

STOCK PORTFOLIO PERFORMANCE BASED ON STOCK VOLATILITY: A STUDY OF INDONESIA STOCK MARKET

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ABSTRACT

The aim of the study was to investigate the relevancy of capital asset pricing model (CAPM) in Indonesia. CAPM states investor who has willingness to take higher risk should compensate with higher return as compensation. Hypothesis testing uses the one sample t-test to validate the return portfolio is not equal to zero. The result of the study revealed that portfolio with highest risk did not provide highest return. Supposition of the results is because limitation of CAPM theory (frictionless market and everyone has risk averse profile). This creates low risk anomaly phenomenon in Indonesia stock market which lower risk portfolio can provide higher return and contractive monetary policy magnify the portfolio performance differences.

Penelitian ini mengkaji relevansi teori *capital asset pricing model* (CAPM) di Indonesia bahwa investor yang bersedia menanggung risiko yang lebih tinggi akan mendapatkan tingkat pengembalian yang lebih tinggi sebagai kompensasi. Pengujian hipotesis return portofolio menggunakan *one sample t-test* untuk membuktikan bahwa return portofolio tidak sama dengan nol. Hasil penelitian menemukan bahwa di Indonesia tidak terbukti portofolio dengan tingkat risiko yang paling tinggi akan memberikan tingkat pengembalian yang paling tinggi. Dari hasil penelitian ini dapat disimpulkan bahwa keterbatasan dalam teori CAPM (*frictionless market* dan semua investor *risk averse*) membuat adanya fenomena *low-risk anomaly* dalam pasar saham di Indonesia yaitu portofolio dengan risiko rendah, memiliki kinerja portofolio yang memberikan tingkat pengembalian yang lebih tinggi dan kebijakan moneter kontraktif mengakibatkan perbedaan kinerja semakin besar.

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1. Introduction

One key issue in wealth management business is finding an efficient portfolio solution for investors to achieve their financial goals. Capital Asset Pricing Model (CAPM) taught us that there is a positive relationship between portfolio risk and portfolio return, i.e. higher risk is needed to compensate for higher return taken. While risk-return trade-off as suggested by CAPM is well accepted both in academic and business community, empirical evidence shows contradictory result that challenge the theories. Empirical results shows that low risk stock produce higher return. Studies on US stock performance for 41 years, from January 1968 to December 2012, find that low risk portfolio, that being build based on stock's standard deviation and stock's beta, provide higher return than high risk portfolio (Baker, Bradley, & Wurgler, 2011). Studies in US stock market for period January 1967 to December 2012, global developed stock market for period January 1987 to December 2012 and in emerging stock market for period January 2002 to December 2012 find that low risk capital weighted portfolio provide higher return than traditional capitalization weighted portfolio (Chow, Hsu, Kuo, & Li, 2014). Studies in 23 developed market for period January 1980 to December 2003 find significant return differences between lowest risk quintile portfolio and highest risk quintile portfolio as large as 1.31% per month after considering world market factor, size factor and value factor (Ang, Hodrick, Xing, & Zhang, 2009).

Main contradictive empirical findings implication is market inefficiency because investors have not properly compensated for extra risk taken (Pyo & Lee, 2018). Attempts to explain the source of market inefficiency have a long history and not long after the CAPM being introduced. There are two main theoretical strand that explain low volatility anomaly. First strand discuss how market friction in the form of restricted borrowing create market inefficiency (Black, 1972). Restricted borrowing inhibit investor that have high risk appetite and high risk tolerance to build portfolio that have higher risk than currently available asset risk. It is more convenient to build portfolio consist of low risk stock and leverage the position than build portfolio consist of high risk stock. Second strand discuss how investment decision have significant impact to next period investment performance (Merton, 1973). This concept known as Intertemporal Capital Asset Model (ICAPM) that extend single period assumption in CAPM. Investor in the context of ICAPM have to consider whether stock investment return may deteriorate in the next period and how this changes in expected stock investment return will change stock volatility. Both deteriorating stock investment return and higher stock return volatility have adverse consequences to achieving investor's investment goals (Campbell, Giglio, Polk, & Turley, 2018). Facing with this potential risks, investor underweight higher risk stock and overweight lower risk stock. Both mentioned theory have same consequences, lower risk stock will have higher demand than higher risk stock, *ceteris paribus*, and lower risk stock will have higher return than higher risk stock but both theory have different cause for low risk anomaly.

