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The works must be unpublished and refer to topics of Economics, computer science, optimization, risks, finance, administration and business and other topics related to Social Sciences.

Presentation of Content

In the first chapter we present *Does the macroeconomic context condition the prediction of business failure?*, by CONTRERAS-FRÍAS, José Guillermo, SEGOVIA-VARGAS, María Jesús, CAMACHO-MIÑANO, María del Mar and MIRANDA-GARCÍA, Marta, with adscription in the Universidad Complutense de Madrid and Universidad Rey Juan Carlos respectively. As a next article we present, *Investigation of the effect of the brand equity on the repurchase intention by mediation of the brand attractiveness and brand trust*, by HASANI-NASAB, Mahmood, with adscription in the Islamic Azad University. As a next article we present, *The effect of marketing mix on export development with regard to the mediating role of market competition*, by HASANI-NASAB, Mahmood & SHIRAZIAN, Zahra, with adscription in the Islamic Azad University. As the next article we present, *Financial viability and environmental aspects in the selection of energy sources for sanitary hot water (SHW) and heated swimming pools*, by LONGARELA-ARES, Angeles, with adscription in the Universidade da Coruña.

Content

Article **ECORFAN Journal- Mexico**
December 2019 Vol.10 No.23 1-18

Does the macroeconomic context condition the prediction of business failure?

¿Condiciona el contexto macroeconómico a la predicción de quiebra empresarial?

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Abstract

The objective of this study is to identify both micro and macroeconomic variables that allow us to analyze in advance the probabilities of business failure. The selected sample contains all the listed companies of the IPC index of Mexico, IBEX-35 of Spain and EURO STOXX50 of Europe for a time horizon of 5 years. Our contribution lies in the empirical testing of the results by two different techniques: general estimating equations (a parametric technique) and a decision tree (a non-parametric technique based on artificial intelligence). The obtained results show that the factors of liquidity, indebtedness and profitability are the ones that affect the prediction of corporate bankruptcy for listed companies, but not the macroeconomic ones, since the macroeconomic peculiarities of each country are diluted by the importance of the economic-financial structure of each company.

Business bankruptcy, Macroeconomics variables, Panel data models, Decision tree

Resumen

El objetivo de este estudio es identificar aquellas variables tanto micro como macroeconómicas que permitan analizar anticipadamente las probabilidades de fracaso empresarial. La muestra utilizada fue de la totalidad de empresas cotizadas de los índices IPC de México, IBEX-35 de España y EURO STOXX50 de Europa para un horizonte temporal de 5 años. Nuestra contribución radica en la contrastación empírica de los resultados mediante dos técnicas distintas: ecuaciones de estimación generalizadas (técnica paramétrica) y el árbol de decisión (técnica no paramétrica de Inteligencia Artificial). Dichos resultados son que los factores de liquidez, endeudamiento y rentabilidad son los que afectan a la predicción de quiebra empresarial para empresas cotizadas y no los macroeconómicos, ya que las particularidades macroeconómicas de cada país se diluyen por la importancia de la estructura económico-financiera de cada empresa.

Quiebra empresarial, Variables macroeconómicas, Modelos de datos de panel, Árbol de decisión

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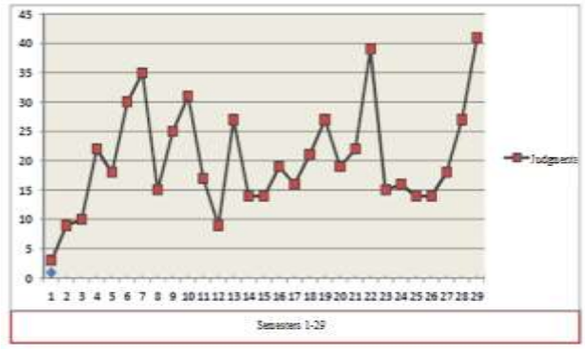
Introduction

The development and use of models for predicting companies in financial difficulties have been the subject of a multitude of studies at least in the last five decades, mainly due to the very negative consequences that business failures have for society in general and for the economy in particular. After more than seventy years of trying to study why companies fail and more than fifty years of modeling the behaviour of companies with financial problems compared to those without, there is still no single, clear theory of business failure (Lukason, 2016). In fact, every time there is an economic crisis there seems to be an increase in studies on the subject. In 1966, when Beaver's first empirical study was published, 9 articles were published in the Web of Knowledge (ISI), the first database of prestigious articles worldwide. The number of articles on bankruptcy has reached 818 in 2017.[1]

