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Chapter 13

Natural Gas: Moving to Chaos and Complexity in Financial Statements

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Additional information is available at the end of the chapter

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1. Introduction

The study of complex systems is an interdisciplinary field [1 p. 4]; however, sciences of complexity remain under common and general principles [2], such as micro and macro level manifold [3, p. 41], emergency and chaos [4], interactions among a large number of agents [5], environment and aggregation [6], interdependencies [7], propagation, nonlinearity, feedback loops, open systems, memory and history, adaptation and self-regulation. Existing models are: a) autopoiesis (reproduction, replication, and ontogeny of structural change), b) dynamic systems (large-scale modeling, nonlinearity and unexpected behavior), c) dissipative systems (conditions far from equilibrium and triggering events), and d) dynamics of chaos (cumulative and chaotic nature of changes, moving away from equilibrium) [2]. Thus, complexity consists of a number of theories [8] and not a unified method and insight [9]; it is an intriguing concept with no characterization agreed on, and discussions are about intuitive notions [10]. Although metaphorical language is one of the existing approaches to complexity [11] and many models could have complex properties [4], concepts need to be properly understood, translating them into a useful model of reality [12], and caution is required, when trying to model a system as complex.

Sciences of complexity interact with other disciplines, such as cognitive and organizational science [6], in a natural interface [13], correlating with complex decision-making, strategies, processes, and emergent features of institutions and processes [8]. Complexity and uncertainty are evident [14] and organizational analysis should be performed within a conceptual-theoretical framework that may require of complexity [7], because the world itself is complex [15]. Organizations deal with complexity and complication [16], and, at some degree, any context involves both features [17]. Complicated contexts allow for prediction while complex contexts focus on interaction between systems [18]; besides, complexity is a state of the world while complication is a state of mind [19, p.2].

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A dispute exists regarding the similarity between chaos and complexity. Although mathematical chaos shows that basic models acquire complex properties [13], no relationship exists between complex systems and chaos [20]. However, existence of chaos supports complex systems [2], and it locates within complexity [8], along with self-organization, nonlinear dynamics, dissipative structures [21], theory of catastrophes and co-evolution organizational models [22].

Management sciences have some interests in complexity [23, 11]; e.g., they explore the application of complex adaptive systems in supply chains [24], breeding program development [25], government processes [26], strategic management and system predictability [27]. Besides, strategies to absorb complexity [29], social project entrepreneurship [29], leadership in micro and mesosystem [30], culture creation [31], environmental complexity and transformational leadership [32] are also of interest. Other examples are complexity in bargaining games [33], markets with extensive-form games [34], competitive advantage and discontinuity [35], replacement of management proposals and feedback loops [36], development of new products [37] and landscape design [38], among others. In addition, chaotic behavior is a part of organizational change [2], co-evolution on the verge of chaos [6], and organizational behavior [39].

Finally, some issues, such as Financial Statement analysis, leadership, corporate finance, or small and medium enterprises and family businesses, have a normativism which needs to be overcome [12], as the hidden complexity underlying some problems [40] favors complexity in organizations [41]. According to this, organizations have to be prepared to deal with it.

The need for a different logic in management areas is clear [17, pp. 15-16] and, although the analysis of Financial Statements seems to be structured and based on fix rule, it is not true [12]. Items and transactions give raise to different systems, such as cost analysis, cash flow analysis, inventory control and asset management, among others. Besides, major indicators of Financial Statements such as balance sheet, cash flow and income statement, are in interaction with each other. Finally, the existence of multiple agents, such as analysts, accountants, managers, directors, supervisors, company stakeholder, investors, market analysts, etc., agree to a complex dynamic based on circumscription, belief and paraconsistent logics, resulting in quite a subjective and logic complexity. Moreover, the analytical approach to Financial Statements, which comprises Management Discussion & Analysis (MD&A) and Notes to Financial Statements sections, gives rise to various interpretations based on the analyst knowledge and subjectivity. The prescriptive orientation of Financial Statements does not coincide with their use, as it involves a multitude of accounting rules intertwined with interpretations and recommendations arisen from subjective knowledge.

Nevertheless, chaos and complexity theory can help in the analysis of these topics. For instance, they allow for examining sector incremental change and positive-negative results as a bifurcation with nonlinearity. This approach, along with models of health and epidemiology [45], applies to balance sheet (Stakeholder's Equity or Assets), cash flow (cash

flow at end of year or increase in cash flow) and income statement (Profit and Loss) in crude oil and natural gas [42], health [43] and tourism sectors [44]. However, it has been pointed out that the application of chaos theory to natural gas industry, led to poor results [46].

