Goodwill Valuation Enhancement through Capitalization Method and Statistical Impact Analysis

Shariq Mohammed 1, Amir Ahmad Dar 2,*, Mohammad Shahfaraz Khan 3, Imran Azad 3, Gopu Jayaraman 3 and Olayan Albalawi 4

Abstract: The valuation of Goodwill (GW) has remained one of the several critical issues in financial analysis. This aspect is particularly important for mergers and acquisitions due to the significance of intangible assets. This study delves into the capitalization method of super profit (CMSP), a prominent technique for GW valuation, enhanced by the integration of statistical tools. Assessing a company’s excess profits over its average return on tangible assets is part of the CMSP. Finding the variables that have a significant impact on GW valuation, such as average profit, capital employed, and rate of return, is the main goal of this research. These issues are thoroughly investigated through statistical analysis to give stakeholders useful information for well-informed decision-making. Additionally, the study seeks to identify the external elements influencing this process as well as the internal aspects influencing GW valuation. Regression analysis, correlation matrices, response analysis and ANOVA are used to improve GW assessment and comprehension of the complex relationships between different factors.

Keywords: GW; capital employed; average profit; CMSP; ANOVA; regression

1. Introduction

In the context of financial research, GW valuation is extremely important, especially when it comes to mergers and acquisitions (M&A), where intangible assets have a significant impact. According to FASB (2014), GW is the difference between the purchase price and the fair value of the identified assets acquired and the liabilities taken on during a transaction. For stakeholders involved in M&A activities to make educated decisions and to ascertain a company’s genuine worth, its correct appraisal is essential (Moro-Visconti 2022).

Companies have been concentrating more on improving their GW assets over time to surpass the book value of those assets to increase market value. Since GW represents the amount spent above and beyond the assets’ book value, keeping an eye on it is essential (Widnyana et al. 2020). A decline in GW usually lowers the value of the company, but it can also indicate reckless or wasteful spending. This is recognized by lenders who may take GW into account when making loan choices to firms. Still, little research has been performed to conclusively determine which factors impact GW the most.

The CMSP is widely recognized as a popular approach for evaluating GW. This approach aims to measure the excess profits that a company makes above its typical return on tangible assets (Eloff and de Villiers 2015). By leveraging these enormous revenues,
analysts can determine the amount of GW intrinsic to a business. However, improving accuracy and dependability requires incorporating sophisticated analytical tools.

By offering a strict framework for examining numerous factors affecting GW value, the use of statistical methods, including regression analysis, correlation matrices, and analysis of variance (ANOVA), enhances the conventional CMSP (Cosmulese et al. 2017). A statistical analysis can provide a deep understanding of the significance of variables such as average profit, capital used, and rate of return in evaluating the value of GW. Through deeper insights into the valuation process provided by this analytical technique, stakeholders can make more informed decisions during M&A transactions.

This paper explores the complex field of GW valuation, highlighting the significance of precise evaluation in financial analysis and mergers and acquisitions. This research aims to help stakeholders navigate valuation exercises by providing a comprehensive framework for evaluating GW. It introduces the CMSP as a prominent technique and emphasizes the integration of statistical techniques.

The CMSP emphasizes the significance of excess earnings in defining a company’s intangible value and offers a theoretical framework for evaluating GW valuation. This study intends to improve the accuracy and dependability of GW assessment by including statistical methods like regression analysis, correlation matrices, and ANOVA, providing a more thorough understanding of the valuation process.

2. Research Objectives

The objectives of this study are as follows:

- Determining the factors that have a major influence on GW valuation.
- Calculating the impact of variables on GW value, such as average profit, capital used, and rate of return.
- Investigating outside influences on the appraisal procedure.

3. Literature Review

The literature has studied GW valuation techniques in great detail, with the CMSP emerging as a standout method. This approach, which is based on the concept of surplus earnings, aims to measure a company’s intangible worth that extends beyond its physical assets. Previous studies have clarified this method’s conceptual framework and application, emphasizing its applicability in a variety of financial analysis and mergers and acquisition scenarios (Burukina et al. 2019). Analysts can evaluate a company’s GW by leveraging its super profits, which gives stakeholders involved in valuation exercises important information.

