



BIMBO

Correlation of Commodities and the Stock Market

Industry: Food

Sector: Non-Cyclical Consumer

Multivariate Statistical Analysis

Objective

To explain the price behavior of Bimbo's stock according to different relevant variables through the Principal Component Analysis (PCA) model, a multivariate analysis method. This will serve as the basis for ARMA and ARCH models, allowing the prediction of the stock's behavior and addressing multicollinearity and conditional heteroscedasticity issues.

Justification

The price of Grupo Bimbo's stock is significantly influenced by macroeconomic variables such as the peso/dollar exchange rate, international wheat and gold prices, the IPC (Mexican Stock Exchange Index), and the company's returns, which were considered and verified through the econometric model. Therefore, it has been decided to employ a mathematical procedure known as Principal Component Analysis (PCA), which transforms a set of correlated variables into a reduced set of uncorrelated principal components. This approach will allow the identification and analysis of new underlying significant variables that impact the value of Grupo Bimbo's stock.

Variables

- Bimbo Stock Price
 - Gold Commodity
 - Wheat Commodity
 - Sugar Commodity
 - Natural Gas Commodity
 - Oil Commodity
 - Corn Commodity
- Mexican Stock Index
 - U.S. Stock Index (S&P)
 - U.S. Stock Index (NY)
 - Canada Stock Index
 - Spain Stock Index
 - Brazil Stock Index
 - Exchange Rate (USD/MXN)
- Exchange Rate (MXN/USD)
 - U.S. Interest Rate
 - PepsiCo
 - Mondelez
 - General Mills
 - Kellogg's
- <https://mx.investing.com>

PCA Process

The analysis is carried out on the variance-covariance matrix Σ . In the process, new variables called principal components are formed in descending order of importance, allowing for the reduction of the dimensionality of the considered database matrices.

Hypothesis

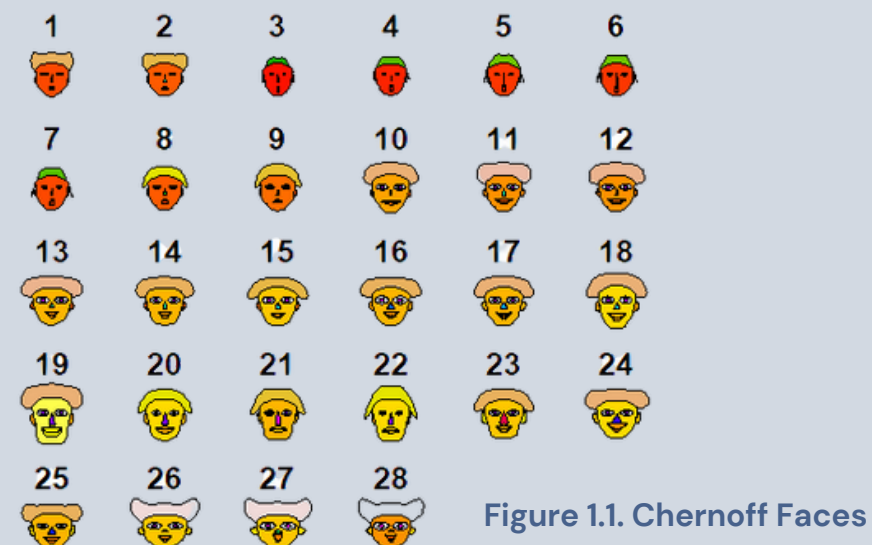
We consider that Grupo Bimbo's stocks do not have an optimistic short-term outlook.

Statistical Method: Principal Component Analysis (PCA)

