Fixed Assets-Infrastructure and Financial Health in Hospitality Industry: A chaotic effect in Emerging Markets

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Abstract: The influence of property, plant and equipment (Fixed Assets) and the quality of infrastructure on return was analyzed in the hospitality industry in emerging markets. The analysis unit was Colombia, a member of the CIVETS emerging market group. Financial healthwas determined by the relationships among return on fixed assets ratio,fixed assets net worth and fixed assets turnover ratios. Besides, the degree of accomplishment of the government plans to improve the quality of infrastructure was considered an indicator of an adequate infrastructure. Transformation by Hénon map equations were applied to data and a recurrence plot, phase space and recurrence quantification analysis were obtained. It was determined the influence of fixed assets net worth and turnoveron the return on fixed assets, and then, the influence of infrastructures on return on fixed assets. A non-linear, non-monotonic relationship existedamongreturn on fixed assets, fixed assets net worth and fixed assets turnover ratios, making investment decision difficult. An adequate development of infrastructure tended to relax the parameters of recurrence, slightly promoting a more steady development of the firms.

Key-Words: Hospitality industry, fixed assets, infrastructure, financial health, recurrence, chaos, emerging markets.

1 Introduction

Assets, such as properties, plant and equipment, are essentials to the hospitality industry. The impairment of assets affects future cash flows [1] and profits; they prevail along the time [2] and are linked to capital structure decisions and production [3] or service.

The replacement allowance of furniture, fixtures and equipment is crucial in valuation of hotels[4] and contracts between owners and operators [5]. Besides, infrastructure and technology are crucial [6]in commercial and development issues [7] and successful hotels are dependent on infrastructure [8] and the development context of their locations[9].

In emerging markets, politics matter [10] and policymakers must judge their past policies [11]as well as pay attention to cyclical change in regional economies [12].In this sense, a non-linear and chaotic effect,in the business financial growth,have been pointed out [12, 13, 14, 15], and, accordingly, better facilities or investment in infrastructure can lead to past financial positions, without no increase in profit.

This constitutes a main issue in this industry, where the huge amount of investment in fixed assets (FA) demands to continue in business.

2 Problem Formulation

The linear interpretation that given certain improvement in some conditions, the industry will develop in a proper manner might not be correct. An increase in reserves for maintaining the quality of the hotel facilities, and doing the necessary upgrade will not always result in a better occupancy and profits.

Not paying attention to past states and assuming a linear effect of public or private policy of investment, may lead to confusing results, especially in emerging markets, where many factors affect economic sectors.

Therefore, the influence of the FA volume and infrastructure on indicators of financial position, performance and profits could follow a non-linear trend weakening these indicators, or keeping them in a recurrence state, instead of leading to better results. Accordingly, the hypothesis to be tested is whether an increase in the FA management o and quality of infrastructure would result in a better financial position, performance and profits of the firms, as determinants of financial health.

3 Problem Solution

The unit of analysis is the industry of hospitality in Colombia, which comprises 270 firms, from which,only 247 firmswho reported an adequatevalue in properties, plant and equipment (FA ˃ 0) were included in the analysis.

Colombia belongs to the group of emerging markets named CIVETS (Colombia, Indonesia, Vietnam, Egypt, Turkey and South Africa). These countries have political and macroeconomic instability, lack of safety and inadequate infrastructure [16, 17, 18, 19]. However, their tourism industry is steady growing.

In Colombia, there is a long delay in the development of an adequate ground infrastructure, still well below the Latin American average [20].

Colombia has been promoting to improve the quality of infrastructures by development planning.This planning targets the regions of the country and has a different degree of accomplishment in each region.Accordingly, the degree of accomplishment in the development planning for each region will be a measure of the infrastructure quality.

Despite financial health has been associated to global financial indicators [21], such as assets, profit and loss and cash flow, it can be defined in terms of processes or ratios.Processes are associated to a specific activity of the company, i.e. working capital management or inventory management, while ratios are more specific and usually related to very few items in the financial statements. Every level includes the lower levels; in this sense, processes include ratios, and global indicators include processes and, subsequently, ratios.