Furthermore, there has been an increasing amount of attention in the literature to integrate statistical tools to improve the accuracy and dependability of GW valuation. ANOVA, regression analysis, and correlation matrices are a few examples of statistical tools that provide a methodical way to examine the many variables that affect GW value. Furthermore, a previous study examined the benefits of statistical tools for assessing the value of consumer loans and demonstrates their effectiveness in capturing the intricacies of asset valuation (Lown and Peristiani 1996).

According to Thakur et al. (2024), there is a substantial positive relationship between GW assets and capital structure in developing nations. However, in wealthy nations, there is a significant negative association. Furthermore, the relationship between GW assets and the capital structure of businesses in developing nations is positively moderated by the development of financial markets. Firm managers can learn from the findings that GW assets can be used as extra collateral when obtaining debt financing. In addition, authorities want to create a debt market strategy that acknowledges GW assets as extra security for debt financing.

But even with the extensive literature on statistical tools and GW valuation techniques, there are still some significant gaps that need to be filled. One such gap relates to our incomplete knowledge of the precise characteristics that—under the CMSP framework—have
the greatest impact on GW value. Although average profit, capital employed, and rate of return have been discovered in prior research, further empirical investigation is still required to determine their respective importance and interactions.

Moreover, there is a lack of comprehensive research in the literature that integrates statistical methods with the CMSP to provide a thorough framework for GW assessment. There is a lack of research that integrates these approaches to provide a more nuanced view of the valuation process. Individual studies have focused on either the methodological aspects of GW valuation or the application of statistical tools. By utilizing a multi-modal approach that combines statistical analysis with conceptual frameworks of the CMSP, this work aims to bridge the existing gap.

This study has a strong foundation of literature already available on GW assessment techniques and the application of statistical tools. This research intends to bridge gaps in our understanding of GW valuation parameters and provide a comprehensive framework for valuation analysis by focusing on the CMSP and investigating the integration of statistical methodologies.

4. Methodology

The present study’s research design is quantitative, utilizing statistical analysis techniques to investigate the correlations between different parameters and GW valuation. Financial statements, annual reports, and other pertinent publicly accessible sources of company information will be the sources from which data will be gathered (Table 1). Variables including average profit, capital used, rate of return, and GW value will be included in the dataset (Table 2). Regression, ANOVA, and analysis of response were among the statistical techniques employed to determine the study’s objectives, and the DOE (Taguchi L16) was utilized for the experimental setup (Akkuş and Yaka 2018).

Table 1. Observed data sets.

<table>
<thead>
<tr>
<th>Levels</th>
<th>AP</th>
<th>R</th>
<th>CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60,000</td>
<td>10</td>
<td>400,000</td>
</tr>
<tr>
<td>2</td>
<td>70,000</td>
<td>15</td>
<td>500,000</td>
</tr>
<tr>
<td>3</td>
<td>80,000</td>
<td>20</td>
<td>600,000</td>
</tr>
<tr>
<td>4</td>
<td>90,000</td>
<td>25</td>
<td>700,000</td>
</tr>
</tbody>
</table>

Table 2. Taguchi L16 with the GW value.

<table>
<thead>
<tr>
<th>Exp. No.</th>
<th>AP</th>
<th>R</th>
<th>CA</th>
<th>GW</th>
</tr>
</thead>
<tbody>
<tr>
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<td>4</td>
<td>60,000</td>
<td>25</td>
<td>700,000</td>
<td>−400,000</td>
</tr>
<tr>
<td>5</td>
<td>70,000</td>
<td>10</td>
<td>500,000</td>
<td>200,000</td>
</tr>
<tr>
<td>6</td>
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<td>15</td>
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</tr>
<tr>
<td>7</td>
<td>70,000</td>
<td>20</td>
<td>700,000</td>
<td>−350,000</td>
</tr>
<tr>
<td>8</td>
<td>70,000</td>
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<td>−320,000</td>
</tr>
<tr>
<td>9</td>
<td>80,000</td>
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<td>600,000</td>
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</tr>
<tr>
<td>10</td>
<td>80,000</td>
<td>15</td>
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</tr>
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<td>25</td>
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</tr>
<tr>
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<td>700,000</td>
<td>200,000</td>
</tr>
<tr>
<td>14</td>
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<td>0</td>
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<tr>
<td>15</td>
<td>90,000</td>
<td>20</td>
<td>500,000</td>
<td>−50,000</td>
</tr>
<tr>
<td>16</td>
<td>90,000</td>
<td>25</td>
<td>400,000</td>
<td>−40,000</td>
</tr>
</tbody>
</table>