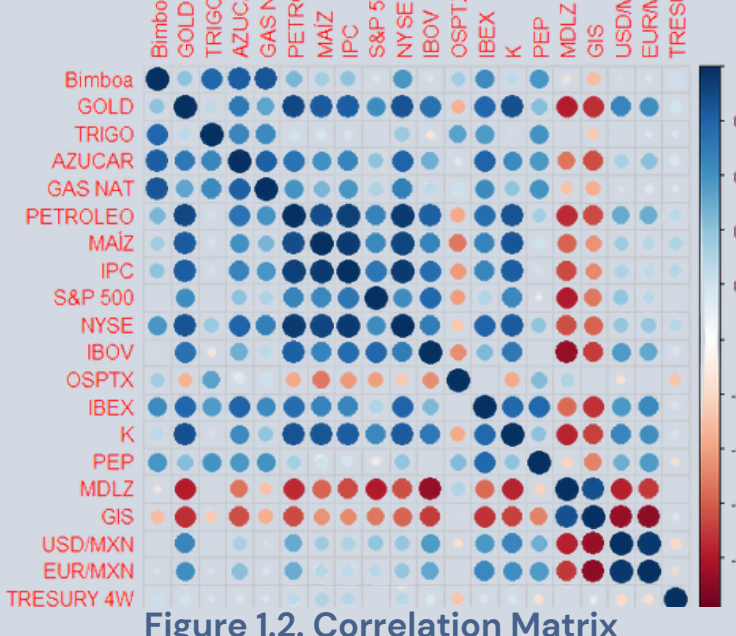
- The first principal component variable is defined as: $Y_1 = a_1'(x - \mu)$; x : individual
- Where a_1 is chosen so that the variance of $a_1'(x - \mu)$ is maximized over all vectors a_1 that satisfy $a_1' \cdot a_1 = 1$
- By construction, the maximum value of the variance of $a_1'(x - \mu)$ among all vectors a_1 that satisfy $a_1' \cdot a_1 = 1$ equal to λ_1 , the largest eigenvalue of Σ and that this maximum occurs when a_1 is an eigenvector of Σ corresponding to eigenvalue λ_1 and that satisfies $a_1' \cdot a_1 = 1$
- The second principal component variable is defined as: $Y_2 = a_2'(x - \mu)$; x : individual
- Where a_2 is chosen so that the variance of $a_2'(x - \mu)$ be a maximum among all those linear combinations of x that are not correlated with the first principal component variable and have: $a_2' \cdot a_2 = 1$
- By construction, the maximum value of the variance of $a_2'(x - \mu)$ between all linear combinations of x that have $a_2' \cdot a_2 = 1$ and that are not correlated with Y_1 is equal to λ_2 , the second largest eigenvalue of Σ and that this maximum occurs when a_2 is an eigenvector of Σ corresponding to the second largest eigenvalue λ_2 and that satisfies $a_2' \cdot a_2 = 1$
- The process for n eigenvalues is followed
- The first principal component accounts for as much of the variability in the data as possible
- Each subsequent component takes into account as much of the remaining variability as possible

Preliminary Results

Based on the closing prices from 2019 to 2024, considering a total of 28 recorded data points. The data analysis will be conducted using the R package.



According to Chernoff Faces (Figure 1.1), which help identify atypical behaviors, the data is represented by associating various variables with different facial features. It is observed that the closing price has experienced constant growth during the established period.



Based on the Correlation Matrix (Figure 1.2), a high correlation is observed among the selected variables, such as gold, wheat, sugar, the IPC (Mexican Stock Exchange Index), and the S&P 500 Index. This relationship provides a clearer understanding of the factors influencing the stock price behavior and reinforces the usefulness of the PCA model, which will allow the reduction of the number of variables.

Importance of components:			
	Comp.1	Comp.2	Comp.3
Standard deviation	3.7192491	1.5027309	1.40247364
Proportion of Variance	0.6287643	0.1026455	0.08940601
Cumulative Proportion	0.6287643	0.7314097	0.82081574

Table 1.1. Importance of Components

Based on Table 1.1, where the PCA model is applied, it can be observed that with three components, 82% of the data can be represented.