Considering financial health as a process that comprises several ratios, fixed assets management comprises the following ratios of the financial statements:

a) Fixed assets net worth ratio:

$$\frac{Net\ FA}{Net\ Worth} \tag{1}$$

with

$$Net\ Worth = total\ assets - total\ liabilities \tag{2}$$

b) Fixed assets turnover ratio (or Fixed assets coverage ratio):

$$\frac{Net\ sales}{Net\ FA} \tag{3}$$

c) Return on assets ratio:

$$\frac{Net\ Income}{Average\ total\ Assets} \tag{4}$$

These ratios will be used as indicators of the financial position, performance and profits of the firms.

In Table 1, they are shown descriptive statistics of financial and infrastructure information. These variables do not fit a normal distribution (Kolmogorov-Smirnov tests for normal distribution,$p \leq .00$ for all of them), and correlations (Spearman rho) among them go from .20(FA net worth and net sales) to .85 (FA return and net income), showing a large dispersion not associated to specific ratios or association between the FA item and one single ratio.

Generally speaking, the higher the ratios of turnover and return, the better; it would indicate that business has less FA by sales revenue, which is a measure of the efficiency in the use of the FA, and also that the firm is getting as much return as possible from its FA.

It is not the same for fixed assets net worth. This ratio indicates the amount of money linked to FA; accordingly, every change in the economic environment could affect the company, by reducing liquidity. In this sense, it is desirable that this ratio be not high.

Table 1 shows scattered results with moderate high mean values in FA net worth and turnover, and negative mean return. These are not proper conditions for the industry; besides, it is contradictory with the support that government is trying to provide to the firms in terms of infrastructure and tax reduction, encouraging to enter the business to promote the country development.

Table 1.Descriptive statistics of financial and infrastructure data

	Mínimum	Máximum	Mean	Standard error
FA (Properties, plant and equipment)	1,923.00	285,345,000.00	6,186,285.36	2.2553654.04
Net sales	.00	189,028,575.00	7,965,677.71	2.0957286.98
Net income	-7,799,180	92,620,104.00	852,986.56	6337696.66
Fixed Assets Net Worth	-12.04	509.48	3.00	32.71
Fixed Assets Turnover	0.00	208.17	6.81	18.55
Fixed Assets Return	-66.36	25.87	-0.33	5.92
Infrastructure Accomplishment (0-100)	63	100	90.28	8.60

All figures in thousands of USD

Figure 1 shows the plots of the natural logs of return on FA against FA net worth, and turnover. In this figure, ratios show a random behavior which makes it hard to identify a pattern. Logs are taken to help determining patterns, but even so no pattern arises.

