Selecting Optimal Portfolio in Pakistan

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Abstract

This study aims to identify the number of stocks required to form a well-diversified portfolio in Pakistan. To identify the optimal number of securities we collected data from Bloomberg for the period of 2009-2015. Companies are randomly selected from Pakistan Stock Exchange. The 40 portfolios are formed by adding different securities (without replacement) by assigning equal weights to all the securities. The study concludes that a portfolio of 20 securities can diversify significant amount of risk.

Keywords: Diversification, Optimal portfolio, Number of stocks, Risk.

1. Introduction

Optimal portfolio selection and portfolio diversification has remained hotcake of literature since the work of Markowitz (1952), Markowitz (1959). Basically, the diversification can be explained as reduction in volatility (risk) of portfolio when number of securities increases. Diversification plays a very important role in portfolio formation, as it is said that do not put all eggs in one basket. The same is for the investment in securities. It is very risky to invest all money in one security because if its value goes down, investors have to bear much loss. To be on safe side, it is good to invest in different securities mainly having negative or no correlation between them, because the loss in the value of one security may be compensated by the gain in other security in the portfolio.

Risk of any portfolio depends on proportion of total investment invested in each stock and their variance and covariance (Statman, 1987). Usually level of risk of a portfolio decreases when number of stocks/securities increases. Evans and Archer (1968); (Tang, 2004) argue that number of stocks must range from eight to ten in order to get optimal portfolio. While, (Benjelloun, 2010); Cleary and Copp (1999); (Statman, 1987) depict different number of stocks in an optimal portfolio ranging from thirty to sixty to minimize the risk. Another interesting finding is presented by Alexeev and Dungey (2015). They report that frequency of data also affects the size of optimal portfolio.

Previous studies provide evidences that portfolios consisting of 8-20 randomly selected securities give the diversification benefits ((Newbould & Poon, 1993; Tang, 2004).

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Hence it can be concluded that optimal portfolio size differs from one stock market to another, and even in same market, it differs from time to time. This paper seeks to find the size of optimal portfolio in Pakistan Stock Exchange (PSX) over the period of seven years, from 2009 to 2015. This study contributes to the empirical evidence on the determination of optimal portfolio size for investors within Pakistan. The study is of interest to investors for developing portfolio and funds allocation decisions in Pakistan. The important considerations in formation of the portfolio are the number of securities to invest in, their combination in a portfolio, and the risk involved. Pakistani investors will be less exposed to risk if they well diversify their portfolios. In context of Pakistan, Ahuja (2015) suggests investment in 10 securities to diversify the risk of portfolio. He randomly selects 15 securities and form the equally weighted portfolio. But our study differs from Ahuja (2015) as we are working on a larger data of 7 years, from 2009 to 2015 and with a large sample size of 88 securities. Our study also explains that diversification is capable of risk reduction and return enhancement of portfolios in Pakistan Stock Exchange. Investors, who invest in PSX, can reduce the risk of their portfolio if they make a diversified portfolio, comprising 20 securities. Statistics about the optimal and diversified portfolio in Pakistan is helpful for investors to make their investment decisions in Pakistan. Results suggest that to achieve the diversification benefits, investors should make a portfolio consisting 20 securities of equal weights to have well diversified portfolio. As we go on adding more and more securities, till 20 securities are added, portfolio risk goes on decreasing, which exhibits the diversification benefits.

This paper is organized as follows: section 2 provides the relevant literature followed by the data and methodology in section 3. Later, section 4 reports the results and discussion and section 5 concludes the paper.

2. Literature Review

Originally, Markowitz (1952) initiates the concept of portfolio diversification and develops the model of diversified portfolio. His model explains the selection of stocks or securities to minimize the risk and maximize the return by giving an optimal portfolio. But there is difficulty in sophistication that which securities should be included in portfolio and this model also has limitation of including one period holding.
Later Merton (1971) considers more realistic strategy of multi period holding portfolio and then Sharpe (1985) presents the portfolio selection with simplified methodology. Furthermore, the Modern Portfolio Theory (MPT) considers the portfolio of mean and variance optimization where mean of expected returns of stocks/securities is taken as measure of portfolio return while risk of portfolio is measured by the variance of stocks/securities. MPT takes all the stocks simultaneously while stocks are separately considered by the investors in allocation model (Reilly & Brown, 2012).