The relationship between independent variables (such as average profit, rate of return, and capital employed) and the dependent variable (GW valuation) will be modeled using
regression analysis. The estimate of each predictor’s coefficient and the identification of relevant predictors of the GW value are made possible by this technique. The direction and strength of the correlations between the variables will be evaluated using correlation matrices. By revealing the degree of correlation between the parameters, this study aids in the identification of any multi-collinearity problems that could have an impact on the regression results. The percentage contribution of each element to the GW valuation was estimated using ANOVA, and the optimal parameter settings where the GW value is the highest can be found using analysis of response (Nguyen et al. 2024; Dar et al. 2024).

It is sufficient to use CMSPI to determine the fair price of the GW based on the parameters listed in Table 1. The experiment that is best suited for three parameters at four levels is the Taguchi L16 approach (Akkuş and Yaka 2018). Table 2 displays the Taguchi L16 approach with four replications at each level and the estimated GW value derived from Equation (1). First, the Anderson–Darling (AD) tool was used to perform the normality test (Kim 2024). Following that, statistical methods like regression, ANOVA, and analysis of response were employed to determine the study’s goals (Nguyen et al. 2024; Dar et al. 2024). Lastly, a few more variables that affect the GW valuation are discussed.

\[
GW = \left( AP - CP \times \frac{r}{100} \right) \times \frac{100}{r}
\] (1)

In the valuation of GW, several parameters are utilized, each grounded in accounting fundamentals, to assess the intangible value of a company.

Average Profit: The core accounting concept of profitability analysis forms the basis of average profit, a crucial GW valuation indicator. A company’s average net income generated over a certain period is represented by it, offering information about its financial performance. The average profit is a crucial metric in GW valuation since it provides insight into the company’s earning potential and shapes stakeholders’ opinions about its future growth and profitability.

Capital Employed: A basic accounting concept known as “capital employed” describes the overall sum of money used in a business’s activities, including both loan and equity capital. Capital employed is a metric used in GW valuation that represents the company’s invested resources and indicates both its stability and potential for profit. It is essential to comprehend the nature and effectiveness of the capital utilized to evaluate GW’s sustainability and value to shareholders.

Rate of Return (ROI): The ROI, which is frequently obtained from the ROI data, is based on accounting concepts that are relevant to the assessment of financial performance. It represents how effectively a business uses its capital to produce profits. The rate of return in GW valuation highlights the company’s competitive edge and long-term sustainability by offering important insights into its capacity to create excess profits from its invested capital. These characteristics are fundamental parts of the CMSPI, which is a popular method for GW valuation. This study improves the accuracy and reliability of GW valuation by integrating statistical tools such as regression analysis, correlation matrices, response analysis, and ANOVA, empowering stakeholders to make knowledgeable judgments regarding mergers and acquisitions. Furthermore, by pinpointing external variables that impact GW valuation as well, the research offers a thorough comprehension of the intricate relationships determining intangible asset value in financial analysis.

5. Steps Involved in the Methodology

The Taguchi method, developed by G Taguchi, is a statistical approach used to improve the quality of goods or processes. It focuses on the robust design and minimizing variability. The following eight steps are involved:

1. Set the objectives, which typically include improving quality, reducing variability, and identifying the best optimal combination for process parameters.
2. Identify control factors (the parameters of the process).
3. Choose an orthogonal array that fits the number of factors and levels identified. Orthogonal array helps in systematically varying and analyzing multiple factors simultaneously with a reduced number of experiments.
4. Perform the experiments according to the selected orthogonal array.
5. Ensure the data collected are accurate and reliable.
6. Use statistical analysis to interpret the experimental data.
7. Determine optimal levels and perform a confirmation experiment. Conduct a confirmation experiment using these optimal settings to verify the results and ensure improvements are achieved.
8. Implement the optimal settings in the actual process.