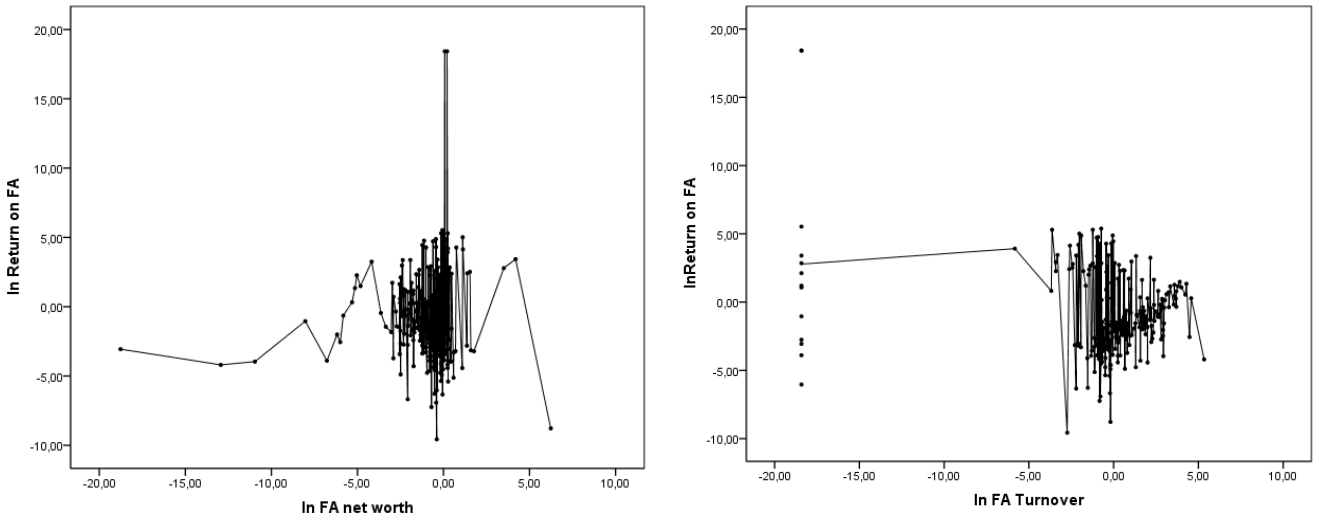

Figure 1. Distribution of FA net worth, FA turnover and FA return.

To reduce this random effect, a data transformation was applied; the transformation is:

$$f(x, y) = (a - x^2 + by, x) \quad (5)$$

These are the coordinatesof a Henon Map, and they are useful here because their application result in a standard pattern. However, the intention is just to create a more simplified and equivalent data distribution to facilitate the analysis. Accordingly, parameters in the equation are chosen to meet this goal, and they are different to those of the usual application.

Its application in this case, for the relationship between Return on FA and FA Net worth, is:

$$X_1 = (1.28 - (l_R)^2) - (0.01\ l_N) \quad (6)$$
$$Y_1 = l_R \quad (7)$$

For the relationship between FA turnover and return on FA, the transformation is:

$$X_2 = (1.28 - (l_R)^2) - (0.01\ l_T) \quad (8)$$
$$Y_1 = l_R \quad (9)$$

with

l_R:ln Return on FA
l_N: lnFA Net worth
l_T: lnFA Turnover

Note, that in the previous equations Y_1 and Y_2 are equal. This would allow using a euclidean space of three coordinates instead of four to depict the relationship among these variables. Figure 2 shows the relations among the aforementioned transformed variables.

Due to the chosen parameters in the transformation, the figure shows almost identical plots. Minimum differences exist in data and they cannot be identified in the plots. The figure shows two parabolas. Besides, due to these similarities, tri-dimensional space withX_1, X_2, Y_1, shows almost the same distribution of data.

To test the hypothesis that a better management of fixed assets would lead to a better firm financial health, a recurrence analysis was conducted. The basic hypothesis is that an increase in fixed assets turnover and a reduction in fixed assets net worth, lead to a superior performance of the firm and return on fixed assets. This is in accordance with the usual interpretation of these ratios.

To conduct a recurrence analysis, data in every ratio are linked. They form pairs of values

$$(\{x_i, y_i\}, \mid x_i \in l_N, y_i \in l_R, x_i < x_{i+1}, \forall i) \quad (11)$$

or

$$(\{x_i, y_i\}, \mid x_i \in l_T, y_i \in l_R, x_i < x_{i+1}, \forall i) \quad (12)$$