Several researchers have worked for effective diversification (Ahuja, 2015; Boscaljon, Filbeck, Ho, & Min-Hsiung, 2005; Bradfield & Munro, 2016; Domian, Louton, & Racine, 2007; Duchin & Levy, 2009; Gupta et al., 2001; Johnson & Shannon, 1974; Klemkosky & Martin, 1975; Markowitz, 1959; Newbould & Poon, 1993; Nyariji, 2001; Statman, 1987; Tang, 2004; Tole, 1982; Wagner & Lau, 1971). Theory of diversification is also tested by Fama (1976) with random selection of 50 securities from New York Stock Exchange (NYSE) and forms the equally weighted portfolio. He reports the standard deviation and finds that portfolio consisting of first 10-15 securities achieve almost all diversification benefits. Bradfield and Munro (2016) find that 15 to 29 securities are required for optimal portfolio in South Africa when equally weighted portfolios are formed. Another study by Duchin and Levy (2009) suggests the Markowitz’s Mean-Variance rule which is 1/N strategy for better performance of individual portfolio rather than any other strategy for portfolio selection. Whereas by using monthly return data of S&P 500 for 40 equally weighted portfolios, Frahm and Wiechers (2011) show that rational selection of assets can form well diversified portfolio as compared to naïve allocation.

Santos (2015) examines the equity markets of Brazil and shows that risk adjusted performance can be better obtained by fewer securities in portfolio with the help of improved allocation. Hu et.al (2014) analyze the benefit of diversification on performance of mutual fund and find that it may not be appropriate to use concentration strategy and benefit of diversification may disappear or affects negatively when there are many different stock in portfolio. He also finds that during the financial crisis, the more number of stocks may be needed to form a well-diversified portfolio.

Moreover, Boscaljon et al. (2005) analyze the equally weighted portfolios of 500 stocks being traded in S&P and NYSE and suggest that a well-diversified portfolio should consist of 30 or less stocks. These results are consistent with Statman (1987). Basically, investors make investment decision with some return expectations with a given level of risk. Risk consists of systematic/non-diversifiable as well as non-systematic/diversifiable risk. As per MPT, risk and portfolio size are negatively related. When the number of securities(size of portfolio) increases, the risk/variance of portfolio goes on decreasing and vice versa (Evans & Archer, 1968; Markowitz, 1952; Reilly & Brown, 2012). Kisaka et al. (2015) examine the Nairobi Securities Exchange for the five year period from January 2009 to December 2013 and find that number of securities should lie between 18 and 22 securities for the optimal portfolio.
3. Data and Methodology
To analyze the optimal number of securities in well-diversified portfolio, we have collected secondary data from Bloomberg. Initially we select top 100 companies from PSX in 2009 and then select those companies which remain top performer till 2015 and excluding the delisted firms, we get 88 companies in data set. The dividend adjusted monthly returns are collected for selected companies for the period of January 2009 to December 2015. Companies are randomly added to form the portfolios and weights are equally assigned to all selected securities.

Different portfolios are formed and statistical measures of return, variance, and standard deviation are calculated to find out the optimal number of securities. Equation used to calculate these statistical measures is based on Modern Portfolio Theory proposed by Markowitz (1952).

Modern Portfolio Theory (MPT) is a theory based on how risk-averse investors can construct portfolios to optimize or maximize expected return based on a given level of market risk.

Assumptions of MPT:
• Asset returns are normally distributed random variables.
• Investors attempt to maximize economic market returns.
• Investors are rational and avoid risk when possible.
• All investors have access to the same sources of information for investment decisions.
• Investors share similar views on expected returns.
• Taxes and brokerage commissions are not considered.
• Investors are not large enough players in the market to influence the price.
• Investors have unlimited access to borrow (and lend) money at the risk free rate.

The relationship between expected variance of portfolio and the number of securities is originally derived by Markowitz (1952), and this formula is widely cited in finance textbooks. When equally weighted portfolios are constructed from randomly selected securities, the expected portfolio variance is:

\[ E\left(\sigma_p^2\right) = \frac{1}{N} \sigma^2 \bar{\sigma} + \frac{N - 1}{N} \text{cov}(i, j) \]

Where:
\( E\left(\sigma_p^2\right) \) is expected variance of portfolio.
\( \sigma^2 \) is average variance of all stocks
\( \text{cov}(i, j) \) is average covariance between all stocks
\( N \) is number of securities in portfolio

We have formed different portfolios by assigning equal weight to each security in a portfolio. There are total 88 securities and their variance is calculated to find optimal
number of securities. Therefore, we form portfolios initially by taking two securities and then adding up to 40 securities (without replacement). Variance of single security is also analyzed to check the effect of portfolio investment as compared to investment in single security.

4. Results
Table 1 shows the summary statistics of 40 randomly selected companies listed on Pakistan Stock Exchange. Individual securities have more standard deviation (more than 10%) and the average return is low as compared to variation in returns. Skewness measures the symmetry in distribution of data while Kurtosis measures the combined sizes (probability) of the two tails. To have symmetric (normal) distribution, skewness value should be close to zero and for kurtosis acceptable value is 3. In the table 1, most of the securities have skewness close to zero and it shows that data is normally distributed.

