk could avoid the potential of incompatibility of normal distribution that did not give attention to higher-order-moments. Due to this, tail risk is considered as the proper way to calculate risk in times when investors want to avoid a crisis or extreme events. Thus, idiosyncratic tail risk implies huge fluctuations as a part of idiosyncratic risk. Bali et al., (2014) showed an interest in knowing the effect of tail risk toward expected return. Huang et al., (2012) showed that firm-specific extreme downside risk or left tail risk had positive effect to expected return. These results was further supported by empirical results by Kelly and Jiang (2014).

However, Long et al., (2018) showed opposite results compared to those of Huang et al., (2012) and Kelly and Jiang (2014). They found that idiosyncratic tail risk has negative effects on expected return which they called as “idiosyncratic tail risk puzzle.” Estimating method from Long et al., (2018) can show negative effects on stock returns because ITR capture well the factors that have negative relation between IV and stock return. This ITR may be related with maximum daily return (MAX, Bali et al., 2011), and/or other firm specific factors such as low-book-to market ratio (Barinov, 2013). If ITR is the better measurement of idiosyncratic risk in certain market, ITR can have negative effects to stock returns. Even if Indonesia stock market fail to show ‘idiosyncratic volatility puzzle (Nartea et al., 2011, Pudjianto & Wibowo, 2019), ITR may show the positive effects of ITR as alternative measurement of idiosyncratic risks to the stock return.

**H1: Idiosyncratic tail risk (ITR) has negative effects to the stock return.**

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1. **Data and Methodology**

## Data

The data used in this research is the data of daily stock price of public companies registered on the Indonesia Stock Exchange from 2006 to 2018. In addition to the daily stock price, in the calculation of idiosyncratic tail risk, risk-free rate data, MKT factor, SMB, and daily and monthly HML were also needed. In order to calculate the control variable, monthly trading volume data, market capitalization, and the amount of outstanding shares were needed. Data that was obtained was data from 662 different companies in Indonesia within a period of 156 months which fulfills the criteria of having at least 10 days of trading day in a month. All the data got from S&P Capital Intelligence.

## 3.2 Estimation of Idiosyncratic Tail Risk (ITR)

Estimation of idiosyncratic tail risk was done based on the studies done by Huang *et al.* (2012) and Long *et al.* (2018), which was done by following these steps:

### First of all, for every stock i on every month, run the regression using the Fama-French three factor model (Fama and French,1993).

$$R\_{i,t} – r\_{f,t} = α\_{i} + β\_{i}^{MKT}\left(MKT\_{t}-r\_{f,t}\right)+β\_{i}^{SMB}SMB\_{t}+β\_{i}^{HML}HML\_{t}+ε\_{i,t}$$

where $R\_{i,t}$ is daily stock return *i* on day *t*, $r\_{f,t}$ is daily risk-free rateon day *t*, $MKT\_{t}$ is daily market return on day *t*, $SMB\_{t}$ is risk factor based size on day *t* and $HML\_{t}$ is risk factor based on book-to-market ratio on day *t*. Residuals of regression, $ε\_{i,t}$**,** are used as the idiosyncratic returnfor stock *i* on day *t*.

### Then, for each stock i for every month t, idiosyncratic tail risk is estimated from idiosyncratic return for 3 years until t-1 month. After that, we apply block minima method to get 20 minimum idiosyncratic return for each stock and for each month. The chosen observations are donated as $x\_{1},x\_{2},…,x\_{n}$. These chosen minimum idiosyncratic retruns are composed of our extreme sample.

### Based on each chosen extreme idiosyncratic stock returns for every month, maximum likelihood method is applied to estimate the tail index or the tail on the Generalized Extreme Value Distribution.

$$I\left(μ,σ,ξ\right)=-n logσ-\left(\frac{1}{ξ}+1\right)\sum\_{i=1}^{n}log\left(1+ξ\frac{X\_{i}-μ}{σ}\right)-\sum\_{i=1}^{n}\left(1+ξ\frac{X\_{i}-μ}{ξ}\right)^{-\frac{1}{ξ}}$$

where $1+ξ\frac{X\_{i}-μ}{σ} >0$. The result of this estimation is idiosyncratic tail riskfor stock *i* every month *t* notated as $ITR\_{it}=\hat{ξ}$.