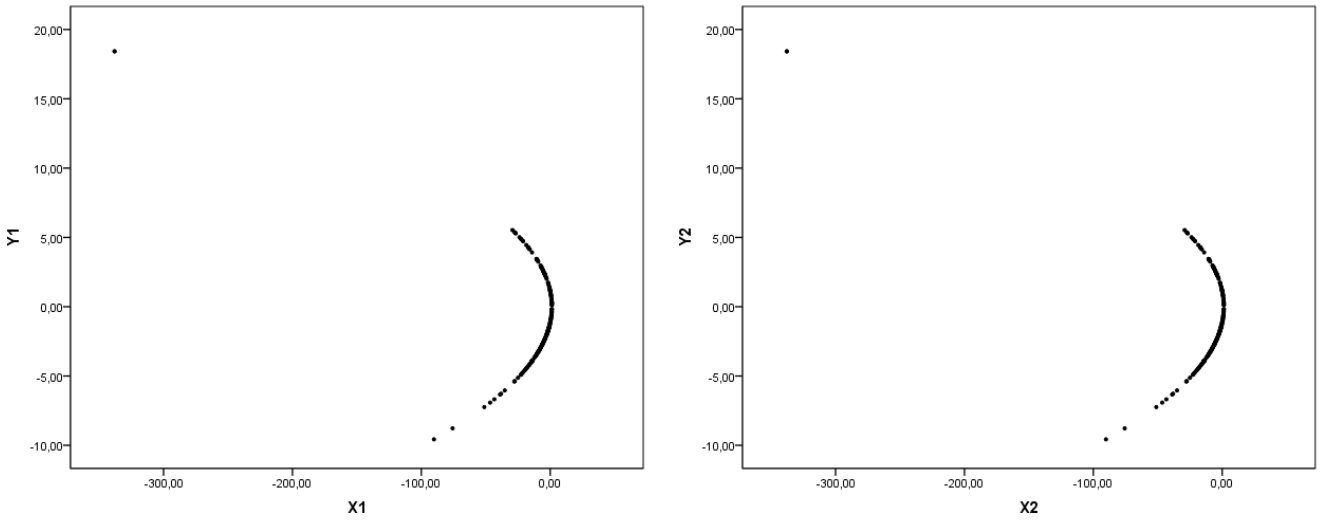

Figure 2. Distribution of transformed FA net worth, FA turnover and FA return.

Accordingly $y_i$follows the ordered series of x_i.The hypothesisis

$$(l_N \& l_T) \rightarrow l_R \quad (10)$$

That is, that changes in FA Net worth and FA Turnover will have an influence on return on FA. In this sense, it is desirable to reach lower values in net worth, and higher values in turnover and return.

Because of this assumption, the ordered pairs of data $\{x_i, y_i\}$ constitute the hypothesis that as long as some ratios change, then returnon FA will change in a cumulative and steady growth. To test this hypothesis, once data in ratio $l_N$or$l_T(x_i)$ are ordered by ascending order, a recurrence analysis is conducted on $l_R(y_i)$.

Recurrence analysis is based on the relationships that the values of variable poses on itspast and previous values and uses recurrence visual analysis, phase space plots and recurrence quantification

analysis. These analytical methods help identifying chaotic and complex relationships among data.

Usually, to obtain a recurrence analysis of a variable, its values are ordered by time; however it is also possible to order them by the values of another variable [14, 15]. When doing so, it is not the time the independent variable leading to results, but the another variable with ordered values, which results in a specific distribution of the dependent variable.

In this case, to see whether the return ratio is yielding better results as long as other ratio increase, the first oneis ordered by ascending values. A multidimensional space of vectors embeds the series, which have as coordinates the present and lead values of the series.Every delay *d*and number of dimensions*m*, originates a vector for each point in the series, in the form

$$v(i) = \{x_i, x_i\text{-}d, x_i\text{-}2d, \ldots, x_i\text{-}(m\text{-}1)d)\} \quad (13)$$

Accordingly, it is created a family of vectors

$$V = \{v(1), v(2), v(3), \ldots, v(N\text{-}(m\text{-}1)d)\} \quad (14)$$

Recurrence analysis uses a matrix*M*, where each point is the degree of proximity between pairs of vectors.If the distance between them is less than a specific threshold distance, the matrix point is 1, otherwise it is 0. The matrix is,

$$M=\{\forall m_{ij} \mid m_{ij}= 0 \text{ if } |v_i - v_i| > \varepsilon;\ m_{ij} = 1 \text{ if } |v_i - v_i| \leq \varepsilon\} \quad (15)$$

were ε is the threshold distance, and $m_{ij}$is each element of the matrix *M*.

After that, phase spaces were obtained for the ratios. A phase space $\mathbb{R}^m$is a plot of all possible states of a system in a m-dimensional space; it is obtained plotting each point *y(t)* in the data series against every point in the same data series but with a delay *y(t-d)*or an advancement *y(t+d)*,within an m-dimensional space. In general, an m-dimensional space can be defined in the form

$$\{S(t), S(t\text{-}d), S(t\text{-}2d), \ldots, S(t\text{-}(m\text{-}1)d)\} \quad (16)$$

andevery point *y(t)* is plotted in coordinates

$$\{S(t), S(t\text{-}xd))\},\ 1 \leq x \leq m\text{-}1 \quad (17)$$

According to this, and keeping in mind the large similarities between the plots in Figure 2, data of X_2 are ordered in ascending order and their associated data of Y_2 (which is identical to Y_1) follows this ordering. Then, a recurrence visual analysis, space phase and quantitative analysis were conducted on the Y_2 data. Embedded dimensions were 3 and lag was 2. Figure 3 shows the visual recurrence analysis and space phase.