<table>
<thead>
<tr>
<th>Security</th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Sample Variance</th>
<th>Kurtosis</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSL</td>
<td>-0.559</td>
<td>-3.333</td>
<td>21.630</td>
<td>467.860</td>
<td>19.574</td>
<td>3.217</td>
</tr>
<tr>
<td>NIB</td>
<td>-0.322</td>
<td>-1.521</td>
<td>13.950</td>
<td>194.597</td>
<td>12.947</td>
<td>2.497</td>
</tr>
<tr>
<td>FCSC</td>
<td>-0.277</td>
<td>-4.375</td>
<td>20.485</td>
<td>419.625</td>
<td>7.495</td>
<td>1.773</td>
</tr>
<tr>
<td>JVDC</td>
<td>0.455</td>
<td>0.000</td>
<td>10.316</td>
<td>106.422</td>
<td>5.250</td>
<td>1.658</td>
</tr>
<tr>
<td>SILK</td>
<td>0.495</td>
<td>-1.527</td>
<td>11.808</td>
<td>139.430</td>
<td>2.254</td>
<td>1.354</td>
</tr>
<tr>
<td>ANL</td>
<td>0.564</td>
<td>-2.188</td>
<td>19.406</td>
<td>376.587</td>
<td>4.772</td>
<td>1.599</td>
</tr>
<tr>
<td>WTL</td>
<td>0.574</td>
<td>-1.984</td>
<td>18.581</td>
<td>345.266</td>
<td>3.622</td>
<td>1.726</td>
</tr>
<tr>
<td>SMBL</td>
<td>0.640</td>
<td>-2.308</td>
<td>15.898</td>
<td>252.739</td>
<td>1.854</td>
<td>1.122</td>
</tr>
<tr>
<td>SNGP</td>
<td>0.650</td>
<td>-0.514</td>
<td>10.750</td>
<td>115.573</td>
<td>1.614</td>
<td>0.863</td>
</tr>
<tr>
<td>JSGCL</td>
<td>0.913</td>
<td>-0.851</td>
<td>17.260</td>
<td>297.920</td>
<td>3.002</td>
<td>0.946</td>
</tr>
<tr>
<td>PTC</td>
<td>1.134</td>
<td>0.642</td>
<td>9.656</td>
<td>93.235</td>
<td>0.848</td>
<td>0.910</td>
</tr>
<tr>
<td>BL PA</td>
<td>1.211</td>
<td>-1.389</td>
<td>17.492</td>
<td>305.976</td>
<td>8.500</td>
<td>2.301</td>
</tr>
<tr>
<td>SIEM</td>
<td>1.302</td>
<td>-0.127</td>
<td>13.756</td>
<td>189.216</td>
<td>1.903</td>
<td>1.204</td>
</tr>
<tr>
<td>PPL</td>
<td>1.454</td>
<td>1.226</td>
<td>6.494</td>
<td>42.178</td>
<td>1.474</td>
<td>0.871</td>
</tr>
<tr>
<td>BOP</td>
<td>1.474</td>
<td>-1.370</td>
<td>16.275</td>
<td>264.865</td>
<td>4.284</td>
<td>1.572</td>
</tr>
<tr>
<td>JSBL</td>
<td>1.532</td>
<td>-0.641</td>
<td>18.010</td>
<td>324.350</td>
<td>12.250</td>
<td>2.720</td>
</tr>
<tr>
<td>IBFL</td>
<td>1.533</td>
<td>-0.427</td>
<td>13.227</td>
<td>174.963</td>
<td>2.071</td>
<td>0.995</td>
</tr>
<tr>
<td>HMB</td>
<td>1.555</td>
<td>0.855</td>
<td>8.682</td>
<td>75.382</td>
<td>0.547</td>
<td>0.633</td>
</tr>
<tr>
<td>SHEL</td>
<td>1.657</td>
<td>0.000</td>
<td>10.652</td>
<td>113.468</td>
<td>7.017</td>
<td>1.662</td>
</tr>
<tr>
<td>INIL</td>
<td>1.712</td>
<td>0.577</td>
<td>10.186</td>
<td>103.747</td>
<td>0.966</td>
<td>0.740</td>
</tr>
<tr>
<td>EFUL</td>
<td>1.739</td>
<td>1.739</td>
<td>12.465</td>
<td>155.366</td>
<td>0.495</td>
<td>-0.077</td>
</tr>
</tbody>
</table>
This table reports the summary statistics of return on securities, randomly selected for optimal portfolio. The analysis use monthly data for the period of January 2009 to December 2015 for randomly selected companies of PSX.