In addition, Korol (2013) states that business problems are not sudden. On the contrary, the appeared five to six years before they enter in the bankruptcy procedure, so they have to be predictable or at least explainable. The economic problem that a company can have in such a situation is very serious and that is the reason why having prediction models that allow us to identify possible difficulties is of great importance for entrepreneurs, managers, shareholders, investors as well as for researchers.

Although this is true, what is even more interesting is to be able to take the necessary actions avoiding consequences that imply greater losses. Many companies go bankrupt as a result of economic crises. For example, in Mexico for the last 10 years, 468 companies from all sectors have been in insolvency in the country. The director of IFECOM in Mexico said that as an immediate effect of an economic crisis there is an increase in litigation between companies. This was the case with companies such as "Comercial Mexicana", which in 2008 began to have problems with the banks with whom it contracted derivative financial instruments to supposedly improve their finances (Contreras, Segovia-Vargas and Camacho, 2014).

As can be seen in Graph 1, the number of companies that enter into insolvency proceedings in Mexico increases during periods of economic crisis. For example, in 2010 (global economic crisis) and 2014 (currency depreciation).



Graph 1 Evolution of the number of companies in bankruptcy procedure in Mexico
Source: IFECOM Work Report June-November 2014

Another example can be found in Spain, where the number of companies that have gone bankrupt in recent years has risen to almost 10,000 companies. Comparing this figure with the years before the crisis, the trend has multiplied by 100. In fact, the global index "Euler-Hermes" on the insolvency of countries, for Spain in 2012, the worst post-crisis period, suffered an increase of 32% over 2011, while the average of the euro area remained around 7%. In the same period, the indicator for Mexico was 23%. This fact is relevant because it is assumed that the social stigma of the insolvency proceedings penalizes companies that enter the legal process and those that enter, is because they are really in a situation of "induced coma", which means that 9 out of 10 of these companies end up in liquidation and not financially reorganized to return to the market (Camacho-Miñano, Segovia-Vargas and Pascual-Ezama, 2015; Segovia-Vargas and Camacho-Miñano, 2018).

These microeconomic data are also reflected at the macroeconomic level. For example, in the growth of gross domestic product (GDP), the unemployment rate, public debt or the risk of credit insolvency. The following graph (Graph 2) shows the trend of the interannual variation of GDP, the unemployment rate and the public debt in the case of Spain and Mexico as well as the figures to buy with the average of the Eurozone.

[1] Using the keyword “bankruptcy”

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The year-on-year variation in GDP shows a sharp drop in this macroeconomic indicator in 2009, both in Spain and in the rest of the Eurozone, a year of the strong impact of the economic crisis. This is due, to a large extent, to the closure of many companies to the economic recession suffered in that period.

GDP
Unemployment

Graph 2 Year-on-year change in GDP and unemployment in Spain, Mexico and the Eurozone
Source: World Bank (www.datos.bancomundial.org)

In 2009 it was also observed that the trend in the unemployment rate rose to 26% in Spain. On the same date, the unemployment rate was 12% in the Eurozone as a whole.

With respect to public debt, there is also a growth in the weight of debt reaching, at the end of 2013, 92.1% of GDP in Spain and almost 90.9% in the Euro Zone, while in Mexico has maintained a growth of more than 3 percentage points since 2012 passing from 43.17% and reaching levels of 50.08% by the end of 2014, according to World Bank data.

These macroeconomic variables analyzed are only a few examples, but the reality is that there are many others that are affected in periods of economic recession and could be used to predict business failure. Similarly, country legislation also affects. For example, the resolution of business failure situations is different depending on the country involved.

This has been demonstrated by comparing different countries within the European Union (Weijs, 2012). In fact, there are economic studies that justify how laws on corporate insolvency can condition the development of entrepreneurship in a country (Lee et al., 2011), national economic growth (Laporta et al., 1998), economic stability (Beraho and Elisu, 2010) and even the development of stock markets (Levine, 1998). It is also empirically verified how one bankruptcy law or another can change foreign investments in a country (Pindado, Rodriguez and de la Torre, 2008). Hence, the correct development of insolvency laws is of vital importance to promoting economic growth and legal certainty for investors.