6. Results and Analysis

Once the simulation run is found to be correct, the input factors are adjusted as decided and the output result such as GW value is estimated. Each input factor is repeated four times in an experimental setup of the Taguchi method (L16). The experiments are conducted considering the fixed factors as given in Table 1 and these data are sufficient to find the GW values with the help of CMSP. The Taguchi L16 orthogonal array based on the experimental results is shown in Table 2 for GW values.

7. Normality Test

The AD test (Stephens 1974) is used to verify the normality of the answers at each component level, which is the underlying assumption of regression and ANOVA. It is an adjustment to the Kolmogorov–Smirnov (K-S) test that gives the tails greater weight than the K-S test does. The definition of the Anderson–Darling test is as follows:

**H0.** The null hypothesis is that the data are normally distributed.

**H1.** The alternative hypothesis is that the data are non-normal.

In Figure 1, the p-value is greater than 0.05, indicating acceptance of the null hypothesis. It means that the data follow the normal distribution.

![Probability Plot of GW](Image)

**Figure 1.** Normality.
8. Analysis of Response (AOR)

AOR is used to determine the optimal levels for each input element. This method aids in decision-making and promotes a deeper comprehension of input variables. The difference between the highest and least response averages for each factor level is known as the delta. Additionally, AOR offers the best possible combination of multiple input elements at different levels when the response value is at its highest. The best results are obtained by using the higher average of each input component. The Minitab program calculates a distinct average for every combination of factor levels for the provided experimental values (Dar et al. 2024).

It is observed from Table 3 that interest rate (r) has the most crucial significance on the response variable as it has rank 1.

Table 3. Response table for means.

<table>
<thead>
<tr>
<th>Level</th>
<th>AP</th>
<th>r</th>
<th>CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>−165,000</td>
<td>200,000</td>
<td>56,667</td>
</tr>
<tr>
<td>2</td>
<td>−100,833</td>
<td>−50,000</td>
<td>−32,500</td>
</tr>
<tr>
<td>3</td>
<td>−36,667</td>
<td>−175,000</td>
<td>−105,000</td>
</tr>
<tr>
<td>4</td>
<td>27,500</td>
<td>−250,000</td>
<td>−194,167</td>
</tr>
<tr>
<td>Delta</td>
<td>192,500</td>
<td>450,000</td>
<td>250,833</td>
</tr>
<tr>
<td>Rank</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 3 displays the computed mean of GW value for each input factor at different values. Figure 2 displays the average response’s effect plot. This study is carried out to identify the influential components and their ideal concentrations. All of the input factors have some effect on GW value, according to the ranks indicated in Table 3, but the input factor of interest rate (r) has the biggest impact, as rank 1 has the maximum slope in Figure 2.

![Main Effects Plot for Means](image)

Figure 2. Main effects plot for mean.

9. Optimal Combination

It has been confirmed that the ideal configuration (combination) for the GW value is \( AP_{opt}, r_2, CA_3 \). The research chooses a few combinations from Table 2 that have the highest GW values, namely experiments 1, 13, and 6. These combinations are chosen to validate the best combination for the GW value. Aside from this, a few further random trials, R1, R2, and R3, are chosen for their universality and are not included in Table 2. It was discovered that the combination that maximizes GW is \( AP_{opt}, r_2, CA_3 \).

10. Regression Coefficient

The variable that has a positive or negative impact on the response variable is shown in Table 4. Positive or negative coefficients of variables show that the variable and the output value have a direct relationship, and vice versa. A rise in AP, a fall in interest rates, and a decrease in capital used all result in an increase in GW value. The conclusion is that the result is statistically significant because the \( p \)-values (for the input components) are about equal to 0. To put it another way, Table 4 illustrates the statistical significance of the relationship between the input components and the response variable.

Table 4. Coefficients of variables.

