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Fractal modeling of international financial rate

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This article shows the development of the Lagrangian, Itô's motto and Koch's principle economic models, focused on the company Industria Peñoles, S.A.B. de C.V., using the stock data from the Mexican Stock Exchange. Here are five cases that were developed based on fractal geometry, for making models. By making each model will allows more realistically observe the behavior of the company in the market.To conclude, the percentage result of the three models will be compared, in order to determine which one has profit performance above the others, or possibly a loss.

Peñoles, Dimensional's, Interest rate, Fractal, Variables, Brownian, Mexican Stock Exchange

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Introduction

The current state of fractals art has a close relationship with the financial markets, due to the use of derivatives of fractal geometry instruments which allows carrying out a more accurate assumptions analysis, providing more solidity in the results interpretation. Knowing the stock data of a company in the market, enabling the development of models based on assumptions, most of the time are not able to show it realistically, and how these data will move in a set period of time, for this reason the existence of efficient markets may not be possible due to high and unstable volatility in the financial market. his article shows the development of five assumptions derived from fractal geometry, which are: interest rate, 1st dimension (one-dimensional), 2nd dimension (two-dimensional), 3rd dimension (three-dimensional) and 4th dimension (fractal), in order that the above analysis of the company Industria Peñoles SAB de C.V. is more realistic.The representation of the cases above mentioned in this study will provide important knowledge, since using the fractal dimension, will be to compared economic-financial company results in short and long term, the economic-financial situation of the company, that is, at the end result of each models is positive will be the yield achieved by the company, otherwise the loss that could be incurred in the market.

Methodology

The stock data located on the Mexican Stock Exchange, of Peñoles Industry S.A.B. de C.V. considering economic-financial company up to April 2016, we set out three economic models, with certain variables to reach the target. These numerical values provide the context of operations in the stock market in order to analyze the financial situation of the company.

You will find bellow the detail development cases in each model, starting with the assumptions base.

Base Assumptions

These assumptions are the basis by which the three economic models were developed to analyze. For each of these assumptions, it is necessary to know the essential variables for its development. The variables to be used: Inflation π = 2.60, Deflation Dπ = 2.12,Interest rate Ti = 3.75,Financing F = 0.50 ,Financial leverage A = 0.25 ,Total cost Ct = -1 ,Margin Mg = 1, Finite α = 1,Infinite ϴ = -1,Weighted average price PPP = 262.18,Exchange rate Tc = 17.3395,Stock outstanding AC = 397, 475, 747,Long-term Lp = 12 months ,Short-term Cp = 6 months, Golden mean $3/4$ = 0.75 and Brownian $1/2$ = 0.50

A PPP and AC logarithm is applied to smooth the data, being as follows:

$$\text{PPP} \rightarrow \log 262.18 = 2.4186$$
$$\text{AC} \rightarrow \log 397{,}475{,}747 = 8.5993$$

To determine the rate interest case, it will be necessary develop:

$$Ti = \left[\frac{PPP}{(Mg-CT)}\right]\left[\frac{3/4 - 1/2}{(Lp-Cp)^{3/4}}\right]^{Tc} \qquad (1)$$

Replacing:

$$Ti = \left[\frac{2.4186}{(1-(-1))}\right]\left[\frac{0.75-0.50}{(12-6)^{0.75}}\right]^{17.3395} =$$
$$[1.2093]\left[\frac{0.25}{3.8336}\right] =$$
$$(1.2093)\,(0.0652)^{17.3395^{17.3395}} =$$
$$(1.2093)\,(0.2752) = 0.3328 \qquad (2)$$

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By raising 0.0652 by the 17.3395 potency, shows a little result, that's why the rescaled range analysis will be used.The obtained result of the interest rate is, 0.3328.First Dimension, the basis for determining the course is as follows:

$$1°\ D = \left[\frac{F+A\ {}^{1}/_{2}}{\propto - \pi}\right]^{3/4} = \left[\frac{0.50+0.25+0.50}{1\ -2.60}\right]^{0.75} = \left[\frac{1.25}{-1.60}\right]^{0.75} (-0.7812)^{0.75} \quad (3)$$

Then it is unable to raise a negative number to a fractional potency, so it is taken as an absolute value, it means, the sign is suppressed.