In view of the above, the objective of this study is to analyze whether or not macroeconomic variables can improve the predictive power of traditional bankruptcy prediction models. Since the listed companies are supposed to reflect the daily life of each country, sector, and company, we are going to use a sample of these companies in the most relevant world indices. It is assumed that new macroeconomic variables could improve models based only on accounting variables.

The specific objective is to contrast or compare the results obtained through the empirical application of two different techniques in order to analyze the robustness of our conclusions. On the one hand, parametric techniques belonging to multivariate statistical analysis are used, such as generalized estimation equations (GEE) and, on the other hand, non-parametric techniques belonging to artificial intelligence (AI) such as decision trees applied to a sample of panel data (Tinoco, Venegas and Torres, 2018).

The article is structured as follows: Section 2 contains the literature review. Next, section 3 includes the hypotheses of the research, the description of the sample and the variables and the methodologies used. In the following section, we present the results and the last section presents the conclusions.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Literature Review

Over the years, many researchers have focused their efforts on trying to determine the level of solvency of a business in order to predict or avoid the bankruptcy of a company through the use of ratios, statistical methods and financial analysis on factors that directly impact liquidity, leverage, and profitability, among others. In 1932 Fitzpatrick carried out the first works giving rise to what is known as the descriptive stage. His primary objective was to try to detect business failures through the use of ratios only. In the same line is the work of Winakor and Smith (1935), applying basic univariate analysis techniques, analyzing the trends of various financial ratios. However, it was not until the 1960s that more complex statistical techniques such as discriminant, univariate and multiple analysis began to be used. Based on these studies, Beaver (1966), Altman (1968) and many others have attempted to develop a general theory of business failure, albeit still unsuccessful. In these studies, the methodology is based on a paired design of companies.

Initially, studies that attempted to predict and therefore explain business failure were based on ratios derived from accounting information (Ohlson, 1980). They consisted of analyzing the cases of real business failures and, using an inductive method, learning the common characteristics of failed companies by comparing them with "healthy" companies. However, even today, with more than half a century of subsequent research, there is still no unanimity among researchers as to which accounting ratios best explain the insolvency situation. In the accounting literature, many researchers have used key ratios from financial analysis or financial statement documents (balance sheet, profit and loss account, or cash flow statement) to explain bankruptcy (Altman et al., 2017). Generally speaking, there are three types of ratios most used by academics on the subject: profitability ratios, debt ratios and economic-financial equilibrium ratios (among others, see: Tascón Fernández and Castaño Gutiérrez (2012); Korol (2013)). The relationship between profitability and liquidity seems logical since the idea is that companies with financial problems are less able to access financing, external financial resources, such as banks, which means significant cash imbalances.

Depending on the methodology used in forecasting insolvencies, the way in which explanatory factors are selected may vary. In other words, if traditional statistical techniques are used, the way in which the variables explaining the sample are selected may condition the results, as not all existing accounting ratios can be included due to problems of multicollinearity between them. In addition, variables are also required to meet certain baseline assumptions, such as the criteria of normality and heteroscedasticity, in order to be able to apply certain statistical techniques.

In the decade of the 80's the first questionings to these last models appear because they are not random Zmijewski (1984) and because of the advances in the methodology with logistic regression or Logit model. Motivated by the importance of incorporating the history of each company, we began with the application of models for longitudinal data, such as the mixed linear model or the mixed logistic model, which incorporate in their analysis the financial statements of each company in a time horizon. At the time of elaborating this type of models, it is also relevant to the selection of the variables to use. Different techniques are used for this: main components, degree of statistical significance of the variables (forward or backward), the judgment of researchers or professionals, cluster analysis, etc.