<table>
<thead>
<tr>
<th>Term</th>
<th>Coef</th>
<th>SE Coef</th>
<th>T-Value</th>
<th>p-Value</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>420,000</td>
<td>122,474</td>
<td>3.43</td>
<td>0.005</td>
<td>1.00</td>
</tr>
<tr>
<td>AP</td>
<td>6.42</td>
<td>1.22</td>
<td>5.24</td>
<td>0.000</td>
<td>1.00</td>
</tr>
<tr>
<td>R</td>
<td>−29,500</td>
<td>2449</td>
<td>−12.04</td>
<td>0.000</td>
<td>1.00</td>
</tr>
<tr>
<td>CA</td>
<td>−0.825</td>
<td>0.122</td>
<td>−6.74</td>
<td>0.000</td>
<td>1.00</td>
</tr>
</tbody>
</table>

11. Analysis of Variance

Trial outputs are subjected to ANOVA to understand how configuration parameters affect GW values. An accurate way to assess the contribution of each element to the output response is to use ANOVA, an efficient technique for data analysis. It demonstrates that each component’s \( p \)-value is less than the significance level of 0.05, indicating a substantial influence from that factor. The proportional contribution of each element in influencing GW value is shown in Table 5. Adjusted (Adj.) sum of squares divided by total Adj. sum of squares yields the percentage contribution, which shows the percentage contribution of each input factor (Sefrou and Belkhouche 2020; Kumar et al. 2019; Gavel et al. 2019).
9. Optimal Combination

It has been confirmed that the ideal configuration (combination) for the GW value is \( AP_1, r_1, CA_1 \). The research chooses a few combinations from Table 2 that have the highest GW values, namely experiments 1, 13, and 6. These combinations are chosen to validate the best combination for the GW value. Aside from this, a few further random trials, R1, R2, and R3, are chosen for their universality and are not included in Table 2. It was discovered that the combination that maximizes GW is \( AP_4, r_1, CA_1 \).

10. Regression Coefficient

The variable that has a positive or negative impact on the response variable is shown in Table 4. Positive or negative coefficients of variables show that the variable and the output value have a direct relationship, and vice versa. A rise in AP, a fall in interest rates, and a decrease in capital used all result in an increase in GW value. The conclusion is that the result is statistically significant because the \( p \)-values (for the input components) are about equal to 0. To put it another way, Table 4 illustrates the statistical significance of the relationship between the input components and the response variable.

<table>
<thead>
<tr>
<th>Term</th>
<th>Coef</th>
<th>SE Coef</th>
<th>T-Value</th>
<th>( p )-Value</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
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<td>3.43</td>
<td>0.005</td>
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<tr>
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<td>1.22</td>
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<td>2449</td>
<td>−12.04</td>
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<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Adj SS</th>
<th>Adj MS</th>
<th>F-Value</th>
<th>( p )-Value</th>
<th>Percentage Contribution</th>
<th>Rank</th>
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<tbody>
<tr>
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<td>3,000,000,000.00</td>
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<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

Figure 3 displays how the interest rate impacts the maximum on a GW value with 66.57%; the capital employed contributes 20.83%, and the average profit contributes 12.60% on a GW value.
12. Factors That Affect the GW

Numerous internal and external factors impact GW valuation, which in turn shapes opinions of an organization’s intangible value. GW is fostered internally by elements, including company culture, customer relationships, and brand reputation. GW is greatly impacted by external factors like competitive landscapes, regulatory regimes, and market conditions. Maintaining and improving GW eventually contributes to sustained financial performance and stakeholder trust in the company’s long-term prospects. This requires an understanding and effective management of these complex aspects. Because of this, a thorough approach to GW valuation takes into account the complex interactions between internal and external dynamics. The three factors—average profit, capital used, and rate of return—have an impact on a company’s GW valuation according to CMSP. The factors that are influenced by the other variables are shown in Figure 4.

Figure 3. Percentage contribution.

Figure 4. Factors that affect the GW.
As an intangible asset, GW is susceptible to several internal and external variables that affect how people view a company’s worth, standing, and future possibilities. The following internal and external variables affect GW as shown in Figure 5.

