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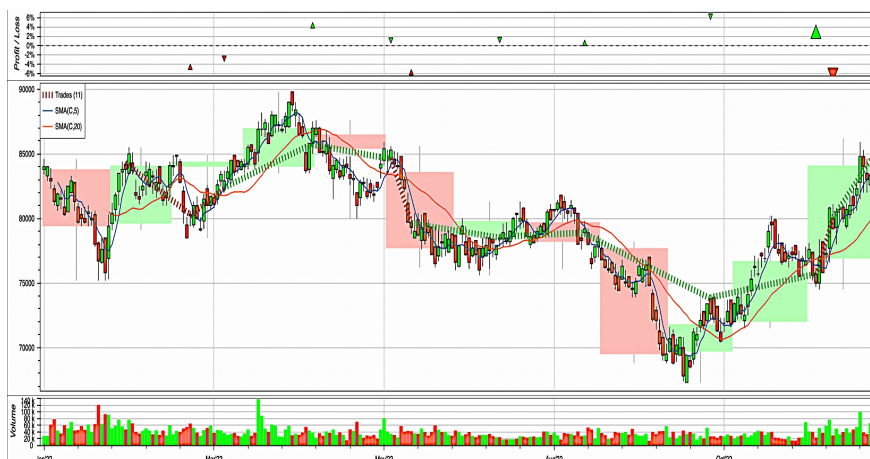
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## Stock Trading Using Fundamental Analysis

In the stock market, investors often seek out undervalued stocks in order to maximize returns. To achieve this goal, one common methodology used by market participants is fundamental analysis. The basic assumption of this approach is that a company's stock price should accurately reflect its true value. The analysis involves analyzing a company's financial and economic credentials to determine whether its current stock price reflects its true intrinsic value. This entails taking into account a variety of factors such as revenue, earnings, assets, liabilities, and other relevant metrics. The end goal of fundamental analysis is to help investors gain a better understanding of the company's financial health and growth potential, which in turn informs their investment decisions on whether to buy, sell, or hold a particular stock.

When it comes to assessing the value of a company, financial analysts often look at various metrics, including its price-to-earnings ratio (PER) and price-to-book ratio (PBR). These two indicators can provide insights into different aspects of a company's financial performance and prospects and are commonly used by investors to compare and evaluate different firms.



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# Theoretical Background

## PER

The Price-to-Earnings Ratio (PER) is a widely used metric in fundamental analysis that helps investors determine whether a company's stock price is overvalued relative to its peers in the same industry or sector. The PER ratio is calculated by dividing the company's market capitalization by its earnings. A high PER ratio suggests that investors are willing to pay a premium for the company's stock, which implies high expectations for the company's future growth potential. However, it is important to note that different industries have varying growth rates and risk profiles, so a high PER ratio may not necessarily be a negative indicator. Ultimately, the PER ratio is just one of many factors that investors should consider when evaluating a stock.

$$\text{P/E Ratio} = \frac{\text{Market value per share}}{\text{Earnings per share}}$$

## PBR

The Price-to-Book Ratio (PBR) is another widely used metric that measures the relationship between a company's stock price and its book value. The book value of a company is whatever that is left after the company completely liquidates its assets to pay off its liabilities reported from the balance sheet. The PBR is computed by taking the current share price and dividing it by its book value per share. Similar to the PER ratio, a high PBR ratio indicates that the market has high expectations of the company's future growth potential. It is again important to note that PBR comparisons should be made under the same industry as different industries may have different asset and liability structures. As a general rule of thumb, if a company's PBR ratio is lower than 1, indicates that the company is undervalued, while a ratio above 1 suggests that it may be overvalued in the market.

$$\text{P/B Ratio} = \frac{\text{Market value per share}}{\text{Book value per share}}$$

# Methodology

## Assumptions

The present report examines differences in PER and PBR ratios among businesses with varying market capitalization. In general, businesses with larger market capitalization tend to have higher PER ratios than smaller businesses, as they are often more established, have larger earnings and revenue streams, and are seen as more reliable and stable. Smaller businesses, on the other hand, may have lower PER ratios but higher PBR ratios, as they may have lower earnings and revenues but also lower liabilities and higher asset values. Additionally, small businesses may have higher growth potential and be more nimble and adaptable than large businesses, which can be reflected in their PBR ratios.