2. Natural gas industry: Complex and chaotic characteristics

The future of natural gas has a chaotic nature, and market poses changing characteristics, what requires the analysis to integrate disciplines such as economics, politics, psychology and meteorology [46]. Besides, the needs for a nonlinear approach to balance the natural gas market [47] and complexity in opportunities for natural gas storage [48] have also been outlined. In recent years, market trends, in the natural gas industry, changed drastically, with a significant increase and volatility in prices [49]. In the United States, variations in the price of natural gas connect with consumer prices, and might be a leading indicator to guide the country's economic policies [50].

On the other hand, uncertainty prevails in the markets [51] and supply and prices [52], as well as contradictions between government policies [53]. There are substantial changes in natural gas market, due to deregulation, becoming more dynamic and unpredictable, with short-term contracts, which heightens the risks of investing in distribution networks [54] and liquefied natural gas market, but making expensive investments needed to ensure an adequate supply [55]. Construction and maintenance of distribution networks require lots of resources in the form of debt and equity [56], promoting companies to be cautious in high risk assets investment, and managing corporate finances. Moreover, prices tend to be volatile in response to underlying supply and demand factors, such as weather, availability of pipelines or consumption patterns [57] and short-term contracts [58].

All of this provides this sector with high volatility, uncertainty and a need for strong competition with other energy sources, allowing for models that include chaos and complexity. Although the industry has an exciting development opportunity, as indicated for the pipeline distribution networks, despite large turbulence in profits [59, 60, 61, 62], new models must be used to provide an explanation of such variations. The sector's future will depend on competitive forces able to create balance between supply and demand [63]; nonetheless just competition and a leader position do not guarantee stability, as turbulence, a sign of complexity, remains. The various interactions and changes in market conditions and business can make information always scarce and small and minor alterations result in acute transformations, as a suggestion of the existence of chaos.

Government regulation of prices can cause gas shortages in times in which consumption increases, but the regulations imposed by the market may also cause shortages by reducing production. It goes from one restriction to another, and avoidance of monopoly is a need, to keep prices below the monopolistic requirements [64]. Although monopoly could determine local stability of prices, the long-term estimate of thereof follow a chaotic model [65] and that there are a large variation in prices under uncertain demand [66].

However, due to price regulation, companies are forced to increase profits by managing operating costs and long-term forecast over the fluctuations in demand and competition from other sources of energy, what benefits from a defective, abductive and circumscription logic in the sector. These Logics go beyond linear comprehension, and they rely on interpretations probed to be true, at the same time that other interpretations are false.

Natural gas prices have increased since 2000, reaching high volatility, according to NYMEX and Henry Hub [49]. For years, these prices follow crude oil prices, a situation that changed [50] in recent years and, although the link could continue to a longer term, in the short term there are wide variations [67]. However, previous authors suggest that, for a long time, natural gas prices adjust to crude oil prices, as a thumb rule (i.e., natural gas is one-tenth the price of crude oil), and despite the creation of new methods, these mechanisms are still in use. Thus, these believes, or belief logic, instead of lineal mechanisms of error reduction, or cause-effect, is relevant, and we need to encourage other approaches.

Moreover, according to the above, reduction or stabilization of falling prices, lead to a decrease in the production of reserves, what it can affect even the most demanding times of the seasonal cycle of gas consumption. That may seem predictable, as consumption per month cycles constitutes regular wide variations, e.g., in the United States. While industrial consumption follows a fairly steady path, residential consumption is sometimes significantly increased and then decreased, in a nearly sinusoidal wave. Consumption in power generation plants is almost the opposite cycle, albeit less prominent; on the other hand, commercial and transportation consumption follows the residential one, with less strength [68]. All of these variations, for United States, are in Figure 1.