For optimal investment, it is necessary to invest in different securities and if an investor forms a portfolio then question arises that how many securities should be in that portfolio? To answer this question, we have done analysis by randomly selecting securities listed on PSX and formed different portfolios. First randomly selected security is Imperial Sugar Limited and its risk is 21.76%, after adding one more security portfolio risk reduced to 16.164% that is 22.1% reduction. The 40 portfolios are formed by adding different securities (without replacement) by assigning equal weights to all the securities (see Table 2).

As we add more and more securities, risk decreases but it decreases with lower percentage (1.4%) after 5 securities portfolio (see Figure 1). But after portfolio of 5 securities, it again decreases by more percentage up to 20 securities and therefore, the results suggest that approximately 20 securities form well-diversified portfolio in Pakistan.
Table 2: Portfolio Risk and Number of securities

<table>
<thead>
<tr>
<th>No of securities</th>
<th>Portfolio Variance</th>
<th>Portfolio Risk</th>
<th>Reduction in risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>473.496</td>
<td>21.760</td>
<td>0.0%</td>
</tr>
<tr>
<td>2</td>
<td>261.276</td>
<td>16.164</td>
<td>-25.7%</td>
</tr>
<tr>
<td>4</td>
<td>158.383</td>
<td>12.585</td>
<td>-22.1%</td>
</tr>
<tr>
<td>5</td>
<td>135.130</td>
<td>11.625</td>
<td>-7.6%</td>
</tr>
<tr>
<td>10</td>
<td>131.438</td>
<td>11.465</td>
<td>-1.4%</td>
</tr>
<tr>
<td>15</td>
<td>98.376</td>
<td>9.918</td>
<td>-13.5%</td>
</tr>
<tr>
<td>20</td>
<td>75.173</td>
<td>8.670</td>
<td>-12.6%</td>
</tr>
<tr>
<td>25</td>
<td>68.916</td>
<td>8.302</td>
<td>-4.3%</td>
</tr>
<tr>
<td>30</td>
<td>58.141</td>
<td>7.625</td>
<td>-8.1%</td>
</tr>
<tr>
<td>35</td>
<td>56.670</td>
<td>7.528</td>
<td>-1.3%</td>
</tr>
<tr>
<td>40</td>
<td>51.724</td>
<td>7.192</td>
<td>-4.5%</td>
</tr>
</tbody>
</table>

This table reports the variance of portfolio and risk of portfolio as number of securities increase.

The purpose of diversification is to minimize the risk, and as we add more securities, the risk should be decreased but this purpose of diversification is achieved when securities have negative correlation or low correlation. We have performed correlation analysis to examine the correlation between randomly selected stocks and we found that randomly selected securities are moderately or highly correlated (between 30% to 60%) and these securities have positive correlation.

![Portfolio Risk Reduction](image)

Figure 1. Portfolio Risk Reduction.

5. Discussion and Conclusion
The purpose of this research study is to determine the number of stocks to form a well-diversified portfolio in Pakistan as every investor has limited amount of funds to invest in securities. To use those funds efficiently, and to get maximum return and minimum...
risk, he/she must know about the size of portfolio. Diversification is important to minimize the risk but it can be helpful up to a certain limit as Kisaka et.al (2015) show that portfolio risk decreases due to increase in number of securities but after certain limit the risk increases again. To achieve this purpose we have selected 88 companies listed on Pakistan Stock Exchange and collected monthly data for the period of January 2009 to December 2015 from Bloomberg Terminal.

The results suggest that the data is normally distributed and the average return on most of the securities is positive. Along with positive return on individual securities, they also have high standard deviation which shows that risk is also high. But when portfolios are formed, risk begins to decrease and as we increase the number of securities in portfolio the risk decreases more (i.e 21.76% to 7.192%). Afterwards, there is minimum decrease in risk as we add more than 20 securities. So if an investor wants to invest in Pakistan then he/she should invest in approximately 20 securities of equal weights to have well diversified portfolio (minimum risk and maximum return) as after 20 securities there is minimal decrease in overall risk. There is inconsistency in result after portfolio size of 10 securities and this can be possibly attributed to random selection of securities having moderate or high positive correlation.

Well, this study has also some limitations: First, securities are randomly selected from Pakistan stock exchange in which there can be some securities that are not actively traded. Second, correlation is not taken into consideration while for having well diversified portfolio it is necessary to have low or negative correlation between them as returns of one security may go down due to certain economic conditions then it may be compensated by returns of other securities. Third, weights are equally assigned to each security but weights can also be assigned on basis of market capitalization or there can be trial and error method to find optimal weight of each security in order to minimize the risk. Fourth, in this study portfolios are formed without replacement of securities and results can be different if portfolios are formed with replacement of securities.

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References