## Strategy

The fundamental analysis approach employed to identify potential stocks in each sector was based on the PER (Price-to-Earnings Ratio) and PBR (Price-to-Book Ratio). Firstly, The average PER and PBR ratios for each sector were calculated using multiple stocks listed in KOSPI. Based on the results, two stocks were selected from two different industries - one with a higher PER and PBR ratio than the sector's average, and one with a lower PER and PBR ratio. For simplicity purposes, the SMA crossover trading strategy was implemented using SMA5 and SMA20 to backtest the data over the past five years to evaluate the performance of the selections.

The sectors that we have chosen are financial holdings and chemical. Stocks chosen from each sector are as below:

- Financial Holdings : Shinhan Financial(055550), CJ(001040)
- Chemical : SKC (011790), Hanwha Solutions (009830)

## Process

Using the pyrx library, stock data for the KOSPI market spanning from 2018 to 2023 was collected, encompassing various stock attributes such as Open, Close, Volume, as well as fundamental indexes like PER and PBR. The stocks were then categorized based on their respective sector average values from year 2018-2023. To separate stocks in the financial holdings sector, an average PER value of 6.43 and an average PBR value of 0.52 was utilized. In the chemical sector, a PER value of 18.52 and a PBR value of 1.16 as the selection criteria. For the calculation of the average PER in chemical sector, an outlier of PER value of 110.28 from year 2020 was excluded.

As of 2018, CJ has a PER value of 25.25 with a PBR of 1.63 which has higher PER than the industry average. Within the same timeframe Shinhan Financial has a PER value of 5.95 and PBR of 0.52 with lower PER and PBR values than the industry average. For the financial sector, SKC has a PER value of 11.14 with PBR 0.84 and Hanhwa Solution with a PER value of 21.69 in 2018 and PBR of 0.66.

To examine the relationship between fundamental indices and the rate of return, a backtesting library was utilized to craft a class for the SMA cross strategy. The strategy is based on comparing the simple moving average of 5 and 20 days. A buy signal, indicated by a golden cross, is generated when the shorter SMA surpasses the longer interval SMA. A sell signal, indicated by a dead cross, is generated when the shorter SMA falls below the longer interval SMA. The strategy was implemented with an initial investment of KRW1,000,000 and commission rate of 0.001. A comparison between returns, buy and hold returns, and annual volatility was conducted in hopes to establish a connection between fundamental indexes and the rate of return.

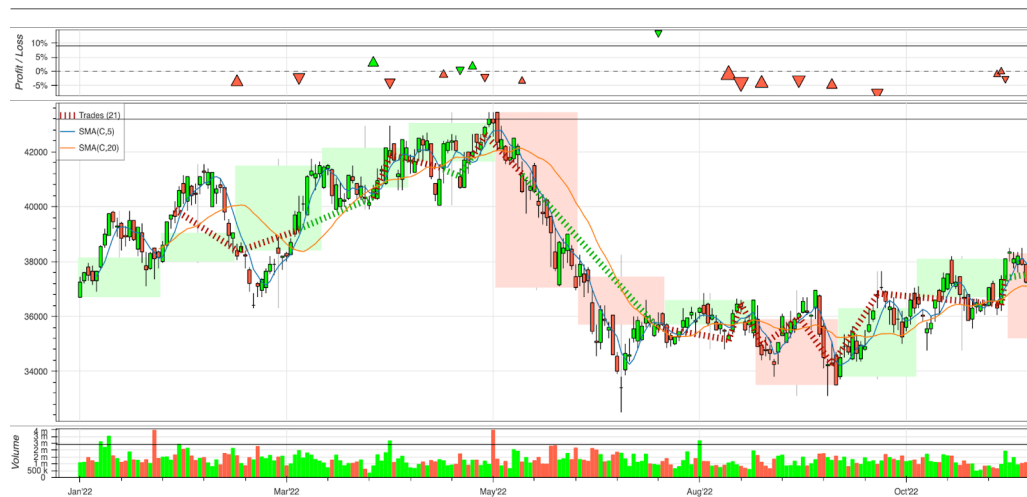
# Results

The results show a comparison of 4 stocks (CJ Corp, Shinhan Financial, Hanwha Solutions, SKC) across 2 sectors (Finance and Steel).