$$|-0.7812| = 0.7812 = (0.7812)^{0.75} = 0.8309 \quad (4)$$

The base assumption result for the first dimension is, 0. 8309.The assumption for the second dimension to be developed:

$$2\ °\ D = \left[\frac{F+A-\ {}^{3}/_{4}}{\theta+D\pi}\right]^{1/2} = \left[\frac{0.50+0.25-0.75}{(-1)+2.60}\right]^{0.50} = \left[\frac{0}{1.6}\right]^{0.50} = (0)^{0.50} \quad (5)$$

The result is 0, for the second dimension.

$$3°\ D = \left[\frac{F+A}{\left[\frac{\log AC}{\ln Ti}\right]}\right]^{1/2} = \left[\frac{0.50+0.25}{\left[\frac{8.5993}{1.3217}\right]}\right]^{0.50} = \left[\frac{0.75}{6.5062}\right]^{0.50} = (0.1153)^{0.50} = 0.33 \quad (6)$$

The result for the third dimension is 0. 3395.The assumption used for the fourth dimension

$$4°\ D = \left[\frac{F+A}{\theta} + AC\right]^{3/4} = \left[\frac{0.50+0.25}{-1} + 8.5993\right]^{0.75} [(-0.75) + 8.5993]^{0.75} (7.8493)^{0.75} = 4.6894 \quad (7)$$

The result is 4.6894 for the fourth dimension.

In the Lagrangian model all numbers with large digits become small numbers, logarithms, neperians and antilogarithms are implemented to reduce digits.Therefore, the base assumptions began to clear depending on its original structure.In this modeling the logarithm of golden mean and Brownian neperian average it is determined:

$$\mathbf{{}^{3}/_{4}} \rightarrow \log 0.75 = -0.1249$$
$$\mathbf{{}^{1}/_{2}} \rightarrow \ln 0.50 = -0.6931$$

The Lagrangian modeling interest rate assumption is:

$$Ti = \left[\frac{\log PPP}{\frac{Mg}{Ct}}\right] \left[\frac{\log {}^{3}/_{4} - \ln {}^{1}/_{2}}{\frac{Lp-Cp}{{}^{3}/_{4}}}\right]^{Tc} \quad (8)$$

In this case we will maintain the PPP variable.

Assumption replacing:

$$Ti = \left[\frac{2.4186}{\frac{1}{-1}}\right] \left[\frac{(-0.1249)-(-0.6931)}{\frac{12-6}{0.75}}\right]^{17.3395} (-2.4186) \left[\frac{0.5682}{8}\right]^{17.3395} (-2.4186)\ (0.0710)^{17.3395} \quad (9)$$

In this case, similarly rescaled range analysis is used, due to the size of the potency.

$$Ti = (-2.4186)\ (0.0121) = -0.0293$$

The result is -0.0293 for the interest rate.

For the four dimensions are determined by the F logarithm and the A neperian:

$$\mathbf{F} \rightarrow \log 0.50 = -0.3010$$
$$\mathbf{A} \rightarrow \ln 0.25 = -1.3863$$

The assumption with the 1st dimension remains as:

$$1°\ D = \left[\frac{\frac{\log F + \ln A}{{}^{1}/_{2}}}{\frac{\propto}{\pi}}\right]^{3/4} = \left[\frac{\frac{(-0.3010)+(-1.3863)}{0.50}}{\frac{1}{2.60}}\right]^{0.75} = \left[\frac{\frac{-1.6873}{0.50}}{0.3846}\right]^{0.75} = \left[\frac{-3.3746}{0.3846}\right]^{0.75} = (-8.7743)^{0.75} |-8.7743| = 8.77 \quad (10)$$

Taking the absolute value:

$$1°\ D = (8.7743)^{0.75} = 5.09 \qquad (11)$$

According to the modeling of the second dimension assumption:

$$2°\ D = \left[\frac{\frac{\log F + \ln A}{3/4}}{\frac{\theta}{D\pi}}\right]^{1/2} = \left[\frac{\frac{(-0.3010)+(-1.3863)}{0.75}}{\frac{-1}{2.12}}\right]^{0.50} =$$

$$\left[\frac{\frac{-1.6873}{0.75}}{-0.4717}\right]^{0.50} = \left[\frac{-2.2497}{-0.4717}\right] = 2.18 \qquad = 2.1 \ (12)$$

We have to determine an AC antilogarithm, for this dimension:

$$AC \rightarrow \ \text{Anti}\log 8.5993 = 0.9345 =$$

$$\left[\frac{\log F + \ln A}{[Anti \log AC - Ti]}\right]^{1/2} =$$

$$\left[\frac{(-0.3010)+(-1.3863)}{[Anti \log 8.5993 - 3.75]}\right]^{0.50} = \left[\frac{-1.6873}{[0.9345-3.75]}\right]^{0.50} =$$

$$\left[\frac{-1.6872}{-2.8155}\right]^{0.50} = (0.5992)^{0.50} = 0.77 \qquad (13)$$