If it is decided to use non-traditional methodologies (De Andrés, Landajo and Lorca., 2012; Du Jardin, 2018; Ravi Kumar and Ravi, 2007) as artificial intelligence methods (rough set, decision trees such as PART algorithms, C4.5, random forest, neural networks...), all available variables can be considered as long as they classify the problem to be studied well, i.e. that its level of significance is acceptable. However, although errors in the classification of failed enterprises have been reduced, they have not been fully classified. According to a study by Aziz and Dar (2006) up to that date, studies predicting the risk of insolvency had used statistical models in 64% of the cases, 25% had made use of soft computing techniques or artificial intelligence, and 11% had studied the phenomenon through another one.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Regardless of the methodology used, accounting ratios involve a number of limitations inherent in accounting. First, accounting data are historical data, based on past events, which sometimes makes it difficult to make predictive decisions in the future (Yeh, Lin and Hsu, 2012). Another limitation of accounting data is that they are subject to manipulation or bias, depending on the incentives that their managers have: the lower payment of taxes, postponing or avoiding a legal insolvency process, showing a healthy image to get credit, and so on. (Campa and Camacho-Miñano, 2014). In addition, the accounting policies of companies, and even the sectors to which they belong may have some influence on accounting variables (Balcaen and Ooghe, 2006). Likewise, whether or not they belong to a group of companies and the type of group could modify these variables (Korol, 2013).

Another problem is the existence of different accounting regulations, which makes it difficult to use data from companies worldwide. Finally, there are academic studies that highlight the role that accounting information plays on the probability of insolvency of companies (Meeks and Meeks, 2009), since the paradox is that the simple probability of insolvency affects the accounting valuation of assets and liabilities and that, in turn, the valuation of these conditions this probability.

Despite all these accounting problems, models with financial ratios (accounting data) are zrecognized and used worldwide. Thus, Agarwal and Taffler (2008); Das, Hanouna, and Sarin (2009) and Bauer and Argawal (2014) point out that, taking into account the profitability of models based on accounting data, market-based models and risk models prevail in the finance literature. For Argawal and Taffler (2008), there is little predictive difference between models based on accounting data and those based on the market, however, the use of models based on accounting allows a higher level of risk-adjusted return.

However, even though various types of research have been conducted related to predicting business failure, the original "Z-Score" model introduced by Altman (1968) has been the dominant and globally applicable model (Altman et al., 2017).

Although its origin is more than 45 years old, it is still used as a prediction tool in bankruptcies or financial difficulties.

Despite all the above, two options are considered to increase the predictive power of the models by researchers: either the use of stock market variables or the use of other non-financial variables. Marais, Patell, and Wolfson (1984) were the first to point out that stock prices improved the prediction of failure, compared to the use of accounting variables only. Barniv, Agarwal, and Leach (1997) found that there were accumulated abnormal results, weighted by market prices, before firms entered the contest. Hillegeist et al. (2004) noted that adding market variables to models improved information opportunity. In fact, Chava and Purnanandam (2010) found a positive relationship between stock returns and the risk of failure. A study by Bauer and Agarwal (2014) points out that hazard models add greater predictability than traditional models for predicting potential insolvencies. Other research has also focused on the predictive power of financial statements (Collins, Maydew, and Weiss, 1997; Francis and Shipper, 1999, among others).

With regard to non-financial variables, variables such as the age of the company since its foundation, size (such as algorithm of total assets, the average number of employees and sales figure) and sector (Tascón and Castaño, 2012) were added to the models.

Among the first studies that attempted to create a theory of business failure and success, the theory developed by Lussier (1995) stands out, based on fifteen internal variables of the company, such as the level of initial capitalisation of the business, the experience of the company in the sector or the training of managers. However, the main problem of this study was the difficulty in obtaining this type of data from failed companies, coming from interviews with managers. Many other variables have been added model by model. Thus, Laitinen and Laitinen (2009) incorporate information on audit reports, and De Andrés, Landajo and Lorca (2012), which make use of standards from different economic sectors. Other more specific audit report variables have also been added recently, such as the auditors' comments, which improve the practical power of the auditors.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Other more specific audit report variables have also been added recently, such as auditor comments, which improve the predictive power of Altman's models (Muñoz-Izquierdo, 2017).

Noga and Schnader (2013) use temporary tax differences, Kallunki and Pyykkö (2013) analyze the past experience of the managers of companies in competition and Chiu, Peña and Wang (2013) explain the probability of business failure depending on the degree of concentration of the sector, based on the idea that the more competition in a sector, the greater the probability of failure.