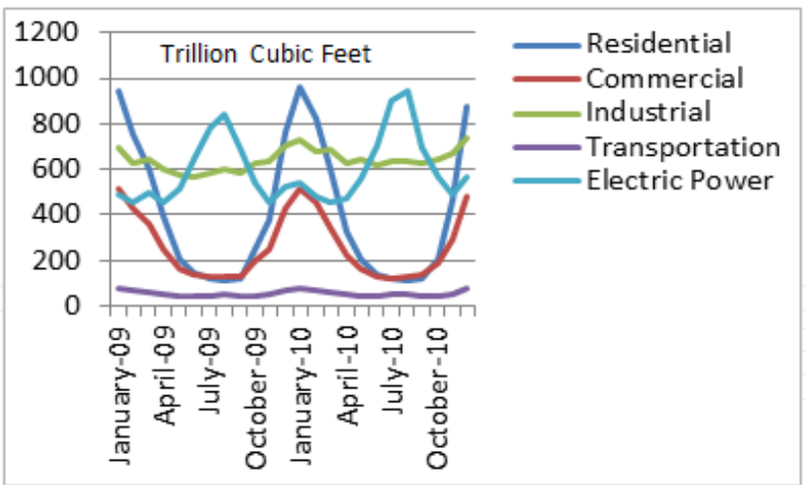

Figure 1. Consumption distribution of natural gas) in US 2009-2010 according to data published in Monthly Energy Review (2011).

Interestingly, although some of this consumption patterns model a sinusoidal oscillation, according to the spectral composition of time series, it consists of a sum of waves of similar or opposite effects, so that a change in one of them results in total consumption changes. Therefore, this repeats for all years and may be the result of a linear aggregation of variables; however, in annual consumption (Figure 2), there are many softer variations and

a mismatch of types of consumption. It is difficult to see a periodic variation over the years, so it should be assumed that annual variations compose of other small ones producing this annual trend along the years. It depicts a growing trend in electric power consumption and a decrease in industrial consumption. Thus, aggregation over time causes different effects on consumption.

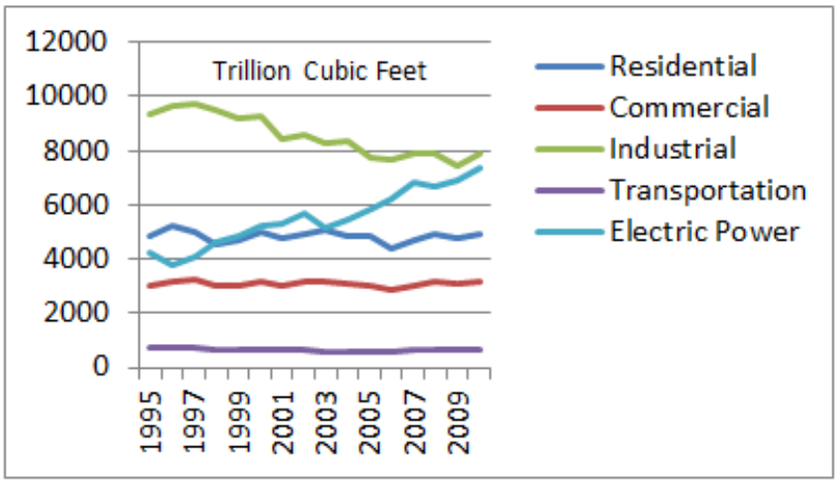

Figure 2. Annual consumption distribution of natural gas in US 1995-2009 according to data published in Monthly Energy Review (2011).

All of the foregoing might result in the dismissal of investment. However, this investment is a need, but it necessitates an environment of confidence in returns. In the short term, these returns become unstable and, in the long term, it turns into a safer fond but with low profitability. This is consistent with assuring sustainability in times of uncertainty, but it is in conflict with high-profitability anxious requirements that often exist in business operations. Stocks, in this industry, suit to conservative, income-oriented investors [56] so it is reasonable to make a bet on investments with long-term security in the low profitability of thereof. Moreover, when an environment of uncertainty and business dynamic exists, assets must be secured, and the payment of dividends needs to be postponed not to jeopardize the future of the company, which will depend on growth. In this environment, logical decisions to be made become more subjective and should take into account conflicting economic activities in the long term. Also, it requires control of resources, which, otherwise, would be handled by third parties in a monopolistic manner. The need for accurate predictions becomes true in situations where it seems impossible to make them.

Markets have become extremely sensitive to the volatility and price rises, missing, on occasions, a reassuring policy; further regulation by the market, without government intervention could produce strategic coalitions to gain control over resources or supplies, and impose prices. In this sense, government regulations apply to control price [49] and there is no doubt about the need for a minimal regulation [57]. However, FENOSA, the largest organization of gas and electricity in Spain and Latin America, served 5.6 million people in Latin America in 2010, but entering different markets did not give reasonably high values, so that regulatory policies could cause problems for the company, along with

climatic conditions [69]. The same holds for other companies like Oil and Natural Gas Corporation Limited, for which, drilling and producing wells did not return investment [70].