## 1. Financial Sector

- a. Low PER & PBR Stock: Shinhan Financial
- b. High PER & PBR Stock: CJ Corp

### Shinhan Financial



Stock Price Graph Reflects Period from 2022.01 - 2022.12

### CJ



Stock Price Graph Reflects Period from 2022.01 - 2022.12

	Returns (%)	Buy and Hold (%)	Annual Volatility (%)
Shinhan Financial	-24.72	-28.74	23.73
CJ Corporation	-17.61	-49.47	26.56

The table above shows that both stocks in the finance sector had negative return rates, with -24.72% for Shinhan Financial and -17.61% for CJ. Interestingly, the stock with the lower PER had a larger negative return rate but a better buy-and-hold rate of -28.74%, compared to -49.47%. One reason for this could be that a high PER ratio often indicates that investors have high expectations for a company's future earnings growth. If the company meets or exceeds these expectations, its stock price may continue to rise, generating higher returns for investors. However, high-PER stocks also carry higher risks. If the company fails to meet investor expectations, market participants may turn against the company, causing its stock price to fall, which may be reflected in the returns of the buy-and-hold strategy, as was the case with CJ.

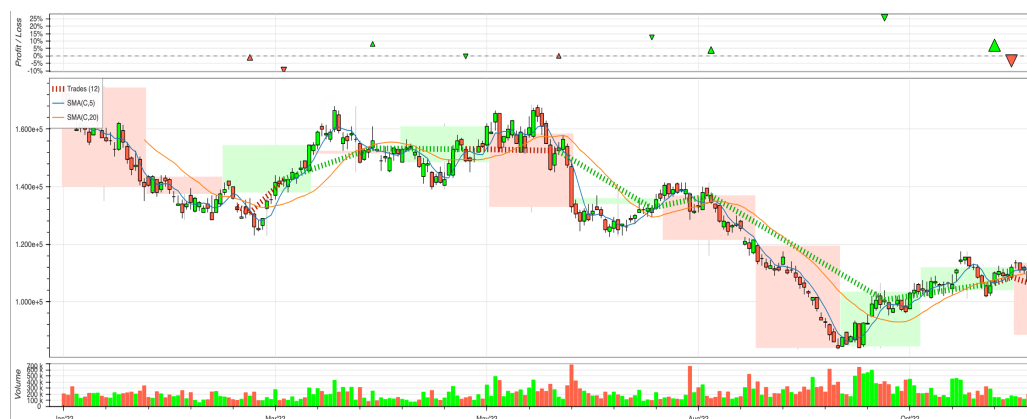
Another notable point is that there isn't a large discrepancy in the annual volatility rates, despite the large difference in market capitalization between the two corporations. Shinhan Financial has a market capitalization of 17.5 trillion KRW, while CJ Financial has a market capitalization of only 3 trillion KRW. One reason for this could be that companies listed on the Korean market may split their subsidiary businesses and list them separately, as was the case with CJ. Hence, such unseen factors may cause companies with a large difference in market capitalization to have similar volatility rates.