Quantitative analysis, using a method of minimum, five points in the diagonal lines and scaling of absolute, yielded a recurrence percent of 65.96%, determinism 92.71%, laminarity of 89.01%, trapping time of 14.12%, and entropy of 4.86%. Determinism is the fraction of recurrence points in diagonal lines of recurrence plot, which is a measure of predictability; entropy is the Shannon entropy of the diagonal lines, and it is a measure of diversity; laminarity is the fraction of recurrence points in vertical lines, which is a measure of laminar states and trapping time is the length of vertical lines, which is a measure of the time the system stay in a specific state [22].

These results show that data pose a large trend to return to previous states of profits and remains in them. Firms do not follow a continuous and linear path of growing without setbacks; actually, setbacks seem to be a norm and hospitality industry cannot develop in a proper way. The trend to converge to some values in the series, turn them into attractors in a non-lineal and chaotic dinamyc. In this sense, the parabolas in Figure 2, are well defined patterns of periodic orbits that attract data to a sink orbit of the map.

Besides, Y_1 is a coordinate in a space were X_1, which comprises FA net worth, is the other coordinate and; Y_1 is the same as Y_2, and X_1shows almost an equal distribution of X_2, due to the specific rearrange of data and the parameters chosen in the Hénon map equations. In this sense, the same conclusions are applied to the relationship X_1-Y_1, but in the opposite way. This is so, because X_1(which includes FA net worth) has an opposite

interpretation to X_2 (which includes FA turnover). It is desirable that FA net worth be as small as possible and FA turnover as big as possible.

This association among transformed ratios depicts a complex environment where managers have to make decisions. Investment in fixed assets could be not the best way to improve the financial health of the firm.

On the other hand, adding de degree of accomplishment of infrastructure can modify the results. Accomplishment in development plans by regional and central governments alter the relationship among variables. One way of determining this is by substituting one of the variables in the tri-dimensional space of l_N, l_T and l_R, with l_C or log of accomplishment degree. To this the log of accomplishment degree is obtained and the same Henon map equations are applied to l_R and l_C in the form:

