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# Decision Making Analysis with Multiple Attributes of Financing of An Inversion of Low Capital Inflationary Uncertainty Using The Analytic Hierarchy Process

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***Abstract* – In this investigation detailed ascertainment of scenarios is performed, taking into account the risk of investing with a medium-term financing under the inflationary effect. The results found are comparisons based on logical scenarios and economically viable between various credit investment schemes, whose formulated alternatives aren't trivial, choosing the best option or current alternative for a future benefit. The credit acquires an entity through three key factors: level of commitment, economic capacity and patrimonial support; even if it meets all of the above, it leaves aside external and foreign aspects of economic entities; as it is inflation, being a crucial risk factor. For the analysis a decision-making assessment model is designed in the selection of a low risk inflationary investment with a multi criteria and multi attribute approach.**

***Keywords* – Multicriteria, Multi Attribute, Investment, Scenarios, Alternatives.**

## I. INTRODUCTION

The uncontrolled and sustained, sometimes generalized increase in prices (inflation) has several negative implications for the economy; companies cannot make a business strategy because they ignore the amount by which the supplies will increase, forced to make frequent price changes.Nowadays, there are different techniques for the decision makingin the optimization of the selection process of the ideal locationof production plants. The techniques more commonly used are (Auet al., 2006): Expanding the classification or scoring methods (Hoffman and Schniederjans, 1996); Analytic Hierarchy Process – AHP(Yurimoto and Masui, 1995; Liu et al., 2008; Dey and Ramcharan, 2008); Linear programming – LP (Brimberg and Revelle, 1999; Schmidt and Wilhelm, 2000); Heuristic (Rönnqvist et al., 1999)and Simulation (Chakravarty, 1999). Similarly, the multi-criteriamapping is also used, within which stands out the Technique forOrder of Preference by Similarity to Ideal Solution – TOPSIS (Liang and Wang, 1991; Mahamid and Thawaba, 2010; Onut et al., 2010;Semih and Seyhan, 2011) and Analytic Network Process – ANP (Feliceet al., 2012).

Investors could not reasonably determine the levels of interest rates or the performance of their investments, which could postpone or cancel them. A greater variability in relative prices causes severe distortions and inefficiency in the allocation of resources, which in turn results invariably in a loss of competitiveness and economic activity.Thus, with general and continuous price increases economic planning becomes difficult and uncertain, which inhibits productive investment and employment, limits the formation of assets and savings, and prevents the construction of infrastructure projects that require long-term periods for its realization.

Currently, financial institutions base their credit analysis on the credibility of an economic entity through three key factors such as the level of commitment (attitude of the borrower or the credit subject to deal with payment of their claims) Patrimonial support or guarantees (degree of coverage in case the main source of payment is not as intended), and the economic capacity to generate the resources to pay the funding source; even when using parameterized methods to analyze possible credit situations in the Mexican Financial System as a measure of convenience; many choices between alternatives are not measured only in these terms. Most of the financial companies set assessment objectives as profit, income against monthly obligations,creditworthiness, financial or job security (as appropriate), often called intangibles, irreducible or non-monetary attributes.

(Canada & Sullivan 1989) state that the person responsible of making decisions that has clear objectives to be established with ease, have the possibility of incurring problems defining attributes or criteria. The research the is presented will allow to increase the scale of credit evaluation tending moderate, medium and highrisk segmentswhich give place to inflation expectations to be better analyzed, in which the decision taker will have the perspective and relevant information associated with multiple attributes with a simple methodology to use and understand, facilitating communication ofthe credit situation and recommended, providing a unique way to quantify the consistency of judgment. Financial institutions have developed different types of tools that facilitate the granting and obtaining of resources to finance private and public productive projects, having commercial credit as a common tool. Scenarios which vary according to the type and purpose of credit, communally we find the following credit elements, requested amount, interest rate, opening commission, term.

Currently standardized models have been created, these allow to attend a high volume of transactions supported in a "efficient" development of the credit packed products and with a massive design, supported by parametric techniques and automated that identify tendency patterns of business, for these grants the lender requests the required documentation to evaluate the viability of the borrower by manual calculations or traditional, such as specialized software.