Based on our research on stock volatility using restricted borrowing is not yet being done in Indonesia. We use CAPM with restricted borrowing which contribute to low volatility anomaly empirical finding by updating through extending empirical findings from (Baker & Haugen 2012) studies in Indonesia stock market from 1990 to 2011 to more recent period 2006 to 2015. We modify the methodology by using longer volatility measure, from 2 year volatility data to 5 year volatility data, and higher data frequency measure, from monthly volatility data to weekly volatility data. Furthermore, we also analyze the impact of Bank Indonesia monetary policy to performance of stock with different volatility groups. Based on above statements, research question that we proposed as follows:

1. How stock volatility affects to stock returns?
2. How monetary policy affects to portfolio performance that construct based on stock volatility?

There are three contributions from this paper, we can have better understanding of Indonesia capital market in CAPM restricted borrowing condition. Together with effect on monetary policy in CAPM restricted borrowing condition. We also use more robust time period from two years to five years when calculate stock volatility.

This research has purposed to advance Indonesia stock market by reveal phenomena in Indonesia stock market. We examine if the low volatility anomaly event also occurs in Indonesia. The result can be used for many type of investor risk profile when come to portfolio construction or stock

selection. If low volatility anomaly happened in Indonesia, then it is not relevant to invest in high risk stock to aim higher expected return as a compensation.

2. Literature review

Capital Asset Pricing Model build upon several assumptions such as (1) frictionless market, e.g. no restriction on borrowing and short selling, no transaction costs, no information costs, (2) investor are risk averse and based their investment decision solely to maximizing expected utility from assets return and risk only, and all assets will be held for one period only (Blitz et al, 2013). Violation in one or more assumption will violate CAPM risk-return predictions.

Capital market equilibrium with restricted borrowing mainly deal with lender imposing different restriction to investor that want to increase their portfolio risk using margin facility. Margin transaction is a two part transaction. First, securities company providing margin facility, i.e. lend cash, to investor in exchange for collateral, i.e. stock, and investor promises to pay interest rates for cash received. Margin facility typically involve overcollateralization, known as haircut. Different stock have different haircut percentage. The maximum margin facility provided is calculated using market price of asset times hair cut percentage. For example, stock has hair cut 50%. If we have equity Rp. 1 billion and we want to leverage investment position, then maximum stock exposure is Rp. 1.5 billion that consist of Rp. 1 billion of equity and Rp. 0.5 billion margin. Lender have the right to sell the collateral when collateral value decline below maintenance margin and investor fail to add additional collateral to maintain the maintenance margin. Second, investor sell the stock and use the proceed to pay off the margin and pay the interest as promised.

Size of haircut percentage determined by the financial condition of the borrower and the type of asset issued and the financial condition of the lender before and after margin transaction (Gorton & Holmström, 2013). When borrower financial condition is weak, lender may doubt borrower ability to add additional collateral and lender may forced to sell the collateral in the market. Research shows that margin facility have destabilizing effect and lender may be forced to sell collateral at fire sale price that lower than margin facility provided (Mitchell & Pulvino, 2012). This condition expose the lender to financial loss. When stock has high volatility, financial crisis will amplify the stock volatility. This condition also expose the lender to financial loss. Problem of providing margin facility not only lies in borrower, lender also part of the problems. When the lender provide margin facility, lender cannot sell the collateral if borrower could fulfill their obligation. This condition expose the lender to liquidity risk. Since margin facility is provided to multiple borrower, inability to sell collateral usually have negative repercussion effect to other collateral. Creating a negative dominos effect that may destabilizing lender financial conditions.