In addition, the high volatility of market favors prediction-based positions depending on events or climate change; however, this is not a matter of predictions using hard data, but beliefs about what it will happen. Serious financial failures may occur [see 71], when circumscription, based on those beliefs, is not appropriate. In this sense, making restrictions could affect stock market behavior. Regulations improve transportation price efficiency, price structures and company pipeline transportation, by storage unbundling, release of capacity programs and change in rate design, allowing keeping storage to overcome fluctuations [72]. This results in substantial financial structure differences. Thus, all of that together with changes in demand due to seasonal variations, which become less predictable when looking at the microvariations and their aggregated effect, result in a financial system that must follow such changes or locate high, above them. There is a need to stabilize demand and find new markets, but also to maintain high fixed costs, in some companies.

However, deregulation has also risks. Thus, it can cause niches or disconnected networks from each other, limiting competition, initially proposed by deregulation, and causing a captive market for certain dealers, despite sophisticated transactions between networks [73]. Therefore, the complexity that emerges from open markets networks may overwhelm the capacity of businesses to coordinate actions [73]. This influences supply and may increase government intervention again, reducing industry efficiency.

The market volatility reflects in supply contracts, which are short term if less than one month, middle term between one and twelve months and long term if above one year [57]. In this context, the major sources of business risks are prices and volume [74]. Strategies to keep liquidity, storing gas, expand and use derivatives are essential, but require changes in accounting practices. These changes include reducing high dependence on liability, increasing investment so as to cover the periods of minimum demand or prices, or cost accounting adjusted to fit fluctuations in operation. On the other hand, while exploration costs and present value increase, and the number of tests grow, the possibility of being competitive, by maintaining demand, guarantees discount rates.

Initial predictions about opportunities and changes in natural gas industry, reveal times of a major reform in energy consumption and costs reductions with many countries maintaining natural gas reserves [75]. However, at the present time, in view of the above, there is a complex dynamic, which results in different markets and characteristics of contracts, independent distribution networks, management of stocks subject to wide fluctuations and changes in demand, finding new demands and intense competition with other energy sources; all of this, requires a different understanding of this industry.

According to the aforementioned, complexity and chaos theory must be in the Financial Statements of natural gas industry analysis. This approach can be based on the existence of different models [76].

3. Financial statements as a complex system in natural gas industry

Accounting transactions affect Assets, Liabilities or Stockholders' Equity, and it is necessary to maintain basic accounting equation in balance, that is: Assets = Liabilities + Stockholders´ Equity.

However, this equation is not a numerical calculation, but an intricated logical reasoning, which allows allocating an amount to an Assts item and to one of the Liabilities or Stockholders´ Equity items, or to another Assets item, but with a different sign. Nevertheless, this allocation composes of a real amount (for instance in Assets) and another identical amount, which constitutes an expectation, or belief, about some accounting events that will happen in the future (for instance, in Liabilities or Stockholders´ Equity).

Let's put an example, while a bank loan is a real entry in Assets, acknowledging a debt in Liabilities is just a payment expectation. In the same way, a cash input in Assets can be recorded as unearned service revenue in Liabilities. In doing so, a future event includes in Liabilities, no matter whether it will be performed or not, and expectation is a part of Financial Statements. Moreover, when a service is provided, but payment is to be received on a later time, there is no reason to include the amount in Stockholders´ Equity. This is so, because it is merely the possibility of increasing the Stockholders´ Equity in the future. In the same manner, there is no reason to include it in accounts receivable, except to state that payment should be made in the future.

It is true that Assets are equal to Liabilities plus Stockholders´ Equity, but that is a logical truth under certain circumstances. Liabilities and Stockholders´ Equity do not imply the existence of Assets, but accountant must create it. Despite that there is no more money than what it is available or more property plant and equipment than those than there are, an asset is also a liability or a stockholder's equity. In doing so, the product of an accounting transaction is one thing, and another, simultaneously.