In the Lagrangian modeling the assumption remains:

$$4°\ D = \left[\frac{\log F + \ln A}{\frac{\theta + AC}{3/4}}\right] = \left[\frac{(-0.3010)+(-1.3863)}{\frac{(-1)+8.5993}{0.75}}\right] =$$

$$\left[\frac{-1.6873}{\frac{7.5993}{0.75}}\right]\left[\frac{-1.6873}{10.1324}\right] = -0.16 \qquad (14)$$

Within this model, it requires to follow these rules, all that is logarithm becomes limit

$\log \rightarrow \lim$ equivale 0.618 that is neperian becomes differential or derivative, the value of each will be successively applied. The number depends on how many neperians are in the assumption, the interest rate assumption, the modeling is:

$$Ti = \left[\frac{\lim PPP}{\frac{Mg}{Ct}}\right]\left[\frac{\lim 3/4 - \frac{d}{d_1} 1/2}{\frac{Lp-Cp}{3/4}}\right]^{Tc} =$$

$$\left[\frac{(0.618 \times 2.4186)}{\frac{1}{-1}}\right]\left[\frac{(0.618\times 0.75)-(0.50\times 0.50)}{\frac{12-6}{0.75}}\right]^{17.3395} =$$

$$\left[\frac{1.4947}{-1}\right]\left[\frac{0.4635-0.25}{8}\right]^{17.3395} =$$

$$\left[\frac{1.4947}{-1}\right]\left[\frac{0.2135}{8}\right]^{17.3395} =$$

$$(-1.4947)\,(0.0267)^{17.3395} =$$

$$(-1.4947)\,(0.0267)^{17.3395} \qquad (15)$$

The rescaled range analysis is used due the potency size

$$Ti = (-1.4947)\,(0.0520) = -0.07 \qquad (16)$$

For the four dimensions are determined by the F limit and the A differential or derivative:

$$F \rightarrow \ \lim 0.50 = 0.30$$

$$A \rightarrow \ \frac{d}{d_1} 0.25 = 0.12$$

The assumption in the model is:

$$1°\ D = \left[\frac{\frac{\lim F + \frac{d}{d_1} A}{1/2}}{\frac{\propto}{\pi}}\right]^{3/4} = \left[\frac{\frac{0.309+0.125}{0.50}}{\frac{1}{2.60}}\right]^{0.75} =$$

$$\left[\frac{0.868}{0.3846}\right]^{0.75} = (2.2569)^{0.75} = 1.84 \qquad (17)$$

According to the modeling the assumption is:

$$2°\ D = \left[\frac{\frac{\lim F + \frac{d}{d_1} A}{3/4}}{\frac{\theta}{D\pi}}\right]^{1/2} = \left[\frac{\frac{0.309+0.125}{0.75}}{\frac{-1}{2.12}}\right]^{0.50} =$$

$$\left[\frac{0.5787}{-0.4717}\right]^{0.50} = (-1.2268)^{0.50} \qquad (18)$$

Taking the absolute value:

$$|-1.2268| = 1.2268 = (1.2268)^{0.50} = 1.10$$

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For this dimension, the AC partial has to be determined:

AC $\rightarrow \quad \partial\, 8.5993 = 6.44$

The assumption remains:

$$3°\ D = \left[\frac{\lim F + \frac{d}{d_1}A}{\partial AC - Ti}\right]^{1/2} = \left[\frac{0.309+0.125}{6.4495-3.75}\right]^{0.50} =$$

$$\left[\frac{0.434}{2.6995}\right]^{0.50} = (0.1608)^{0.50} = 0.40 \qquad (19)$$

The assumption for this modeling is:

$$4°\ D = \left[\frac{\lim F + \frac{\mathrm{d}}{\mathrm{d}_1}A}{\frac{\theta + AC}{3/4}}\right] = \left[\frac{0.309+\ 0.125}{\frac{(-1)+8.5993}{0.75}}\right] =$$

$$\left[\frac{0.309+0.125}{\frac{7.5993}{0.75}}\right] = \left[\frac{0.434}{10.1324}\right] = 0.0428 \qquad (20)$$