Margin facility risk deal with market liquidity. Central bank control market liquidity by setting monetary policy. An expansive monetary policy, central bank lower interest rates and provide additional liquidity to the market. When liquidity is high, margin facility risk is low, lender tend to reduce haircut percentage in order to gain more revenue. A contractive monetary policy, central bank increase interest rates and absorb liquidity from the market. When liquidity is low, margin facility is high, lender tend to increase haircut percentage in order to reduce liquidity risk.

Lender have different treatment to borrower depends on type of stock that they are buying. If borrower buy stock that have high volatility, lender will penalized the investment in the form of higher haircut percentage. If borrower buy stock that have low volatility, lender will provide incentive to the borrower in the form of lower haircut percentage. The implication is borrower have higher capabilities to increase risk using leverage when they buy low volatility stock as opposed to high volatility stock.

Since monetary policy have direct effect to haircut percentage, different monetary policy will have different effect to demand for low volatility stock and high volatility stock. An expansionary monetary policy will reduce the haircut percentage and borrowing restriction will be low. A contractionary monetary policy will increase the haircut percentage and borrowing restriction will be high. Hence demand for low volatility stock tend to be higher than high volatility stock in a contractionary monetary policy. The implication is low volatility stock have higher expected return than high volatility stock in an contractionary monetary policy than in an expansionary monetary policy.

3. Data and methods

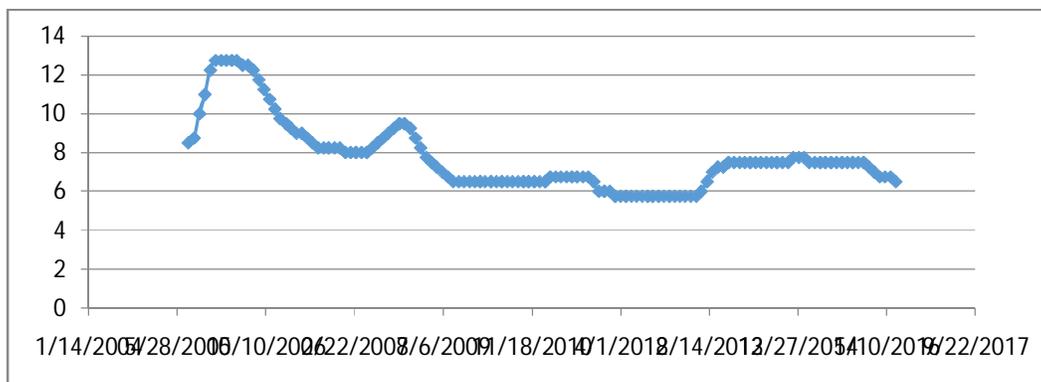
Data on weekly and monthly stock price obtained from Bloomberg Terminal over the 15 year period from January 2001 to December 2015. We calculate each stock standard deviation using weekly stock price change using 5 years data (January 2001 to December 2005) and excluding dividend and extreme price change i.e. more than 50% for one month return (January 2006 to December 2015). The samples have to meet the criterion to be included into portfolio construction. The standard deviation then ranked into quintile and equally weighted portfolios is created. First quintile represent the lowest 20% stock standard deviation and the fifth quintile represent the highest 20% stock standard deviation.

Portfolio performance measurement start from January 2006 to December 2015 based on capital gain only. We rebalance the portfolio to accomodate 5 year standard deviation change each month. For example, January 2006 portfolio created based on weekly stock standard deviation from January 2001 to December 2005 and February 2006 portfolio created based on weekly stock standard deviation from February 2001 to January 2006.