## 2. Chemical Sector

- Low PER & PBR Stock: SKC
- High PER & PBR Stock: Hanwha Solutions

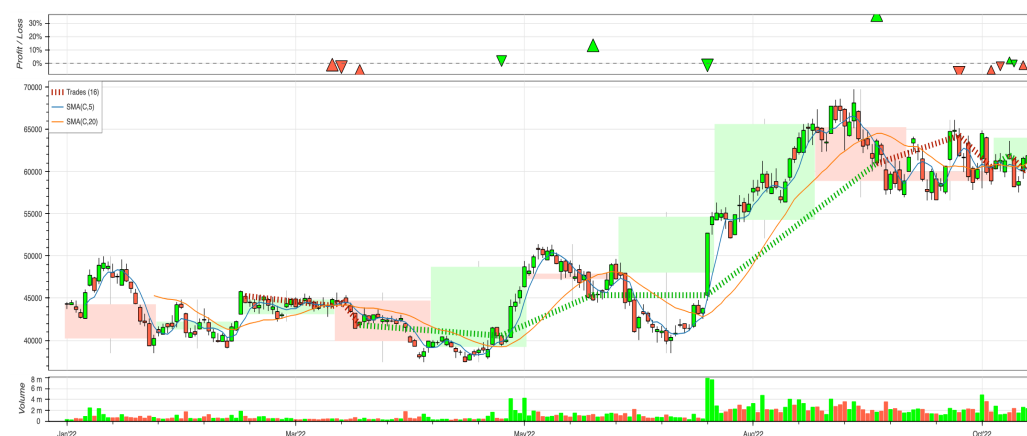
	Returns (%)	Buy and Hold (%)	Annual Volatility (%)
SKC	428.37	90.32	58.00
Hanwha Solutions	121.69	36.29	52.98

## SKC



Stock Price Graph Reflects Period from 2022.01 - 2022.12

## Hanhwa Solution



Stock Price Graph Reflects Period from 2022.01 - 2022.12

Moving on to the chemical industry, both SKC and Hanwha Solutions had positive returns of 428.37% and 121.69%, respectively. SKC was identified as a potential undervalued company in 2018, with its stock price not reflecting its true intrinsic value. The massive return rate potentially reflects the market's recognition of the company's value, leading to an increase in its stock price. The two companies also have similar volatilities, this was somewhat expected since both companies have similar market capitalization classified in the same industry sector.

## Conclusion

This report established a relatively simple trading strategy using fundamental analysis and backtested it to check its performance. The performance of stocks with a PER lower than the recent 5-year industry average PER and a PBR lower than 1 were selected and compared against those with higher PER and PBR metrics. Since only 4 stocks across 2 sectors were studied, it is difficult to draw a concrete conclusion as to whether selecting stocks with low PER and low PBR is an optimal trading strategy for investors, especially in the Korean market. There are several limitations associated with the current methodology:

### Limitations of SMA as a Backtesting Indicator

The Simple Moving Average (SMA) is a widely used method to analyze stock performance due to its simplicity but has several limitations when used to backtest the performance.

1. The SMA is a lagging indicator calculated based on the past prices of the current stock. This means that the SMA does not provide a forward-looking indication of future prices or returns, and therefore, may not be an accurate predictor of future performance.
2. The SMA does not capture market dynamics such as macroeconomic events, and fails to capture changing trends in the industry. These factors can have a significant impact on a stock's performance and cannot be captured by the SMA alone.
3. The SMA is based on a fixed time period which was 5 and 20 days for this report. The fixed time period may not be appropriate for the selected stocks, as different stocks may exhibit different trends that require different time periods to accurately capture their performance.

### "Korean Discount" Phenomena of KOSPI

The South Korean market has been historically associated with low valuations, primarily due to the weak corporate governance policies that have resulted in inefficient capital allocation. A significant portion of the shares of the company are owned by the family members of the founder. These members control the governance of the company, and have a tendency to view company funds as private assets leading to extremely low capital returns for ordinary shareholders and market participants. This has resulted in many South Korean companies accumulating large amounts of unused capital surplus and assets, ultimately leading to a lower return on equity (ROE). Low ROE rates have made investments in Korean companies less attractive for foreign investment, making it difficult for the Korean market to receive its actual market valuation.



### Possible Extensions

The scope of the report only covers two sectors: Finance and Chemical. While these two sectors outline a brief idea of how the PER and PBR metrics can be utilized for investors, it merely scratches the surface of fundamental analysis. On a broader scale, a cross industry analysis can be conducted, particularly for those sectors with greater growth prospects, where the average industry PER greatly exceeds the average market PER.

While stocks with a low PER and PBR ratio may be a desirable investment opportunity for investors, it is important to note that different industries and sectors have different average PER and PBR ratios. Companies with lower PER generally have lower growth prospects, which could limit their potential for significant long-term revenue generation. It is possible that undervalued stocks remain undervalued, and hence investors should conduct thorough research and analysis before making any investment decisions in these stocks.