In natural gas industry, strong Assets investment may require substantial debt, with the expectation that payments must be secured by an adequate demand. However, on occasions, dependence on demand types, i.e., industrial demand [50], or the growing demand for electric power plants, makes it to be dependent on the consumption, an indicator of prices. Thus, the existence of these cycles and the uncertainty associated with the dynamics of change, in consumption market, produces a small expectation of compliance, and a lack of foresight and remedies for operation. In this sense, basic equation might not be true to some companies, considering expectations, and not conviction, in that they will meet their obligations in the future. This has an impact on contract prices and the consumer must be protected against significant variations in prices. According to this, there is an expectation about what it is going to be charged that could not be fulfilled. Cycles of consumer prices are extremely difficult to predict, even with the various available techniques [46] and the basic equation requires adjustments in expectations to show the existence of consumer protectionism regulations and price cycles.

Recognizing in the Financial Statements that a certain amount of money is owned (Asset) and, at the same time, it is owed (Liability) violates the classical logical principle (excluded third) that something cannot be its opposite at the same time. However, complexity agrees opposite forms, and, within it, another form of logic (dialogic) overcomes excluded third principle [4], allowing transactions in Financial Statements to follow a default reasoning. For instance, a transaction is assigned to an item, unless an example exists (or reasoning) that justify assigning it to a different item. Also, an abductive reasoning is used by following the ordinary standards, being possible to assign an amount to an item, whenever a reasonable explanation is available. Moreover, in the presence of a greater knowledge, or a different set of beliefs about Financial Statements, their organization would change, what it is an example of knowledge and beliefs argumentation. This, bases on arguments of circumscription logic (explanations not taken into account in the initial set of premises or assumptions), default reasoning (existence of examples that contradict the general law) and abductive reasoning (generalizations based on the need for economy and simplicity).

The principles of circumscription logic [77] indicate that a minimum must be obtained to meet the fact that the proposition is true only if it is necessary to be, or a proposition is false if it is possible to be. Therefore, if there is a possibility that an unearned service revenue amount is false, because the service could not be provided, then the statement "the transaction X is included in unearned service revenue" is false. Thus, $A \equiv L \cup S$ (A: Assets, L: Liabilities, S: Stockholders' Equity; ≡: Equivalence) is not confirmed, since deposit made in cash does not coincide with the service provided in the future, because that service may not be carried out.

The existence of a circumscription is evident in the natural gas markets, where the experience of participants determines the balance to be carried out between different contracts. In this way, it seeks to respond to changing market conditions, by the balance between supply and demand, both on short and medium term [57], what requires distributing assignments in the different items of Financial Statements, by proper expectations management. In this sense, allocation depending on the balance of the portfolio is a minimum circumscription based on the familiarity with the market. So a belief becomes a transaction in the Financial Statements; this transaction is true (accurate) unless it is likely to be false (not accurate). Not only that, but also financial trading of natural gas, causes many profits to be generated by investment operations, based on the expectation of reducing price risk, which also leads to a circumscription associated with beliefs and knowledge.

However, depending on the cost structure of the company this circumscription can be performed more or less widely. In this sense, the weight on the basic equation can be in the preservation of assets, and diversification of its use, or in increasing debt with a commitment to operations or short-term opportunity contracts, balanced with medium to long term contracts or more efficient investment to moderate cycles that happen and enhance the use of natural gas in other applications. In fact, the search for contracts that meet the requirements of the entities providing funds, ensuring the price with a moderate acceleration to allow for compliance with debt, is something that takes time [51]. This means

that, in the Financial Statements, there are imbalances between the sets A (Assets), L (Liabilities) and S (Stockholders' Equity), promoting owning and use of assets, risk associated to a commercial and financial volatile market, or increase in debt and equity, searching for long-term contracts, operation diversification and use of fixed assets. However, these are different models in the accounting analysis, and they have a strong impact on the financial structure of firms.

According to this, circumscription on the market and Financial Statements will determine the future of organizations in this industry. Circumscription accepts a minimum truth in Financial Statements transactions. That is, accepting just what it is necessary to be truth and not what it has a chance to be false. This implies a logical circumscription on these Financial Statements. In general, we can say that circumscription on Financial Statements (FS) consists in a number of models, or minimum principles, so that:

C(FS) : (Tm Tm is a minimum set of FS); C being the circumscription held on FS and T a set of statements which are necessary truth.

In this way, the basic equation of Financial Statements is openly interacting with the environment, and the logic of multiagents, multilevel and co-evolution with environment bases on actions that are true. This is recognition of the assumptions made.