### *Methodology*

The generation of a target model requires the integration of variables that describe the scenario being considered with the level of importance that these reserve. In the

credit context under the inflationary uncertainty, there can be observed the increase on supplies and basic energetics for the daily operation of the business sector; although it is useful to use as a measure of evaluation the economic capacity to generate the resources to pay the sources of financing of a company (sales,profits, etc.), as well as borrowing capacity,obtaining these minimum resources necessary to cover the contractual obligation to pay can be compromised by the inopportune increase in the supplies prices, raw material and/or energetics needed for daily operation, resulting a reduction of the resources. These factors are not directly expressed in terms of credit sensitivity are called attributes intangible irreducible or non-monetary. Taking as a measure of resolution decision making multiple (Canada J. R y. Sullivan W. G (1989)) and have the perspective of the scenario is considered the following flow diagram of the methodology of analysis.

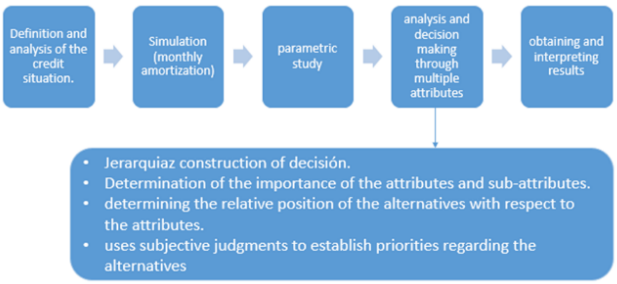


Fig. 1. Methodology flow diagram

Beginning with the review and obtaining sufficient information to perform the steps described in figure 1, a detailed analysis of the definition and a credit scenario analysis will determine with determine the result of the credit assessment.However, having clearly defined goals with ease, to the decision maker represents a problem to define the attributes and criteria, by which the achievement of the objectives is measured; considering that the use of rational methods to assess this situation, can associate a measure of unique value for each alternative in the problem of the decision.

To consensus the order of the decision variables with 7 financial experts from different bank institutions, the result was obtained in order of importance from 1 to 7 as shown in Table 1. Havingthe perspective of the model where the decision criteria for granting loans as mentioned: a minimum of two years in current job verification; monthly income of applicant (which must be at least 2.9 times to 1); the financial commitments of current monthly payments and requested, in this case if the rent payment, it must not exceed 50% of net monthly income, current monthly financial responsibilities and requested, plus family expenses, and if applies the rent payment, these must be as a maximum a bit of the net monthly income; have no negative history in the issuing institution as in the credit historical with other granting institutions based on the reports issued by a specialized company called credit bureau, for both applicants and other participants in the credit (spouse, obligatory solidarity,guarantees if any, etc.); just like, taking into account the **accumulated inflation**of the sector to which the applicant belongs.

Table 1. Grant variables ordering

| VARIABLE | EXPERT | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Work seniority | 4 | 7 | 2 | 5 | 6 | 2 | 4 |
| Monthly income | 2 | 3 | 3 | 2 | 1 | 1 | 6 |
| indebtedness coefficient | 5 | 6 | 1 | 1 | 2 | 6 | 1 |
| Household expenditure | 3 | 5 | 5 | 6 | 5 | 5 | 5 |
| Background at institution | 1 | 1 | 4 | 3 | 3 | 3 | 7 |
| Credit bureau background | 6 | 2 | 6 | 4 | 4 | 4 | 3 |
| Inflation | 7 | 4 | 7 | 7 | 7 | 7 | 2 |

The most important step for this model was to identify feasible variables for the grant agreement to the consulted experts.Getting simple ordinal scale classification criteria in descending order of preference, having presented a list of variables of bestowal, which resulted as follows (Table 2):

Table 2. Simple ordinary scale

| VARIABLE | |
|---|---|
| Work seniority | 1 |
| Monthly income | 2 |
| indebtedness coefficient | 3 |
| Household expenditure | 4 |
| Background at institution | 5 |
| Credit bureau background | 6 |
| Inflation | 7 |

The proposed methodology will allow reducing the applicant's exposure to higher risk and giving more credits to more and better prospects or subjects of this, with the following three types of profile as shown in Figure 2. Have current loans in other institutions, with long-term information from credit bureau without creditinformation, each profile or group is separated into three levels of risk according to the model.