To test portfolio low volatility anomaly, we calculate each portfolio descriptive statistics, e.g. mean on monthly return, standard deviation, skewness, and kurtosis, return t-statistics, and Sharpe Ratio. There are two phase calculation. In first phase calculation, we do not consider monetary policy while in second phase calculation we do consider monetary policy. Definition of monetary policy, i.e. expansive and contractive, is based on Hughen and Beyer (2015) methodology that define changes in sign of 1 month Sertifikat Bank Indonesia interest rates change as a change in monetary policy. Based on this methodology, there are 8 period of monetary policy, 4 expansive monetary policy and 4 contractive monetary policy. Below is the period of each monetary policy for Januari 2006 to December 2015 period.

Table 1. Variable Operationalization

No	Name	Description
1	Monthly return	Percentage changes on ending value minus beginning value stock portfolio based on volatility
2	Portfolio 1	First quintile of stock portfolio that construct based on lowest to highest stock volatility
3	Portfolio 2	Second quintile of stock portfolio that construct based on lowest to highest stock volatility
4	Portfolio 3	Third quintile of stock portfolio that construct based on lowest to highest stock volatility
5	Portfolio 4	Fourth quintile of stock portfolio that construct based on lowest to highest stock volatility
6	Portfolio 5	Fifth quintile of stock portfolio that construct based on lowest to highest stock volatility
7	Expansionary Monetary policy	Period when 1 month Sertifikat Bank Indonesia interest rates decrease
8	Contractionary Monetary policy	Period when 1 month Sertifikat Bank Indonesia interest rates increase



Source: Bloomberg

Figure 1. One Month SBI Rate

Table 2. Monetary Policy Classifications Period

No.	Period	Length (Month)	Monetary Policy
1	January 2006 - April 2006	4 months	Contractive
2	Mei 2006 – April 2008	24 Months	Expansive
3	Mei 2008 – November 2008	7 Months	Contractive
4	December 2008 – January 2011	26 Months	Expansive
5	February 2011 – September 2011	8 Months	Contractive
6	October 2011 – Mei 2013	20 Months	Expansive
7	Juni 2013 – January 2015	20 Months	Contractive
8	February 2015 – December 2015	11 Months	Expansive

Source: Processed

Analysis technique

We use data from Bloomberg Terminal in examining the monthly return of different stock portfolio created based on stock standard deviation for the period of January 2006 to December 2015. We calculate the portfolio performance, after excluding extreme price change and not considering dividend, using standard descriptive statistic measures such as mean on monthly return, standard deviation, skewness, and kurtosis for each stock portfolio. Two phase analysis is performed as follows. Phase one, portfolio performance is calculated for period of January 2006 to December 2015 without consideration of the impact of different monetary policy to stock portfolio performance. Phase two, portfolio performance is calculated using the same methods and period but with consideration of the impact of different monetary policy, i.e. expansionary monetary policy and contractionary monetary policy, to stock portfolio performance.

4. Results and discussion

We find that low volatility stock tend to have higher portfolio return than high volatility stock both in without and with consideration of monetary policy. Portfolio performance without consideration of monetary policy is not monotonic. From table 3 and graph 2, we can see that portfolio with largest return is not the lowest volatility portfolio but second lowest volatility portfolio. The performance rank based on mean monthly return is portfolio 2, portfolio 1 (lowest volatility portfolio), portfolio 3, portfolio 4 and portfolio 5 (highest volatility portfolio).

There are large return differences valued at 0,77% per month between portfolio 2 as second lowest volatility portfolio with portfolio 5 as highest volatility portfolio and at 0,65% per month between portfolio 1 as lowest volatility portfolio with portfolio 5. Lowest and second lowest volatility portfolio have similar characteristics, (1) higher downside risk as shown by negative skewness 0,90 relative to negative skewness 0,18 for highest volatility portfolio and (2) portfolio 2 that have highest return is also have highest kurtosis 2.29 while portfolio 1 with lowest volatility

have kurtosis 1,13 and portfolio 5 with highest volatility have kurtosis 0,70. Sharpe ratio show monotonic results, lowest volatility portfolio have highest Sharpe ratio and highest volatility portfolio have lowest value Sharpe ratio.