Moreover, in the section of Management Discussion and Analysis (MD&A) in the report of Financial Statements, where, to a large extent, the framework is the scheme of management [78], a subjective interpretation of accounting data shows the position of business, investment and financial needs, results and other information, with an interpretive structure based on a different logic. This section, takes on a highly subjective narrative from different theoretical frameworks or models, and Critical Accounting Policy (CAP) makes financial management subjectively be based, but aimed at a satisfactory financial performance. Items discussed in CAP are the allowance for loan losses, loan sales, investment, intangible items, stock compensation, revenue recognition, capitalizing software and restructuring costs, among others [79]. Besides, Critical Accounting Estimates (CAE) presents an analysis of the variability or uncertainties to occur, along with estimation and accuracy [78].

The information about financial conditions, results of operations, liquidity and capital resources, market risks, other risk factors, and many others issues are included in MD&A, along with interpretations about financial data, in terms of cash flow, net product sales, expenses, stockholders' equity, earnings from operations, etc. On the other hand, Notes to Financial Statements, provides with interpretations based on nontraditional logic and models. They are another language and arguments explaining policies and solving doubts in Financial Statements. According to this, company policies aim to provide a structure for Assets management, reserve management, and debt or portfolio schema design, and they are the basis of interpretation of this section, where the company future is designed. In MD&A, the following suggestions can be made:

The assets increased, due to property acquisition and extension of loans, based on a reasonable price prediction. It is possible to purchase reserves and sell them in long-term contracts with limited price escalation. That might result in long-term sustained revenues.

Implicit in these assertions, several assumptions guide the operations performed. However, the acceptance of these assumptions within a monotonic logic of reduction of uncertainty, causes the final conclusion seems to be the result of a linear accumulation of explanatory factors. This, however, is not true because different scenarios may occur. For example, while it is true that, in contracts, procedures to protect profits are included, it is also possible that price dynamics relativize them, thus losing a certain value. On the other hand, industry dynamics may lead to trade more contracts in the short term, in the spot market; so finding an escalated sell, along the time, does not provide the same benefits and, therefore, opportunities are lost. Finally, although reserves might have been sustained, it is also possible that market changes cause a lost in the volume of drilling, increasing stock prices and compromising long-term benefits.

Thus, predictions made in MD&A bases on a set of beliefs, which are not a cumulative process of reducing uncertainty, but they move within uncertainty, framing suggestions on assumptions that are believed most successful. Yet, in a changing market and business dynamics, other assumptions are also successful, i.e., the fact of making some recommendations does not mean that other recommendations that could be provided and are contrary to the formers, are not appropriate. This cannot be solved by linear predictions or logic trying to find out what the best option is, but by logic capable of incorporating contradictory thesis.

The aforementioned problem can be solved by basic principles of paraconsistent logic. This logic supports contradictions. Paraconsistent logic requires caution in the use of contradictions, but takes into account the fact that if an inconsistency exits, it does not imply that something is wrong. It can be assigned V to the truth value, 0 (False) or 1 (True); determining, accurately, the decision to make, and having in mind that every assumption (B) is true or false, imply that we assume:

$V(B, 1) \leftrightarrow V(\neg B, 0)$; i.e. B is true if and only if no-B is false

And also

$V(B, 0) \leftrightarrow V(\neg B, 1)$; i.e. B is false if and only if no-B is true

It means that only one of the propositions B and no-B (the opposite of B) is true, if and only if the other is false. Thus, at least one of the propositions is accomplished, but not both of them. This is different to determine that one of them is false if the other is true. The way of solving contradictions and paradoxes is by creating relationships between terms and not by making inferences from a term to another, as making inferences assumes that one term is true and, consequently, the other is false.

According to this, it means that following initial recommendations is a right choice whenever the other ones are false, so determining the false value of the other scenarios is a prerequisite to opt for the former. This logic poses a high standard of cautiousness, for reaching conclusions it must follow a process of revising every proposition, and determining the relationship among them and their truth value. This complex logic,

expressed in MD&A, is not trivial, but it leads to different conclusions than those obtained by classical logic, where an inference guarantees that something is true or false. The key is that the company does not know what it will happen in the future, and expected or unexpected results could be obtained anyway, so a mean to guarantee results is to know that predictions are right because no possibility exists they are not.