13. Internal Factors
1. Brand reputation: GW is largely determined by how well known and strong a company’s brand is among consumers and within its industry. While bad press or brand scandals can undermine GW, a positive brand reputation established on superior products, outstanding customer service, and ethical business practices can increase GW (Hnatiuk 2021).
2. Customer relationships: Long-lasting and solid client relationships promote loyalty, repeat business, and positive word-of-mouth referrals, all of which are important components of GW. Businesses that emphasize individualized experiences, client engagement, and pleasure frequently have greater levels of GW (Gorajski and Machowska 2019).
3. Employee satisfaction and expertise: GW may be enhanced by a talented and driven team that promotes innovation, productivity, and service excellence. Businesses that make investments in the growth, training, and work environment of their employees encourage dedication and loyalty, which can increase GW.
4. Intellectual property and innovation: Patents, trademarks, and unique technologies are examples of intellectual property assets that create barriers to entry and allow for competitive advantages, which in turn foster GW. Businesses that innovate and safeguard their intellectual property add value and distinguish themselves from competitors, which improves relations (Sudyn 2015).
5. Corporate culture and values: Gaining stakeholders’ confidence and respect via honesty, openness, and social responsibility helps strengthen a company’s corporate culture. Businesses that exhibit a dedication to moral behavior, ecological sustainability, and community involvement cultivate positive relationships with stakeholders, investors, and the general public (Wheeler and Davies 2004).

14. External Factors
1. Market conditions and industry trends: The opinions of a company’s development potential and market positioning are shaped by external variables, including industry trends, competitive dynamics, and market demand, which can have an impact on GW. While businesses experiencing economic downturns or disruptive shifts may
1. Face difficulties, companies operating in growing industries or expanding markets may benefit from increased levels of GW (Dore 2018).

2. Regulatory environment: Government regulations, compliance mandates, and regulatory changes can all affect GW through their effects on risk management, reputation, and business operations. By reducing legal and regulatory risks, businesses that demonstrate conformity with industry standards and adjust to regulatory changes build GW (Andre et al. 2009).

3. Economic and geopolitical factors: Macroeconomic factors, such as GDP growth, interest rates, inflation, and geopolitical stability, have an impact on investor attitude, corporate investment decisions, and consumer confidence. Higher levels of GW across industries are typically supported by stable and prosperous economic conditions (Gierusz et al. 2022).

4. Competitive landscape: Through their effects on market share, pricing dynamics, and customer preferences, competitors, new entrants, and alternatives can exert competitive pressure that can negatively affect GW. Businesses that set themselves apart via innovation, high-quality products, and attentive customer care keep their advantages over competitors and foster GW (Doganoglu and Klapper 2006).

5. Stakeholder perceptions and media coverage: GW is impacted by how the public views a company, which is molded by social media discussion, media coverage, and stakeholder engagement. These factors also affect brand reputation and trust. GW can be increased by positive media attention, influencer endorsements, and positive reviews, but it can also be weakened by bad press or controversies that harm one’s reputation (Wheeler and Davies 2004).

15. Future Directions

Future research should explore integrating machine learning algorithms with traditional GW valuation methods to enhance predictive accuracy. Investigating the impact of evolving market conditions and digital transformation on GW valuation can provide deeper insights. Additionally, examining the role of industry-specific factors and cross-border mergers in GW assessment will enrich the understanding of intangible asset valuation. Longitudinal studies tracking GW over time about corporate performance could also offer valuable perspectives on the sustainability of GW.

16. Conclusions

The influence of three input parameters on the GW value was ascertained using the Taguchi method L16. The ANOVA regression and analysis of response were used to evaluate the experimental results. The regression coefficients indicate that the AP impacts positively and the rate of return and capital employed negatively impact GW. The rate of return was found to have a significant influence on the GW when the ANOVA was used to calculate each factor’s percentage contribution to the response variable. The factors that affect a given set of data are listed as follows, ranked from the most influential to least: rate of return, capital employed, and average profit. In general, a company’s ability to build, preserve, and lose GW is influenced by a variety of internal and external factors. To protect and build GW over time, managing these elements effectively necessitates strategic planning, stakeholder engagement, and proactive risk management. Statistical tools like regression analysis and ANOVA will help determine the influence of various factors on GW, ensuring a comprehensive valuation. Consequently, this approach minimizes risks and supports strategic decision-making, leading to successful mergers and acquisitions. The percentage contribution and significance of the independent variables may change depending on the level values assigned. It is the designer’s responsibility to set proper level values.
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