Table 3. Result without considering monetary policy

	Lowest risk				Highest risk
	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5
Mean	1.00%	1.12%	1.10%	0.49%	0.35%
Standard Deviation	2.56%	4.63%	4.84%	4.34%	4.30%
t-stat	4.26	2.66	2.49	1.23	0.89
Skewness	-0.90	-0.89	-0.64	-0.37	-0.18
Kurtosis	1.13	2.29	1.16	0.82	0.70
Sharpe Ratio	0.39	0.24	0.23	0.11	0.08

Source: Processed

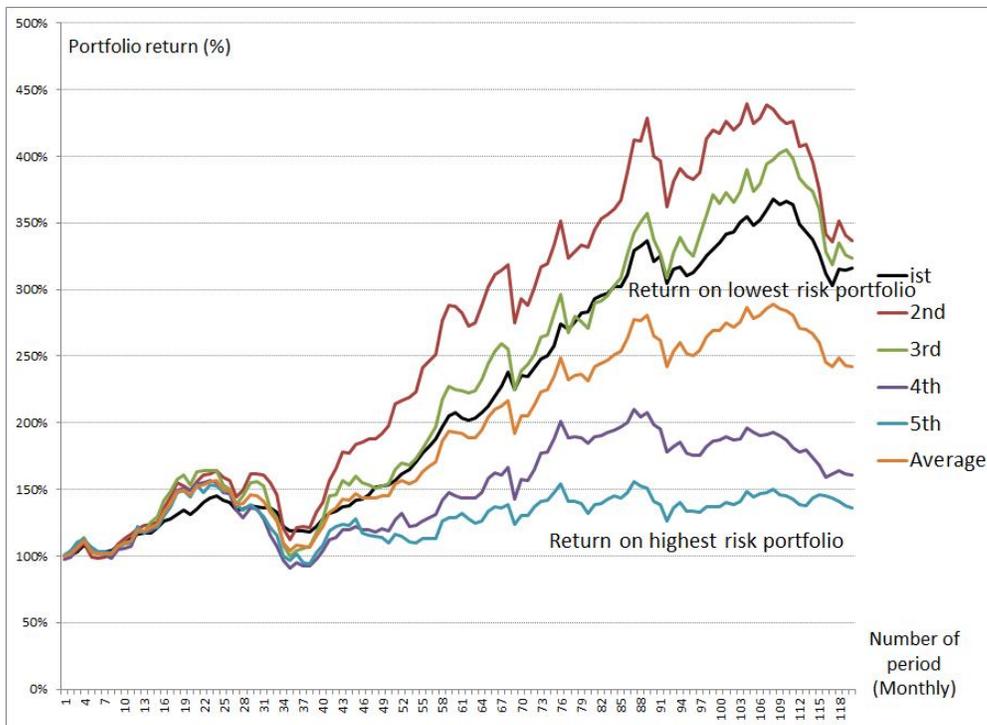


Figure 2. Result without considering monetary policy

Source: Processed

When we considering different monetary policy impact to portfolio performance, we find relatively same pattern for portfolio return but significantly different portfolio characteristics. From table 4 and graph 3, we can see that in expansionary monetary policy, portfolio with largest return is still the second lowest volatility portfolio and the pattern is similar to portfolio return without considering monetary policy. Downside risk pattern shows monotonic pattern, portfolio 1 lowest volatility stock have the highest downside risk and the downside risk gradually dissipate and becoming more upside bias in portfolio 4 and portfolio 5 highest volatility stock. Portfolio 1 lowest volatility stock have lightest tail with negative kurtosis 0,13. Portfolio 2 have heavier tail with positive kurtosis 2.91 that gradually decline to positive kurtosis 0,16 in portfolio 4 and 0,17 in portfolio 5 highest volatility stock.