*The analytic hierarchy process*. Thomas L. Saaty (1980) was the first to design and document the Analytic Hierarchy Process, and his contributions have been in transportation planning, selection of cards, corporate planning, marketing and manufacturing among others. The advantage of this method is its ability to structure a complex problem of people,variables, attributes and multiple periods in a hierarchical way, making comparisonson paired elements (usually, alternatives and attributes), using a scale indicating the advantage with an element dominates another, with regard to an element of a higher level and the use of AHP to solve a decision problem which consists of five stages:

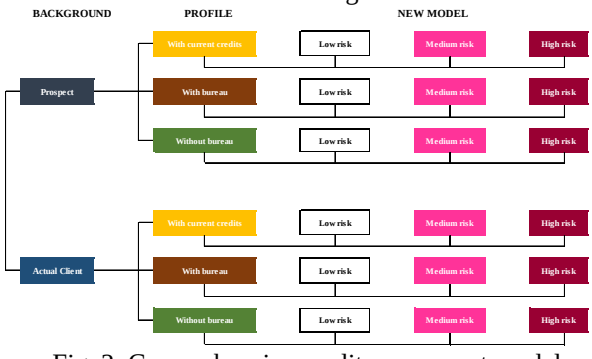


Fig. 2. Comprehensive credit assessment model

Construction of a decision hierarchy separating the decision problem into a hierarchy of its elements including the decision alternatives; (2) Determining the relative

importance of attributes and sub-attributes (if any); (3) Determination of relative position (weighting) of each attribute regarding the next attribute or sub attribute top level; (4) Determination of (a) indicator (s) consistency as to make paired comparisons; (5) Determining the priority weighting (score) General of each alternative.

*Building a Hierarchy Decision*. The AHP begins to decompose a complex decision problem into a hierarchy of sub problems. Saaty (1980) applies the term "elements"to the overall objective, attributes, sub-attributes and alternatives for a problem as shown in Figure 3. The upper level, called the convergence point, it only has one element, and the target is wide. The following levels can have several elements each, although their number is very small, between 5 and 9. Because you are going to compare a level the elements must have the same order of magnitude.

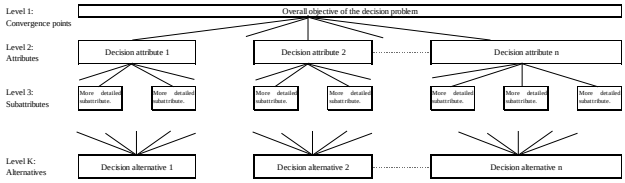


Fig. 3. Overall objective of the decision problem

It should be noted the independence of selected attributes and sub-attributes. AHP mathematics are based on the principle of the composition of the hierarchy, this principle states that are independent of the elements on one unique level of the hierarchy and their relative importance (weights priority) does not depend on the elements in the next level the hierarchy. A. Arbel & A. Seidmann (1984) in his book Performance Evaluation of Flexible Manufacturing Systems says it has to consider the following guidelines when hierarchy is built.

- Choose the amount of levels used so that it represents with efficiency the problem it faces.
- The order of levels should reflect a logical causal relationship between adjacent levels.
- Define the number of members in a particular in adequate detail level, without unnecessary complexity.

The attributes to be considered in the research are: length of employment, monthly income, debt ratio, household spending, history of institution, credit bureau records, Inflation; capturing the level of detail required, so that sub-attributes are not required. In Figure 4 the determination of the importance of attributes and sub-attributes to the variables P1, P2, ... P5.n shown. Once the hierarchy established, priorities (relative weights importance) for each set of elements in all levels of the hierarchy are established. Obtaining priority data for decision makers, evaluating a set of elements of a hierarchical level in a paired way,in relation to their relative importance and an element in the next higher level of the hierarchy.