$$X_3 = (1.28 - (l_R)^2) - (0.01\ l_C) \quad (18)$$

$$Y_3 = l_R \quad (19)$$

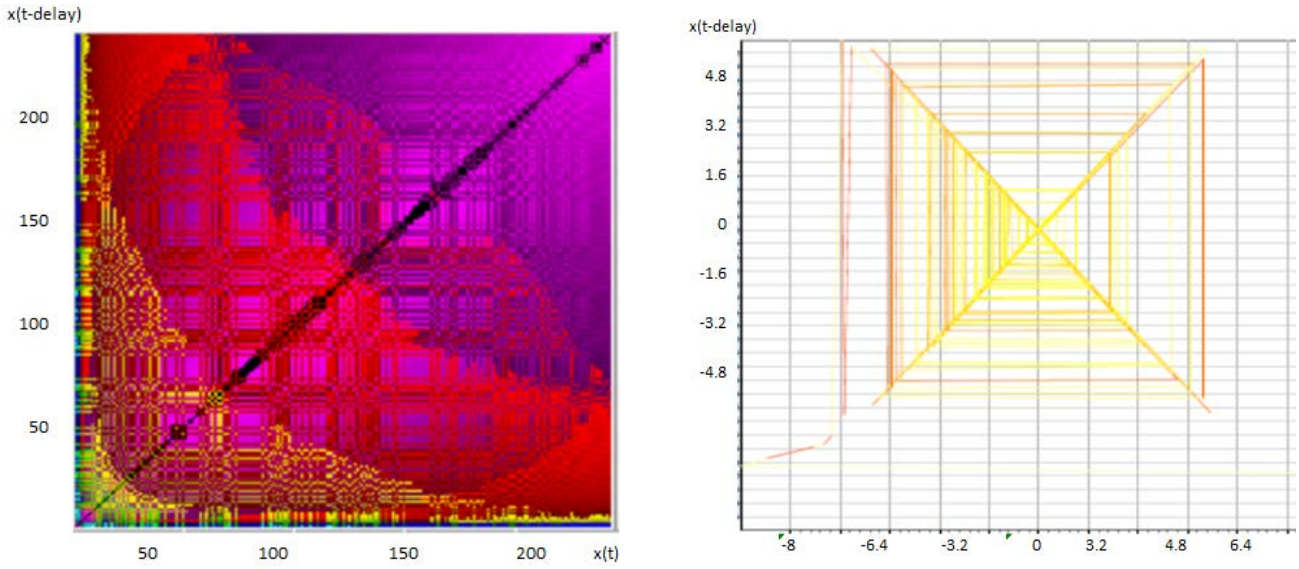

Figure 3. Visual recurrence analysis and phase space of Y_2 (Return on Fixed Assets).

Given that the previous dimensions, X_1Y_1, X_2Y_2, were almost identical, it is possible that the new result leads to similar conclusions. For testing this, a new visual recurrence analysis, space plot and quantitative analysis were conducted on Y_3 but with its data following the ordered data of X_3.

The results were identical to those of Figure 3, and apparentlythey lead to the conclusion that the degree of accomplishment in infrastructure does not add anything to performance of companies.

However, quantitative analysis, using a method of minimum, five points in the diagonal lines and scaling of absolute, yielded a recurrence percent of 43.28%, determinism 78.43%, laminarity of 81.26%, trapping time of 11.73%, and entropy of 4.18%. These results are better than those of Y_2. In this sense, the degree of accomplishment of infrastructure tends to lower the recurrence status in return on FA, which means that companies can follow a steadier path in their growth, with lesser returnto previous states and staying in the same state along their FA amount of investment.

According to these results, phase spaces of return on FA showed similar arrangement with a strong recurrence in their data, so starting with some values in this ratio does not guarantee a lineal growth, but that many things could happen. When ordered by the transformed variables, which include the FA net worth and turnover, several data in return on investment act like attractors. Accordingly, many points in the series remain around those data.

However, some precautions must be taken when interpreting these data. The models obtained yielded proper fit, they have a high fraction of determinism

and laminar states, but only five points are introduce in the diagonal lines, to identify the existence of association, what makes all the parameters substantially to increase. Besides, distances among values are determined by minimum and absolute parameters, what also leads to a better fit but changes the model to a weaker one. This can lead to results contrary to others obtained in emerging markets [22].

Prediction and laminarity point out that a structure exist in the series, but this structure is made out of parameters of scaling, method and points in diagonal lines that favor it.

4 Conclusion

Making fixed assets investment decision is not easy in the hospitality industry. The investment in assets cannot easily be reversed, and firms have to extract the most profit from them. So companies would expect that the investment made be follow by an increase in profits.

However, financial ratios associated to fixed assets do not show this monotonic trend, and returning to previous positions is highly probable to happen.

Besides, the quality of infrastructure and its interaction with fixed assets do not favor superior financial health, neither, although it tends to reduce recurrence.Complementing the analysis with the degree of accomplishment in infrastructure development,add little to results in visual plots and phase space, but reduce parameters in the quantitative analysis.

In the hospitality industry of emerging markets, financial healthis not related to investment in fixed assets and infrastructure, in a linear and monotonic manner. This relation consists on a chaotic recurrence; it is a risk for the sustainability of the firms, making them reduce liquidity and increase debt [21].

Increasing investment in fixed assets or having a proper development of infrastructure, combined with an increase in the value of fixed assets, do not clearly lead to improvements in financial health, in this industry. The relationship is complex and involves recurrence patterns and independency of the fixed assets or infrastructure value. This relationship is a non-linear one and poses chaotic characteristics.

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