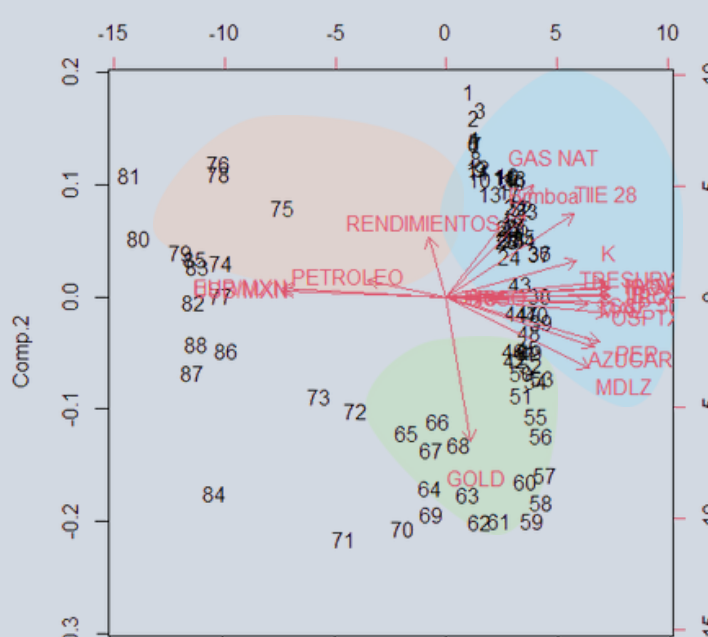


Figure 1.3. Principal Component Graph

With the obtained data, we can conclude that with three components, the behavior of the 20 variables influencing Bimbo's stock price can be explained. The visualization of the grouping is shown in the Principal Component Graph (Figure 1.3). Based on the results obtained, the three identified groups are renamed as the following underlying significant variables:

- Gold
- IPC (Mexican Stock Exchange Index)
- Wheat Price

Final Model

A reliable, valid, and accurate model will allow for a precise description, diagnosis, and forecasting of the represented reality, for which we used EViews. Using the LOG-LOG model with the variables: gold, wheat, and the IPC, which are the variables that best explain the stock price. We included two terms, ARCH and ARMA, to correct for conditional heteroscedasticity and autocorrelation. B1B_1B1 represents the elasticity of Y with respect to X. It is the percentage change in Y for each percentage point change in X.

Dependent Variable: LY Method: ML - ARCH Date: 12/05/24 Time: 21:20 Sample (adjusted): 11/29/2019 11/13/2024 Included observations: 1250 after adjustments Convergence achieved after 124 iterations Coefficient covariance computed using outer product of gradients MA Backcast: 10/16/2019 11/27/2019 Presample variance: backcast (parameter = 0.7) GARCH = C(8) + C(9)*RESID(-1)^2 + C(10)*RESID(-2)^2				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-2.634724	0.676325	-3.895648	0.0001
LX1	0.042098	0.020578	2.045818	0.0408
LX2	-0.079015	0.022019	-3.589461	0.0003
LX7	0.857275	0.042890	15.28909	0.0000
AR(1)	0.999003	0.001843	542.1416	0.0000
MA(1)	-0.227654	0.032438	-7.018146	0.0000
MA(31)	0.065916	0.024990	2.637694	0.0083
Variance Equation				
C	0.000283	1.33E-05	21.25951	0.0000
RESID(-1)^2	0.177567	0.037306	4.759749	0.0000
RESID(-2)^2	0.106340	0.021179	5.020879	0.0000
R-squared	0.996405	Mean dependent var	4.072374	
Adjusted R-squared	0.996448	S.D. dependent var	0.332157	
S.E. of regression	0.019796	Akaike info criterion	-5.045712	
Sum squared resid	0.487125	Schwarz criterion	-5.004664	
Log likelihood	3163.570	Hannan-Quinn criter	-5.030281	
Durbin-Watson stat	1.897208			

Elasticity of Key Variables:

- Stock price relative to gold: 0.042 (positive and weak relationship).
- Stock price relative to wheat: -0.079 (inversely proportional, reflecting the impact on key input costs).
- Stock price relative to IPC: 0.065 (moderate impact from the local market).