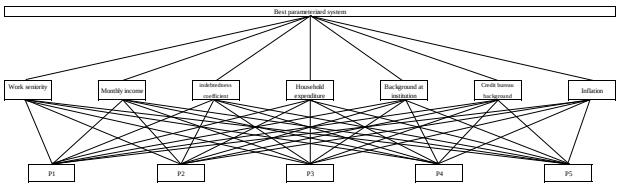


Fig. 4. Determination of the importance of the attributes and sub-attributes

Questioning decision makers on "How much more important is the seniority of the job that increase in inflation?" And the level of the alternatives, "in the term granted, with what intensity is preferred P1 to P2 ". Whose magnitude response indicates the advantage of the preference of one element of decision over another, expressing the degrees of preference between the two elements X and Y are shown in Table 3.

Table 3. Determination of the importance of the attributes and sub-attributes

| if x is … than y, | Preference number to assign |
|---|---|
| Just more important / nonpreferred | 1 |
| Rather more important / preferred | 3 |
| Much more important / preferred | 5 |
| Absolutely more important / preferred | 7 |

The important suppositions of the comparation method AHP are:

1. Of one dimension and depends of each attribute in the previous next level
2. In a paired manner covering all relevant aspects of importance.
3. Evaluating the sub problems in an accurate way and relatively coherent.

Table 4 shows the numeric matrix preference for paired comparisons between attributes, it is observed that with respect to the general convergence point, the debt coefficient (C) it's barely more important than the precedent of the institution (E), and thus successively, determining than the entrances in each column, are the reciprocal of the entrances in the corresponding row, which indicates the inverse relationship of relative advantages when compares the Y attribute for the X attribute, versus the X attribute in comparation with Y. In the tables 4 and 5, paired comparison results are shown in both decimal and accumulated to facilitate subsequent calculations.

Table 4. Paired comparison Matrix.

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| A | 1 | 7 | 3 | 5 | 7 | 3 | 5 |
| B | 1/7 | 1 | 3 | 3 | 1 | 1 | 7 |
| C | 1/3 | 1/3 | 1 | 1 | 3 | 7 | 1 |
| D | 1/5 | 1/3 | 1 | 1 | 5 | 5 | 5 |
| E | 1/7 | 1 | 1/3 | 1/5 | 1 | 3 | 7 |
| F | 1/3 | 1 | 1/7 | 1/5 | 1/3 | 1 | 3 |
| G | 1/5 | 1/7 | 1 | 1/5 | 1/7 | 1/3 | 1 |

When the person who makes the decision, introduced as paired preferences, do not know the weight vector that characterizes the relative advantage of each element with respect to a specific item in the next higher level in the hierarchy. Therefore, after obtaining judgments matched as Table 4 and 5, the next step is to calculate a priority vector (or weighted elements in the matrix). In terms of

matrix algebra, this is to calculate the "principal vector" (own vector) of the matrix, then normalize the sum of 1,000.

Table 5. decimal equivalent matrix

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| A | 1.0000 | 7.000 | 3.0000 | 5.0000 | 7.0000 | 3.0000 | 5.0000 |
| B | 0.1429 | 1.0000 | 3.0000 | 3.0000 | 1.0000 | 1.0000 | 7.0000 |
| C | 0.3333 | 0.3333 | 1.0000 | 1.0000 | 3.0000 | 7.0000 | 1.0000 |
| D | 0.2000 | 0.3333 | 1.0000 | 1.0000 | 5.0000 | 5.0000 | 5.0000 |
| E | 0.1429 | 1.0000 | 0.3333 | 0.2000 | 1.0000 | 3.0000 | 7.0000 |
| F | 0.3333 | 1.0000 | 0.1429 | 0.2000 | 0.3333 | 1.0000 | 3.0000 |
| G | 0.2000 | 0.1429 | 1.0000 | 0.2000 | 0.1429 | 0.3333 | 1.0000 |

Table 6 shows the normalized matrix divide each element of Table 4, the sum of the respective column. Finally, the entries in the row in the last two columns of Table 4, is formed by the sum of the five elements in the row and the average of such elements (main vector) respectively.