Finally, it should be noted that the latest trend in business failure investigations is cross-country comparisons. Few studies have carried out a comparative study mainly due to the lack of access to data from different countries. The development of international trade databases has led to these studies, although there is still a theory of business failure to be built. One of the first studies was that of Altman and Narayanan (1997). They reviewed business failure prediction models in 22 countries. Another study by Ravid and Sundgren (1998) compared the efficiency of Finnish and US legal codes governing business failure. Analyzing 70 companies from each country, they found that, although the economic factors affecting bankruptcy proceedings coincide in both countries, Finnish legislation favors a liquidation process to a greater extent than the American one, rather than achieving the reorganization of a company. Laitinen (2002) also analyzed companies from 17 European countries and the United States, concluding that there are differences between countries with regard to the degree of reliability of the models. On the basis of the analysis of their sample, the countries that obtained the highest degree of reliability in their classification were Germany, Belgium, Italy, Finland and Greece, and the lowest were Switzerland, Ireland, and Portugal.

Similarly, Bellovary, Giacomi, and Akers (2007) refer to models in 18 countries. Davydenko and Franks (2008), with a sample of approximately 1,500 companies from Germany, France and the United Kingdom, concluded that the legislation in force in each country affected business crises, although the role of banks or competition also affects the tendering of companies.

A study conducted by Korol (2013) compares data from Polish companies listed, healthy and in competition, with Latin American companies (from Mexico, Argentina, Peru, Brazil and Chile) using traditional methodologies and artificial intelligence.

He concludes that it is more difficult to explain the Latin American companies than the European ones since the normative and macroeconomic context of the Latin American ones conditions the competition. Another study by Laitinen and Suvas (2013) compares 30 European countries, pointing out that, despite the differences between countries, it is possible to predict business failure with some acceptable classification errors.

A recent study is the work of Altman et al. (2017). It stands out for an exhaustive review of the literature on the importance and effectiveness of Altman's Z-Score model for predicting global bankruptcy and its applications in bonds and other related areas.

The review is based on an analysis of 33 scientific articles published from 2000 to the present in the major financial and accounting journals. The result of the analysis shows that while a general international model works reasonably well, with predictive accuracy levels ranging from 75% to 90%, classification accuracy can be improved considerably with country-specific estimates, especially with the use of additional variables.

In short, the line of research on predicting bankruptcy between countries is key due to the globalization of international markets and the existence of a global investor.

Therefore, the existence of a common bankruptcy or failure prediction model for different countries with a high degree of reliability remains relevant and is one of the purposes of this thesis.

The research continues around the world in order to "perfect" predictive models with the addition in the application of both parametric and non-parametric techniques more efficient that have attempted to obtain greater accuracy in prediction.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Research hypotheses, sample, variables and methodologies

1. Research hypotheses

H_0: The presence of macroeconomic variables conditions business failure in a global context of listed companies. In other words, macroeconomic variables should increase the predictive power of models without taking these variables into account.

2. Sample

For the selection of the companies in this study, all the companies that made up the following reference indices without prior knowledge of their financial situation were used: IPC of Mexico (35 companies), IBEX35 of Spain (34 companies) and EURO STOXX 50 of the Eurozone (50 companies).

Therefore the sample is made up of 119 companies. The geographical unit refers to the selection of the region or country to which the units of analysis belong. In most of the investigations carried out, it has been chosen to include samples belonging to a single country or region, however, in this research the geographical unit has been extended to several countries considering the place where the companies carry out their economic activity.

The time unit comprises the time period of the database. Normally these periods are annual and vary from 3 to 10 years. In the present study, the accumulated data for the last quarter of each year from 2010 to 2014 were available, so there is a time horizon of 5 years.

3. Description of the variables

The determination of the dependent variable is a subject of multiple divergences and contradictions. The analysis of bankruptcy or business failure gives rise to disagreements due to the nation consensus in the definitions and to the timing and indicators that are used to declare such a state. Given that the factors that can cause business failure are many and of diverse nature, the intention of this paper will be to detect indications or indicators from the information contained in the financial statements.