Moreover, in Notes to Financial Statements, clarifications about profits from sales, supplies and promotion costs which are recognized when payment is somehow guaranteed, etc., are included. This indicates that the final structure of the Financial Statements links to changing expectations about the behavior of agents in the system, who according to unexpected events, might change their behavior, leading to new emerging systems resulting from interactions between actors. Thus, Notes to Financial Statements participates of belief logic, e.g., development of a number of assumptions which are valid only until one of them ceases to be. Therefore, a set of beliefs B exists, which is not empty, and consists of beliefs b1, b2, b3, ..., bn:

B(b1, b2, b3,…, bn)

These beliefs can presume the market behavior, the commitment of the buyer, the performance of commodity prices, the maintenance of goodwill, etc. According to this, depending on the reasoner [80] that analysts are, several options exist. One of them is to equal the analyst to the best accurate reasoners, who never believes a proposition that is false; what can be expressed as:

$\forall p\ (Bp \rightarrow p)$

Thus, the belief B in a proposition p signs that the proposition must be true, i.e., they believe that market dynamic will raise prices, and it happens. Thus, they only believe in things that will occur.

In Notes to Financial Statements, managing certain items reflects the complexity, for instance, trading of liabilities on stocks markets or anticipating contract conditions. It deals, in a broad sense, with the uncertainty of not knowing how the price will behave. Strongly grounded on fixed assets, some companies in this industry need to calculate depreciation according to expectations about demand and reserves, and these expectations constitute a set of beliefs. Moreover, Assets follow an explosive growth once they have reached a certain threshold value. This growth has already been shown in other financial sectors; surpassing a certain amount of assets originates many more assets to be acquired in an exponential manner. However, it must go through a period of turbulence, as shown in Figure 3. This turbulence causes uncertainty in the performance of companies, which may choose to go back and maintain their Assets whenever turbulence is not fully overcome; once this turbulence is overcome, turning back is more difficult, because it is to reverse a process and give up virtually to what it has been achieved.

As it is shown in Figure 3, once the turbulence is overcome, a rapid increase might resemble a catastrophic phenomenon, due to a sudden and irreversible change in a parameter. It must be noted that there is no possibility to return to initial conditions once this phenomenon has

taken place. This occurs due to the incremental increase in Asset differences. Decreasing the differences in Assets would reduce business operations, number of employees, properties, plant and equipments, and so on, with serious consequences for business sustainability.

What could a company do, after a substantial investment in fixed assets? Company cannot go back, and the market does not forgive that distribution or production networks are not functioning properly; demand cannot wait, and the cost of doing nothing is even higher [53]. Accordingly, the company's future would be jeopardized.

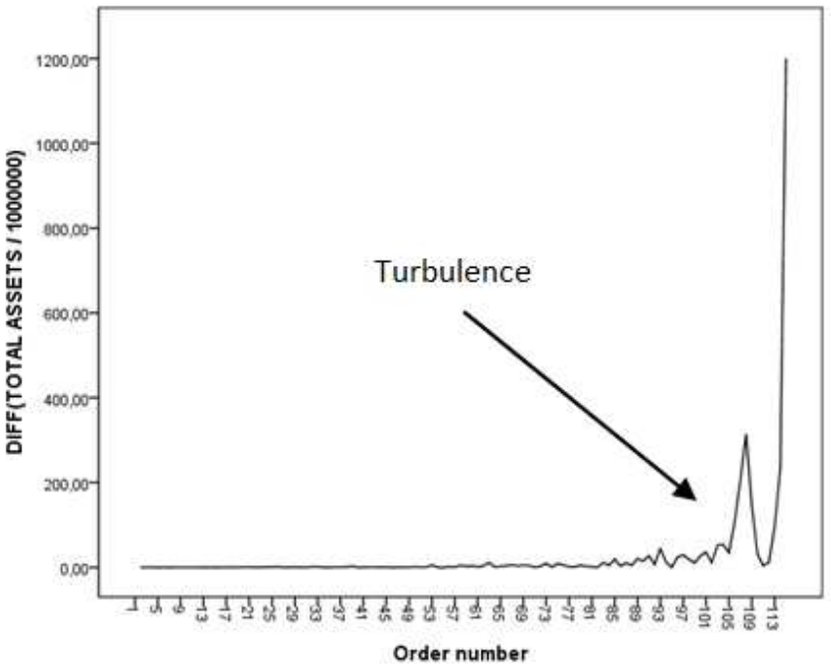

Figure 3. Differences in Total Assets, in orderly values: Total Assetsn+1 – Total Assetsn (Data from Colombia, Energy Industry)

Operation revenues of pipelines companies reached record figures in 2010 [61] but expected future earnings heavily rely upon at a cycle's peak [81]. Interest rates need to be competitive for investors, because a lot of money is necessitated in the form of debt and equity, leading to a financial structure more weighted towards debt; this is cheaper than the cost of stockholder's equity [56].