In contractionary monetary policy, see table 5 and graph 4, portfolio 1 the lowest risk portfolio perform extremely well. It is the one and only portfolio that produce positive results and the return differences is very large 0,78% per month relative to portfolio 2 second lowest risk portfolio and 1,06% per month relative to portfolio 5 highest risk portfolio. There are unique changes in portfolio skewness and portfolio kurtosis. Portfolio skewness change from negative skewness 0,51, meaning highest downside risk, in lowest risk portfolio to gradually more upside bias return for portfolio 2 to portfolio 5 highest risk portfolio. Portfolio kurtosis shows non monotonic relationships, i.e. inverted U-Shape pattern, from negative kurtosis 0,13 then kurtosis became positive and reach highest positive kurtosis in portfolio 3 and then decline and stabilize significantly lower in portfolio 4 with positive kurtosis 0,16 and portfolio 5 with positive kurtosis 0,17. Lowest volatility stock have higher return with limited downside risk and relatively low risk of negative surprise because of their lighter tail.

Tabel 4. Result after considering monetary policy – during expansionary period

	Lowest risk				Highest risk
	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5
Mean	1.31%	1.87%	1.72%	1.07%	0.86%
Standard Deviation	2.36%	4.19%	4.52%	4.01%	4.08%
t-stat	4.99	4.02	3.43	2.41	1.89
Skewness	-0.51	-0.32	-0.20	0.12	0.25
Kurtosis	-0.13	0.49	0.50	0.16	0.17
Sharpe Ratio	0.55	0.45	0.38	0.27	0.21

Source: Processed

Tabel 5. Result after considering monetary policy – during contractionary period

	Lowest risk				Highest risk
	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5
Mean	0.35%	-0.43%	-0.19%	-0.72%	-0.71%
Standard Deviation	2.87%	5.13%	5.29%	4.79%	4.59%
t-stat	0.76	-0.52	-0.22	-0.94	-0.96
Skewness	-1.24	-1.41	-1.10	-0.80	-0.72
Kurtosis	1.56	2.91	1.13	0.65	0.73
Sharpe Ratio	0.12	-0.08	-0.04	-0.15	-0.15