# Appendix

Complete backtested results for Hanhwa Solution, SKC, Shinhan Finance, CJ,:

```
----- Shinhan Financial Group (055550) -----
Start                2018-01-02 00:00:00
End                  2022-12-29 00:00:00
Duration              1822 days 00:00:00
Exposure Time [%]    97.88961
Equity Final [$]     752767.65
Equity Peak [$]      1323565.3
Return [%]           -24.723235
Buy & Hold Return [%] -28.744939
Return (Ann.) [%]    -5.643558
Volatility (Ann.) [%] 23.734989
Sharpe Ratio         0.0
Sortino Ratio        0.0
Calmar Ratio         0.0
Max. Drawdown [%]    -47.225396
Avg. Drawdown [%]    -9.553687
Max. Drawdown Duration 741 days 00:00:00
Avg. Drawdown Duration 127 days 00:00:00
# Trades              82
Win Rate [%]         32.926829
Best Trade [%]        33.2666
Worst Trade [%]      -11.312392
Avg. Trade [%]        -0.355435
Max. Trade Duration   96 days 00:00:00
Avg. Trade Duration   22 days 00:00:00
Profit Factor         0.906359
Expectancy [%]        -0.186786
SQN                  -0.478566
_strategy             SmaCross
_equity_curve         ...
_trades               Size EntryB...
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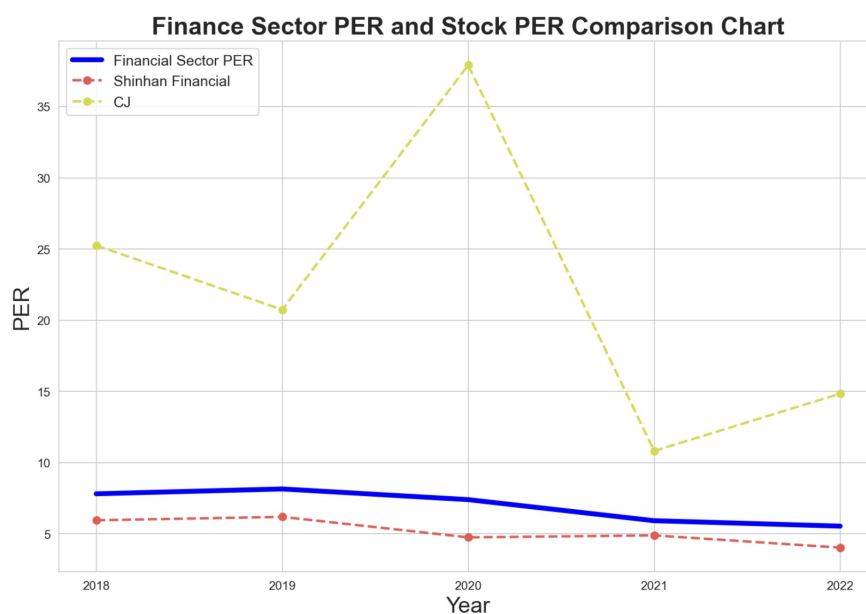
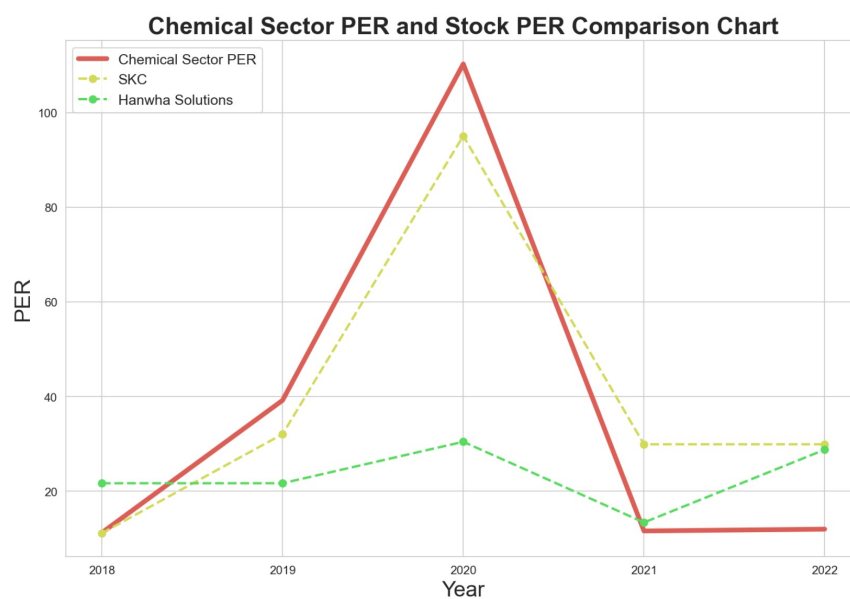
```
----- CJ Corp (001040) -----
Start                2018-01-02 00:00:00
End                  2022-12-29 00:00:00
Duration              1822 days 00:00:00
Exposure Time [%]    97.970779
Equity Final [$]     823879.725
Equity Peak [$]      1189829.125
Return [%]           -17.612027
Buy & Hold Return [%] -49.469156
Return (Ann.) [%]    -3.885187
Volatility (Ann.) [%] 26.558389
Sharpe Ratio         0.0
Sortino Ratio        0.0
Calmar Ratio         0.0
Max. Drawdown [%]    -41.918313
Avg. Drawdown [%]    -9.06292
Max. Drawdown Duration 1129 days 00:00:00
Avg. Drawdown Duration 127 days 00:00:00
# Trades              72
Win Rate [%]         36.111111
Best Trade [%]        21.39198
Worst Trade [%]      -11.963037
Avg. Trade [%]        -0.251718
Max. Trade Duration   70 days 00:00:00
Avg. Trade Duration   25 days 00:00:00
Profit Factor         0.987567
Expectancy [%]        -0.032148
SQN                  -0.37178
_strategy             SmaCross
_equity_curve         ...
_trades               Size EntryB...
```