Table 6. Standard Matrix

| | A | B | C | D | E | F | G | ∑ʌ | ∑ʌ/7 |
|---|---|---|---|---|---|---|---|---|---|
| A | 0.4251 | 0.6476 | 0.3166 | 0.4717 | 0.4005 | 0.1475 | 0.1724 | 2.5815 | 0.3688 |
| B | 0.0607 | 0.0925 | 0.3166 | 0.283 | 0.0572 | 0.0492 | 0.2414 | 1.1006 | 0.1572 |
| C | 0.1417 | 0.0308 | 0.1055 | 0.043 | 0.1717 | 0.3443 | 0.0345 | 0.9228 | 0.1318 |
| D | 0.085 | 0.0308 | 0.1055 | 0.0943 | 0.2861 | 0.2459 | 0.1724 | 1.0201 | 0.1457 |
| E | 0.0607 | 0.0925 | 0.0352 | 0.0189 | 0.0572 | 0.1475 | 0.2414 | 0.6534 | 0.0933 |
| F | 0.1417 | 0.0925 | 0.0151 | 0.0189 | 0.0191 | 0.0492 | 0.1034 | 0.4399 | 0.0628 |
| G | 0.0851 | 0.0133 | 0.1055 | 0.0189 | 0.0082 | 0.0164 | 0.0345 | 0.2817 | 0.0402 |
| Totales | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 1 |

*Determining the relative position of the alternatives regarding attributes. The next stage of AHP is determined the own vector (priorities) of each of the alternatives, regarding each of the attributes, Table 7 shows the values obtained (approximate weights priority) to perform the operations of matrices defined by the paired comparison process; But nevertheless, it is also feasible to use performance data to calculate quantized priority weights alternatives regarding attribute.*

Table 7. Solution Matrix

| | | |
|---|---|---|
| Work seniority | 0.3688 | |
| Monthly income | 0.1572 | |
| indebtedness coefficient | 0.1318 | |
| Household expenditure | 0.1457 | |
| Background at institution | 0.0933 | |
| Credit bureau background | 0.0628 | |
| Inflation | 0.0402 | Vectors |
| **ΣΛ/7** | **1** | |

Using the above information, we can calculate the priority weighting (weighted evaluation) for any alternative products only add weights for all routes leading to such an alternative. Thus, for P1 alternative we are: 0.3688(0.1690) +0.1572(0.1713) +0.1318(0.1705) +0.1457(0.1685) +0.0933(0.1801) +0.0628(0.4741) +0.0402(0.1690) = 0.1896. The results for the alternatives P2, P3, P4, and P5 are shown in Table 8.

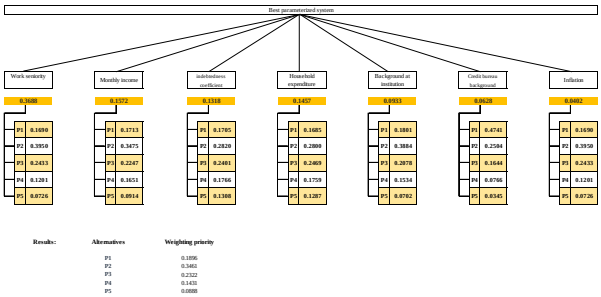


Fig. 6. Results of the weights

Table 8. Value of alternatives P1 ... P8

| Alternative | Priority of weight |
|---|---|
| P1 | 0.1896 |
| P2 | 0.3461 |
| P3 | 0.2322 |
| P4 | 0.1431 |
| P5 | 0.0888 |

## II. CONCLUSIONS

In recent years the behavior of inflation has remained relatively stable for a prolonged period due to the counterweight between two opposing trends: first, the food component, inflation in merchandise registered precisions that reflect global inflation (international) of various raw food material; second, service inflation continues to show downward trend; resulting inflation stability total. With an analytic hierarchy process we can see what its subjective assessment of credit conditions in accordance with the policies and guidelines of the financial institution and of persons responsible for decision-making; for assessing the probable risk situations

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