Forecast

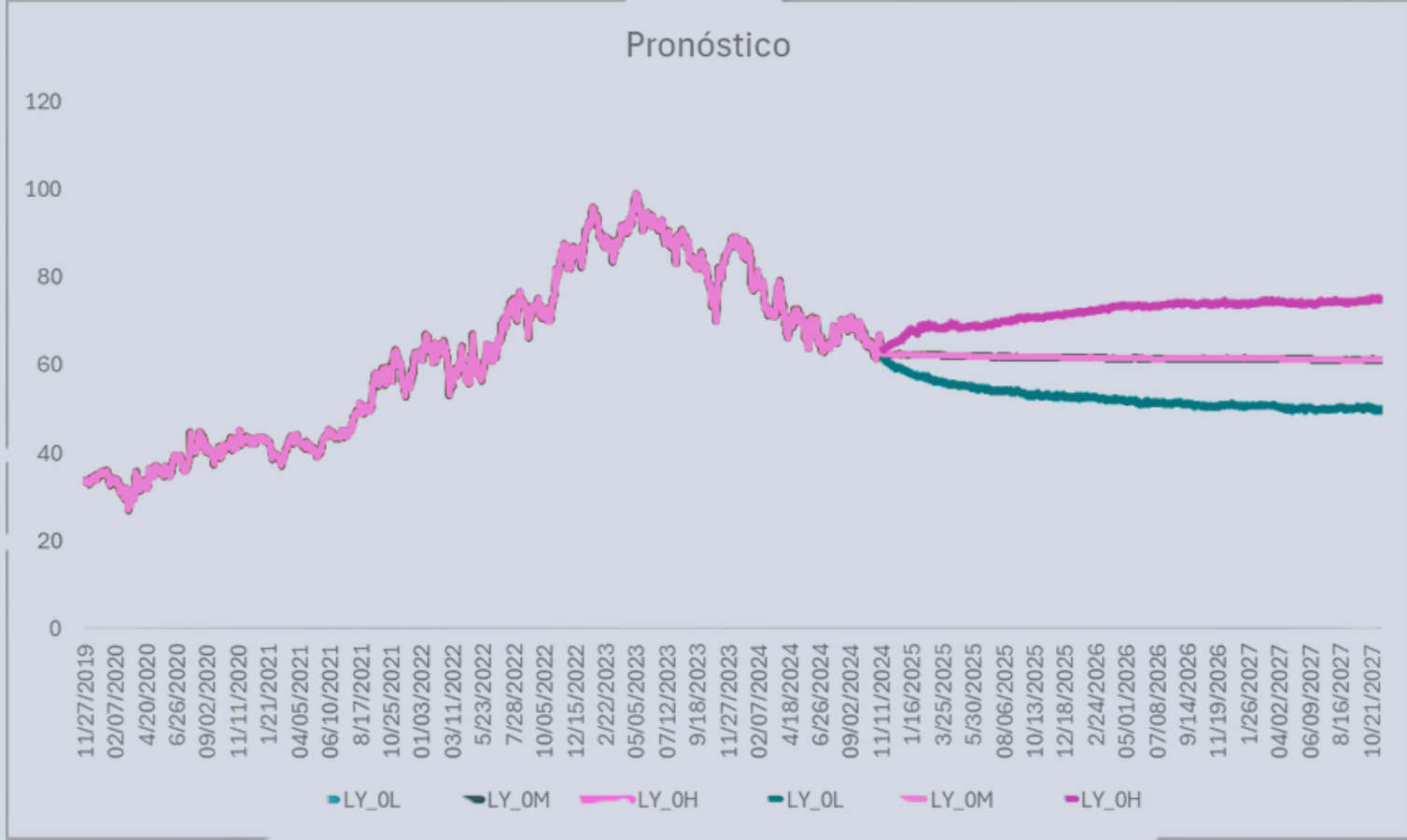
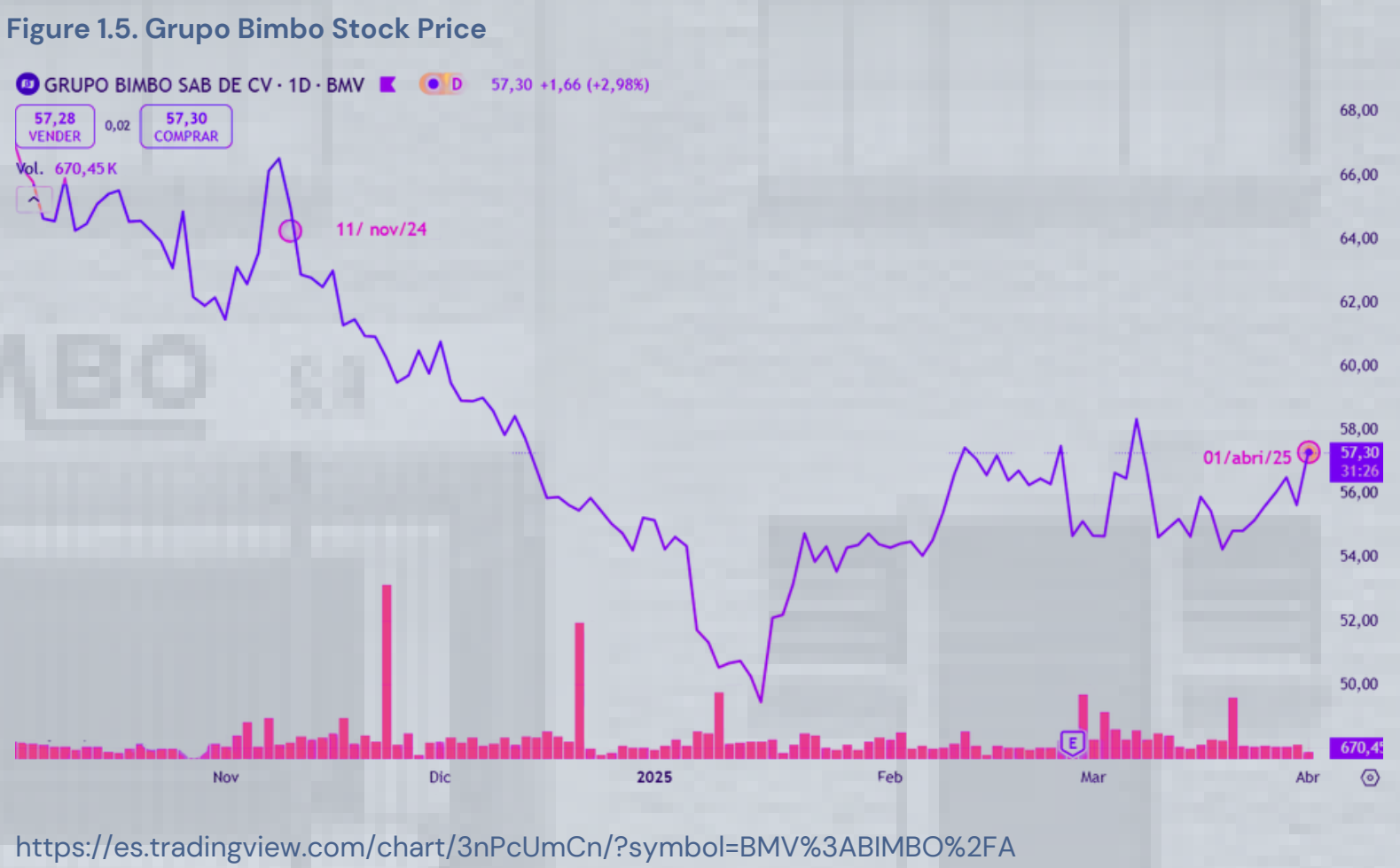