Due to the problematic exposed, and before the diversity of definitions, in the present study we have classified the companies in two categories, healthy and bankruptcy, according to the score obtained when using the Z-score of Altman (1968), an indicator that continues valid for almost fifty years. Based on Altman's experience with companies in financial difficulties, an index was developed using five ratios and five weights, with the aim of forecasting the bankruptcy of listed manufacturing companies. The experience of this model led the author to conclude that Z-Score scores below 1.81 indicated a high probability of bankruptcy. On the other hand, scores above 3.00 indicated a low probability of bankruptcy. The range between 1.81 and 2.99 was referred to as the "ignorance zone". Companies with this Z-score should be analyzed in depth to determine their probability of bankruptcy. After applying this indicator to the 119 companies in the study and using information from their financial statements, we obtain a classification as shown in the following table (Table 1).

Year	Healthy firms	Bankrupt firms	Not-classified
2010	46	38	35
2011	43	45	31
2012	43	46	30
2013	46	41	32
2014	46	41	32

Table 1 Classification of firms according to Z-SCORE ALTMAN
Source: Own elaboration

An average of 27% of companies could not be classified according to the Z-score due to lack of accounting data. However, of the remaining 73% of companies in the sample that have been classified, 51% are healthy and 49% are bankrupt. This concludes that we start from a balanced sample of healthy and bankrupt companies for each of the years within the time series analyzed.

On the other hand, the selection of the independent or explanatory variables that will be used in any model is of special importance and attention on the part of the researchers, since based on them it will be possible to draw appropriate and accurate conclusions.

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In order to determine the role of macroeconomic variables in the explanation and prediction of business failure, this research paper considered two types of explanatory variables: microeconomic variables (financial ratios) and macroeconomic variables.

For Brealey and Myers (1999), using financial ratios has the advantage of not being overwhelmed by the large volume of information and data contained in financial statements. According to Segovia-Vargas and Camacho-Miñano (2018), an advantage of using ratios is that they reduce the dispersion in the figures of the financial statements of companies due to their size. This fact facilitates the inter-company comparison. Large firms produce large accounting numbers and small firms produce smaller accounting numbers. Therefore, the use of ratios has the advantage of reducing the bias that could arise from the size of firms.

As far as the selection of financial ratios is concerned, this study was carried out taking into consideration the following elements:

1. The data extracted from the financial statements available for the study.

2. The bibliographical review of a considerable number of articles in this line of research. This review took into account the number of papers in which financial ratios were most frequently used (see section 2, Tascón Fernández and Castaño Gutierrez, 2012).

Variable	Definition	Nº Papers	Indicator
X_1	Current Assets/Current Liabilities	1	Liquidity
X_2	Total Liabilities/ Total Assets	18	Indebtedness
X_3	Total Liabilities / Stockholders' equity	3	Indebtedness
X_4	EBIT / Revenues	1	Profitability
X_5	EBIT / Stockholders' equity	5	Profitability
X_6	Net Income / Net revenues	2	Profitability
X_7	Net Income / Stockholders' equity	6	Profitability
X_8	Net Income / Total Assets	14	Profitability
X_9	Revenues / Fixed Assets	5	Efficiency

Table 2 Microeconomic variables (financial ratios)
Source: Own elaboration

The rest of the explanatory variables are the most relevant macroeconomic variables (Hernández-Tinoco and Wilson, 2013) of each of the countries under study (Table 3):

Variable	Definition
Sector	Industry: Classification according to the specialization of the economic activity
País	Country
GII	Global Insolvency Index (Euler Hermes)
TEA	Business Entrepreneurship Index. Early - Stage Entrepreneurial Activity
PIB	GDP- Gross Domestic Product
Desempleo	Unemployment (Rate of unemployment)
Corrupción	Corruption Perception Index
Cumplimento ley	Enforcement: law enforcement index
Inflación	Inflation
Situación legal	Legal situation: Classification according to civil law or common law

Table 3 Macroeconomic variables
Source: Own elaboration

The main characteristics of our sample are shown in the following tables 4 and 5:

Variables	Minimum	Maximum	Mean	Standard Deviation
X_1	0.06	7.63	0.72	0.77
X_2	0.06	0.99	0.66	0.21
X_3	0.06	98.16	5.33	9.72
X_4	-80.90	0.80	-0.18	5.18
X_5	-9.10	1.84	0.05	0.62
X_6	-34.14	1.09	-0.05	2.03
X_7	-3.84	0.88	0.02	0.29
X_8	-0.12	0.11	0.01	0.02
X_9	0.03	209.94	3.13	12.46