Koch's principle modeling is similar than Itô's motto, using the same bases as Lagrangian model.The antilog will become as the following formula:

$$1/2\,\frac{d}{d_1} + 3/4\,\frac{d}{d_2} =$$

$$\left[\frac{1/2\,PPP}{\frac{Mg}{Ct}}\right]\left[\frac{1/2\,\partial/\partial_{II} - 3/4\,\partial/\partial_I}{\frac{Lp-Cp}{\partial/\partial_{II}}}\right]^{Tc} \qquad (21)$$

Replacing:

$$Ti = \left[\frac{(0.50\times 2.4186)}{\frac{1}{-1}}\right]\left[\frac{(0.50\times 0.75)-(0.75\times 0.25)}{\frac{12-6}{0.75}}\right] =$$

$$\left[\frac{1.2093}{-1}\right]\left[\frac{0.375-0.1875}{8}\right]^{17.3395} (-1.2093)\,(0.0234)^{17.3395} \qquad (22)$$

The rescaled range analysis is used due the potency size.

$$Ti = (-1.2093)\,(0.5285) = -0.63$$

Fort the four dimension, it will be determined by the F Brownian and the A golden mean:

F $\rightarrow \quad 1/2\ 0.50 = 0.125$

A $\rightarrow \quad 3/4\ 0.25 = 0.1875$

In the 1st dimension the assumption model is:

$$1°\ D = \left[\frac{\frac{1/2\,F + 3/4\,A}{\partial/\partial_I}}{\frac{\propto}{\pi}}\right]^{\partial/\partial_{II}} = \left[\frac{\frac{0.125+0.1875}{0.25}}{\frac{1}{2.60}}\right]^{0.75} =$$

$$\left[\frac{1.25}{0.3846}\right]^{0.75} = (3.2501)^{0.75} = 2.42 \qquad (23)$$

According to the model assumption is:

$$2°\ D = \left[\frac{\frac{1/2\,F + 3/4\,A}{\partial/\partial_{II}}}{\frac{\theta}{D\pi}}\right] = \left[\frac{\frac{0.125+0.1875}{0.75}}{\frac{-1}{2.12}}\right]^{0.25\ \partial/\partial_I} =$$

$$\left[\frac{0.4167}{-0.4717}\right]^{0.25} = (-0.8834)^{0.25} = 0.96 \qquad (24)$$

For this dimension, is necessary to determine the formula that multiplies AC $(0.25\times 0.50) + (0.75\times 1.0)$ $= 0.87$ AC $\rightarrow \quad 0.875\times 8.5993 = 7.52$

The assumption is:

$$3°\ D = \left[\frac{1/2\,F + 3/4\,A}{\left(1/2\frac{d}{d_1} + 3/4\frac{d}{d_2}AC\right) - Ti}\right]^{\partial/\partial_I} =$$

$$\left[\frac{0.125+0.1875}{7.5244-3.75}\right]^{0.25} = \left[\frac{0.3125}{3.7744}\right]^{0.25} = (0.0828)^{0.25} = 0.53 \qquad (25)$$

The assumption for this modeling remains:

$$4°\ D = \left[\frac{1/2\,F + 3/4\,A}{\frac{\theta+AC}{\partial/\partial_{II}}}\right] = \left[\frac{0.125+\ 0.1875}{\frac{(-1)+8.5993}{0.75}}\right] =$$

$$\left[\frac{0.3125}{10.1324}\right] = 0.03 \qquad (26)$$

Conclusion

In the development of the three economic models: Lagrangian, Itô's motto and Koch's principle, the following results were obtained:

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Lagrangian- Ti = -0.0293,1°D = 5.0981,2°D = 2.1839,3°D = 0.7741 and 4°D = -0.1665- Itô's motto Ti = -0.0778,1°D = 1.8413,2°D = 1.1076,3°D = 0.4010,4°D = 0.0428- Koch's principle Ti = -0.6391,1°D = 2.4206,2°D = 0.9695,3°D = 0.5364 and 4°D = 0.0308 to obtain the yield or loss of the company Industrias Peñoles S.A.B de C.V., the following operation is perform in each one of the results of the three models:

$$\frac{Ti+1°D+2°D+3°D+4°D}{5} \times 100 \qquad (27)$$

Observing the results expressed in percentage it stands that through the Lagrangian method a higher result is obtained in performance with the company respecting the rest two other methods, though, is important considering that no one of the results appears negative, so it shows that the company will have an efficient performance in the market. It should be noted that by using the fractal geometry instruments, the results obtained are more realistic and reliable.

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