Financial ratios are open to different explanations depending on the tacit knowledge that people have of the company, and the reasons to compute them [82]. In the Gas Natural Industry, common ratios are those related to debt. For instance, companies with modest Long-Term Debt Ratios are more tolerant to grow, and a high debt ratio shows operating problems, other ratios are Return on Common Equity, Net Profit divided by Common Equity, and Cash Flow, which is a more stable measure than profits [56].

However, relationship among these ratios gives an idea of liquidity, profitability and sustainability, and it is vital to analyze the joint behavior of several of them. Examples of these indicators are:

Liquidity:

$$Working\,capital = Current\,Assets - Current\,liabilitites$$

When working capital is negative, the company is at risk of not paying sort-term obligations and could fall under bankruptcy.

Sustainability:

$$Free\,Cash\,Flow = Cash\,Provided\,by\,Operations - Capital\,Expenditures - Cash\,Dividends$$

It is the ability of the company to generate cash.

Profitability:

$$Gross\,Profit\,Rate = \frac{Gross\,Profit}{Net\,Sales}$$

It provides an insight about how the company is doing regarding sales in relation to gross profits, which can be obtained by other means than sales.

Relationship among these indicators depicts in Figure 4.

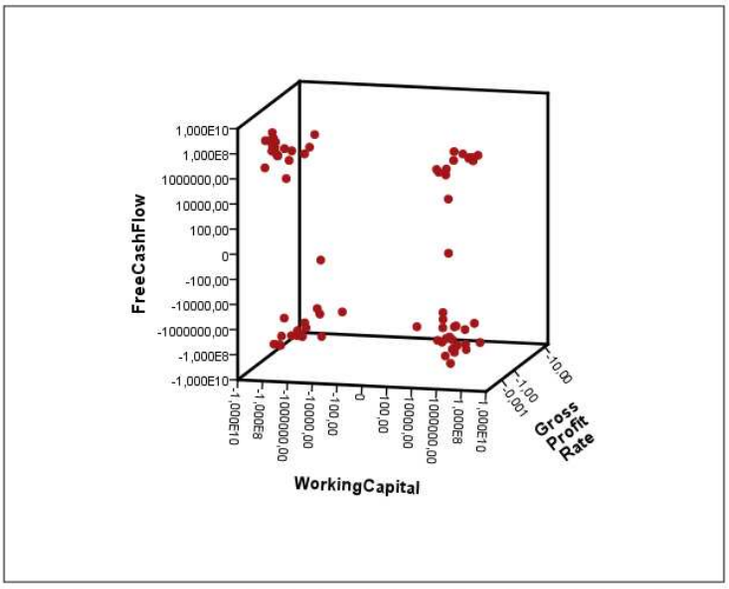

Figure 4. Scatter plot of log Free Cash Flow, log of Working capital, and log of Gross Profit Rate

In this figure, the distribution of the ratio values, resemble a grouping in four areas. It is crucial to note that sustainability (Free Cash Flow) does not associate to one liquidity (Working Capital) figure, but to opposite ones; i.e., positive and negative liquidity figures lead to the same sustainability ratio. It is the same with profitability, where Gross Profit Rate results in different states of liquidity (Working Capital). According to this, there is a complex relationship among these ratios that can be modeled with chaos theory [see 12, 42, 43]. In this figure, several attraction points exist, which give rise to areas where profitability, sustainability and liquidity satisfy several options of performance, and not a fixed rule

associates to a better performance. Having enough liquidity, or profitability do not guarantee the sustainability of the company, but it is the relationship among these indicators what determines the future of the company. Small oscillations in Free Cash Flow, accompanied by small oscillations in Working Capital, can lead to large changes in Gross Profit Ratio, impacting stockholders' rights to payment, and sustainability of the company can be reduced by small changes in Working Capital producing a decrease in Free Cash Flow.

4. Conclusion

The approach to Financial Statements from a complex perspective and chaos theory in Natural Gas Industry is a need. This is true not only because of the existing complexity in the industry, but also because they reflect a form of interpretation and analysis that might help to understand some of the phenomena that occur in this field. Thus, complex logic and the relationships between the indicators of Financial Statements, can contribute to new developments and ideas about what it is occurring in Natural Gas Industry.

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