## Operationalization of Control Variables

The control variables are used to control the effect of other risk factors which influence on the stock returns. All control variables are calculated monthly. These are the control variable being used as Long et al., (2018):

* Market beta (BETA): Each stock’s systematic risk of the market is defined as the beta in CAPM at least three years monthly data.
* Market capitalization (SIZE): Firm size is defined as the log(market capitalization). The market capitalization is calculated by stock price times number of outstanding shares at end of previous June.
* Book-to-market (BM): Book-to-market is defined as the log(book-to-market) at the end of the last year.
* Momentum (MOM): Momentum is defined as stock returns during 11 months from t-12 to t-2.
* Short-term reversals (REV): Short-term reversals is defined as one-month stock return t-1.
* Illiquidity (Amihud): Illiquidity is defined as the ratio of the absolute stock return to trading value in rupiah terms using monthly frequency and multiply 1010.
* Co-skewness (Coskew): The Co-skewness is defined as the third standardized cross central moment from the individual stock return and the market return.
* Co-kurtosis (Cokurt): the Co-Kurtosis is defined as the fourth standardized cross central moment from individual stock return and market return.
* Idiosyncratic volatility (IV): Monthly idiosyncratic volatility of each stock is defined as volatility of the daily residual returns of each stock for each month from the Fama–French 3 factors model.
* Idiosyncratic skewness (Iskew): Idiosyncratic skewness of each stock for each month is defined as the skewness of the daily residual returns for each stock for each month from the Fama–French three factors model.
* Idiosyncratic kurtosis (Ikurt): Idiosyncratic kurtosis of each stock for each month is defined as the kurtosis of the daily residual returns of reach stock for each month from the Fama–French 3 factors model.
* Maximum daily return (MAX): Maximum daily return is defined as the highest daily return during the previous month for each stock.

## Univariate Time Series Analysis

Univariate time series analysis was done using several steps: All companies were sorted and divided into 5 portfolios (quintile portfolio) based on idiosyncratic tail risk (ITR), Then, monthly equal-weighted return and value-weighted return portfolio was calculated and along with their average. This equal-weighted and value weighed stock return are used as dependent variables for each portfolio. After that, sixth portfolio was made which was the difference in return between the high and low idiosyncratic tail risk portfolio. Later, the alpha from CAPM and Fama-French Three Factor Model (FF3) was calculated from the portfolio that had been divided.

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## Firm-level Fama-MacBeth Regression

Firm-level cross-sectional regressions were done by following the Fama-Macbeth regression model (1973):

$$R\_{i,t+1}=λ\_{0,t}+λ\_{1,t}ITR\_{i,t}+λ\_{2,t}BETA\_{i,t}+λ\_{3,t}SIZE\_{i,t}+λ\_{4,t}BM\_{i,t}+λ\_{k,t}Other risk measures\_{k,t}+ε\_{i,t}$$

where $R\_{i,t+1}$is return for i on the month *t*+1 and independent variable is ITR, BETA, SIZE, BM dan other control variable on previous months.

The regression was run for every month stock return on ITR without and with other control variables until 14 times. When we estimate the value of $λ\_{1}$ and other parameter to remove the violation of homoskedastic assumption, we adjust standard deviation using White’s heteroskedastic robust method. We expect $λ\_{1}$ has negative effects to the stock return to prove our hypothesis.

1. **Empirical Results**

## Descriptive and Correlation Statistics

Table I shows the statistical descriptive analysis result done to the monthly value of stock return and the risk factors included were ITR, BETA, SIZE, BM, Coskew, Cokurt, IV, Iskew, and Ikurt from 12,784 observation. It also also shows that the monthly stock return has more than 3 curtosis. Normal distribution has the number of curtosis equal to 3. Thus, it could be concluded that the monthly stock return does not have normal distribution. In addition, it was found that the BETA value had the average value of 0.5844. The average value of BETA was supposedly to show the market BETA value which is 1.00. The difference in the BETA value was caused by using daily data of each company on this research to do the calculation. The use of daily data caused underestimation because non-synchronous trading of the individual stock tends to reduce the covariance between a individual stock and the market. Therefore, the BETA value obtained is less than the supposedly market BETA value which is 1.00.

Table I

**Descriptive Statistics**



It is also found from Table I that there are negative BM values. This is caused by using the logarithmic function in the calculation of the SIZE and BM variable from the market capitalization data and book-to-market ratio. The use of logarithmic function resulted in negative value if the market capitalization and book-to-market ratio is greater than 1. Calculation using logarithmic function was done to create the skewness and kurtosis variable of SIZE and BM to have reasonable values.

Table II

Correlation between ITR and Other Risk Variables



Note: Numbers inside brackets are *t* statistical value. Symbol \*, \*\*, and \*\*\* shows the significance level of 10%, 5% dan 1%, respectively.