Gráfico 1.4. Gráfico de pronóstico realizado por EViews.

Our last actual price was 62.64. We made three forecasts: optimistic, medium, and pessimistic, projected in EViews (Figure 1.4). The medium and pessimistic forecasts indicate a downward trend, averaging between 52.65 and 61.67, while the optimistic scenario predicts an average price of 72.02.

Recomendations

Due to the current political and social situation worldwide, we consider that the stock price behavior will likely continue its course between the pessimistic and medium scenarios, close to the levels of the latest prices observed in Figure 1.5. Forecasts suggest refraining from purchasing, given the expected loss of value in conservative scenarios.



https://es.tradingview.com/chart/3nPcUmCn/?symbol=BMV%3ABIMBO%2FA

References:

- Investing.com. (2025). Historical Data. Retrieved on March 20, 2025, from <https://mx.investing.com>
- TradingView. (2025). Bimbo/A (BMV) Stock Chart. Retrieved on March 27, 2025, from <https://es.tradingview.com/chart/3nPcUmCn/?symbol=BMV%3ABIMBO%2FA>
- De la Garza, Jorge. Multivariate Statistical Analysis: A Technical and Practical Approach. McGraw Hill, Spain, 2012.

Conclusions

Based on the analysis conducted, it is concluded that the stock price of Grupo Bimbo is significantly influenced by macroeconomic variables such as gold, wheat prices, and the IPC, resulting in a simplified model. Through the use of Principal Component Analysis (PCA) and econometric LOG-LOG models, along with the inclusion of ARCH variables, the most relevant factors explaining the stock price behavior were identified, highlighting the inversely proportional relationship with wheat and the positive correlation with the IPC. These findings enable forecasts under different scenarios, where the average estimated price remains around 62.64, with an optimistic projection reaching up to 72.02.

- Veliz, Carlos. Multivariate Analysis, Multivariate Statistical Methods for Research. Cengage, Spain, 2016.
- Gujarati, D. N. (2010). Econometrics (5th ed.). McGraw-Hill.
- R Package
- EViews Package