Source: Processed

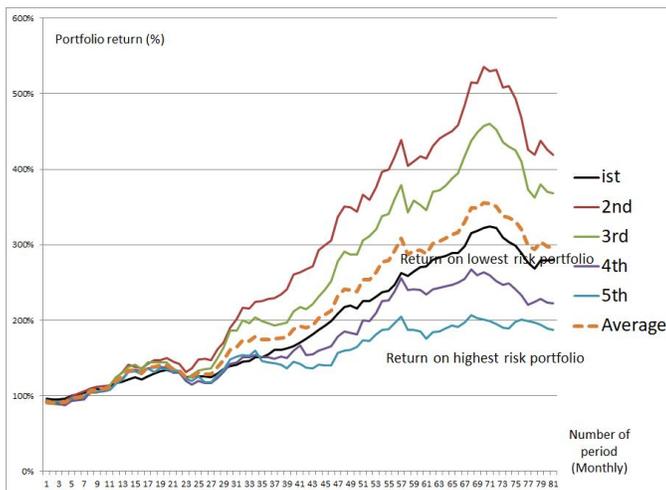


Figure 3. Result during expansionary monetary policy

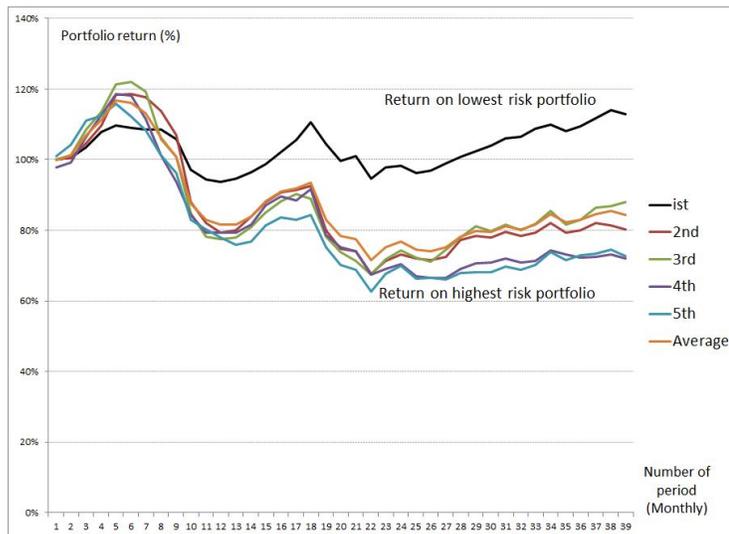


Figure 4. Result during contractionary monetary policy

Low volatility anomaly violating fundamental implication of Capital Asset Pricing Model, where investors are not properly compensated for additional risk that they take. One restriction that remain is borrowing restriction, i.e. hair cut and margin facility interest rates. There are no effort to reduce borrowing restriction but effort to increase borrowing restriction is getting higher which imply low volatility anomaly will persist in the future. In Indonesia, Bursa Efek Indonesia provide haircut percentage guidelines that being updated regularly to be used by securities companies. Haircut percentage provided may not reflect the securities companies ability to provide margin facility and also ignoring the credit worthiness of investors. Haircut percentage provided also tend to reflect the weakest securities companies ability to provide margin facility and investor weakest credit worthiness which make borrowing restriction becoming more severe.

Since low volatility stock tend to have higher return, then it is normal to question their valuation. Higher return tend to lead the stock to becoming overvalued. Our methodology to rebalance the portfolio regularly, i.e. monthly rebalance, reduce the risk of investing in overvalued stock but exposed investor to other risk. Investor that want to rebalance their portfolio regularly have to consider their capacity, their liquidity needs, and implementation costs. There are stocks that have low liquidity that make implementation cost of portfolio rebalancing becoming very high that makes rebalancing cannot be justified by the benefit sought form low volatility stocks.

A low volatility strategy can only makes sense in the context of matched volatility between stock volatility and wanted volatility exposure and their economic rationale and relevance. Consider stock in mining sector and stock in consumer goods sector may have equal standard deviation but have very different exposure to risk. Findings also show that each portfolio have different risk exposure that shown by their skewness and kurtosis patterns. Hence more work need to be done to analyze further how to matched low volatility stocks with wanted low volatility exposure that makes economics sense in investing.

5. Limitations

The limitation on this research, we do not consider dividend when calculate portfolio return and our technique analysis based on descriptive statistic. In conclusion, this research support with previous finding and literature on the impact of stock volatility on stock performance.

6. Conclusion

Indonesia stock markets have been experiencing low volatility anomaly for decades. Similar to global stock market that also experiencing low volatility anomaly for decades. Even though low volatility anomaly is violating Capital Asset Pricing Model, lender and policy maker maintain their borrowing restriction policy, in the form of higher percentage of haircut and higher margin facility interest rates that contribute to the anomaly occurrences for decades.

Low volatility stock portfolio promising more superior results, especially in contractionary monetary policy, implementation low volatility strategy depends on investor's capacity, liquidity needs, and implementation costs. Moreover, contractionary monetary policy is significantly have shorter period than expansionary monetary policy that reduce the benefit of changing tactical asset allocation to lower stock volatility. Expansionary monetary policy have significantly higher portfolio return than contractionary monetary policy.

Creating portfolio based on volatility expose investor to portfolio tendency toward unwanted concentration in particular stock size, stock liquidity, and sector or industry as shown by findings on portfolio skewness and kurtosis. Creating portfolio based on volatility alone may detached investor strategy with their economic rationale and relevance, which can be highly undesirable from strategic asset allocation perspectives.

This research confirms two hypotheses that we stated by showing that lower volatility stock portfolio has higher performance than higher volatility stock portfolio and monetary policy magnify return differences between high and low volatility stock.

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