Table II shows the result of the correlation average in the cross-section between ITR and other risk factors. Correlation between ITR and SIZE, IV and Max is -0,1074, -0,1643 dan -0,1352, respectively. Correlation between ITR and those three factors are three highest correlation values even though they are not significant statistically. Absolute statistical value *t* which is the correlation result between ITR and IV is -1,8195. This value is close to 1,96 which is the statistical value of *t* if *α* = 5%. ITR itself explains the information found on the distribution tail, where IV explain the information completely. Therefore, it could be stated that ITR and IV have different information since no relation was found between the ITR and IV. The same conclusion applies between ITR and the other risk factors.

## Univariate Fama-French Analysis

Table III shows that there are signs that indicate the presence of "idiosyncratic tail risk puzzle" on this research. The last column for panel A shows the difference of portfolio stock return between the portfolios with high and low ITR has negative values, but it is not significant. The average of portfolio also tends to decrease with the increase of ITR. In addition, CAPM alpha and FF3 alpha of panel A, shows a significant difference. The difference between High-Low ITR is 0,92% per month and significant in 5% with t-statistic -2.3. Abnormal return from low to high ITR from both CAPM and FF3 tends to decrease monotonically. Thus, We can conclude that in the portfolio-level analysis, we find "idiosyncratic tail risk puzzle" or negative effect from idiosyncratic tail risk toward return in Indonesia. Our finding showed the same results with Long et al., (2018) who used the Chinese stock market data. This results also show possibility that in Indonesia stock market, ITR is more representative as a proxy of idiosyncratic risk.

## On the other hand, Panel B from Table II showed that there is no idiosyncratic volatility effects on the stock return in Indonesia market. This result is contractive with Ang et al., (2006;2009), and Bali et al, (2008; 2011). However, this result is consistent with Miralles-Marcelo et al. (2012) in Spanish market and Nartea et al., (2011) dan Pudjianto & Wibowo (2019) in Indonesia stock market. Idiosyncratic risk estimated with IV have positive effects on stock return. Even if the difference of high-low portfolio is not significant statistically, coefficient from low to high IV portfolio tends to increase.

## Firm-level Fama-MacBeth Analysis

This section was focused to see the effects of ITR on the stock return using Fama-Macbeth regression. The calculation result on Table IV indicates that ITR has no significant role in stock return. However, all the

Table III

Effects of ITR (IV) to the Stock Return in Portfolio Level



Note: Numbers inside brackets are t statistic value. Symbol \*, \*\*, and \*\*\* shows the significance level of 10%, 5% dan 1%, respectively.

coefficient of the ITR has consistently negative sign. It means that after controlling risk factors such as BETA, SIZE, and BM, the risk factors reduce the effects of the ITR to the stock return. Simultaneously risk factors also do not affect to the expected return. This could be shown from the t-statistic of all risk factors do not significant in 5% significant level.

The calculation result on Panel B in Table IV shows that by doing Fama-Macbeth cross-sectional regression on ITR, BETA, SIZE, BM, and risk factors of systematic risk, does not result in any factor that significantly affect the cross sectional expected return. The same result is also shown on Panel C in Table IV, which shows no factor that significantly affects the expected return.

Based on the results from IV Table, it can be said that even if ITR has the negative coefficient from all regression models but that number is not significant statistically. This indicates that ITR in individual level cannot show idiosyncratic tail risk puzzle. This result is consistent with Long et al., (2018). However, idiosyncratic volatility (IV) also does not have significant effects to the stock return. This result is contradictory to the evidence form Pudjianto & Wibowo (2019) and Nartea et al., (2012). They showed that positive relationship between IV and stock return. Perhaps this contradictory result comes from different period of data.

## **Conclusion**

In this research, there are two methods of analysis being done which are univariate Fama-French analysis and firm-level Fama-MacBeth regression. The research focused on the influence of idiosyncratic tail risk to

Table IV

Panel A: ITR Effects on Stock Return After Controlling Various Risk Factors

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Panel B: ITR Effects on Stock Return After Controlling Various Risk Factors

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Panel C: ITR Effects on Stock Return After Controlling Various Risk Factors

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Note: Numbers inside brackets are t statistical value. Symbol \*, \*\*, and \*\*\* shows the significance level of 10%, 5% dan 1%, respectively.

stock return in Indonesia in the period of 10 years with 662 companies involved could be concluded that idiosyncratic tail risk has a significant negative effect to the stock return in Indonesia in portfolio level. However, the result of firm level Fama-MacBeth shows idiosyncratic tail risk has no effect to the stock return in Indonesia. Then, it can be said that idiosyncratic tail risk factors contain information that are not present in other idiosyncratic risk factors at least portfolio level.

Further analysis can be done by making portfolios based on other controlled variables, using bivariateportfolio-level analysis. It is needed to be investigated that the relation idiosyncratic tail risk with certain firm specific factors like investment and cash flows of the firm.

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