```
----- SKC (011790) -----
Start                2018-01-02 00:00:00
End                  2022-12-29 00:00:00
Duration              1822 days 00:00:00
Exposure Time [%]    96.590909
Equity Final [$]     5283744.15
Equity Peak [$]      6684579.65
Return [%]           428.374415
Buy & Hold Return [%] 90.322581
Return (Ann.) [%]    40.564113
Volatility (Ann.) [%] 57.998445
Sharpe Ratio         0.6994
Sortino Ratio        1.603366
Calmar Ratio         0.645137
Max. Drawdown [%]    -62.876788
Avg. Drawdown [%]    -7.979774
Max. Drawdown Duration 531 days 00:00:00
Avg. Drawdown Duration 42 days 00:00:00
# Trades              62
Win Rate [%]         43.548387
Best Trade [%]        46.604987
Worst Trade [%]      -14.868967
Avg. Trade [%]        2.737698
Max. Trade Duration   113 days 00:00:00
Avg. Trade Duration   29 days 00:00:00
Profit Factor         2.248145
Expectancy [%]        3.5067
SQN                  1.350524
_strategy             SmaCross
_equity_curve         ...
```

```
----- Hanhwa Solution (009830) -----
Start                2018-01-02 00:00:00
End                  2022-12-29 00:00:00
Duration              1822 days 00:00:00
Exposure Time [%]    97.808442
Equity Final [$]     2216851.073
Equity Peak [$]      3518207.023
Return [%]           121.685107
Buy & Hold Return [%] 36.287885
Return (Ann.) [%]    17.684383
Volatility (Ann.) [%] 52.979336
Sharpe Ratio         0.333798
Sortino Ratio        0.618375
Calmar Ratio         0.278555
Max. Drawdown [%]    -63.48619
Avg. Drawdown [%]    -7.505111
Max. Drawdown Duration 840 days 00:00:00
Avg. Drawdown Duration 59 days 00:00:00
# Trades              67
Win Rate [%]         35.820896
Best Trade [%]        194.322192
Worst Trade [%]      -28.571802
Avg. Trade [%]        1.189455
Max. Trade Duration   169 days 00:00:00
Avg. Trade Duration   27 days 00:00:00
Profit Factor         1.880353
Expectancy [%]        2.909533
SQN                  0.540372
_strategy             SmaCross
```

## Appendix

Graphs showing comparison between average PER value of the sector and PER value of the stocks:



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