Table 4 Descriptive statistics of the selected microeconomic variables
Source: Own elaboration

Variables	Minimum	Maximum	Mean	Standard Deviation
GII	-0.30	0.33	0.03	0.15
TEA	0.00	0.19	0.07	0.05
PIB	-0.03	0.05	0.01	0.02
Desempleo	0.05	0.26	0.12	0.08
Corrupción	0.03	0.09	0.06	0.02
Enforcement	0.42	0.86	0.67	0.08
Inflación	-0.01	0.05	0.02	0.01

Table 5 Descriptive statistics of the selected macroeconomic variables
Source: Own elaboration

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

4. Methodologies

We will use two types of methodologies, one parametric and the other non-parametric. The parametric method is based on the analysis of panel data, that is, repeated measurements over a period of time on the same individual, thus obtaining a history that shows the development or evolution of the characteristics being measured. For the application of this methodology, it is necessary an efficient analysis of the databases since when data are missing (they should be estimated) or the presence of atypical data can have a negative or illogical influence on the results. In addition, this efficient analysis can contribute to a better prediction and, therefore, to a better evaluation of the companies under study.

When panel data are available, the use of linear models ignores possible correlations between variables and therefore erroneous conclusions would be reached regarding statistical significance. A tool that is appropriate for analyzing dichotomous variables with this type of data is through generalized estimating equation (GEE), introduced by Liang and Zeger (1986) which are an extension of generalized linear models (GLM), in which the existing correlation between variables is taken into account to increase the efficiency of the estimator.

To estimate β, the GEE is $\sum_{i=1}^{n} \frac{\partial \mu_i^{\tau}}{\partial \beta} V_i^{-1}(Y_i - \mu_i(\beta)) = 0$, where $V_i = \gamma\, A_i^{1/2} R_i(\alpha) A_i^{1/2}$ and being, $R_i(\alpha)$ the correlation matrix. The element (j, k) of this matrix is the correlation between y_{ij} and y_{ik}.

The correlation between repeated measures, however, can have an important effect on the estimated variance of the regression coefficients and will, therefore, have to be taken into account to make correct inferences. Since it is rare that the true correlation is known, it is considered a working correlation matrix, R. This matrix is of size t x t because it is assumed that there is a fixed number of points in time at which individuals are observed. In addition, the correlation matrix R_i is considered to depend on a vector of association parameters, denoted by α. This unknown vector of parameters has a structure that will be determined by the researcher.

There is not much information on how to choose the best correlation structure and it is often difficult to determine. However, the possible loss of efficiency is reduced as the number of individuals grows. Unstructured was used in this paper. In addition, GEEs perform better when the following conditions are met:

- The number of observations per subject is small (5 observations per company in this study) and the number of subjects is large (119 companies in this study).

- These are longitudinal studies or, to put it another way, with a panel data structure, always obtaining measurements at the same instant of time for each individual (2010 - 2014 in the present study).

When using the GEE model, it should be noted that it is a model that is not based on the use of the likelihood function. One of the criteria most used and implemented in different data analysis packages is Wald's statistic. This criterion can be used to select the best structure of the R_i matrix (α) according to the data, or to select variables to be taken into account within the model and previously requires a rigorous analysis of the data. Therefore, the first analysis of the predictive model does not have to consist of mainly estimating the predictive model, but of evaluating the underlying assumptions that are as important as the final result.

A second method is a non-parametric approach based on Artificial Intelligence (AI), i.e., it does not start from previously established hypotheses, and considers the baseline data in a fully exploratory manner. The IA is in charge, among other applications, of building computer programs capable of carrying out intelligent work based on learning from the data by means of pattern recognition, with the purpose of extracting information that allows establishing properties and characteristics of a certain set of objects. Of all the artificial intelligence techniques, we have selected the decision trees for their easy comprehension for the end user and for their explanatory power.

Decision trees are part of so-called automatic learning and are diagrams of logical constructions of the optimal classification of a given group of data according to their characteristics or attributes.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

According to Molina and García (2006) a decision tree can be interpreted as a series of compacted rules for its representation in the form of a tree and what differentiates one decision tree from another is the algorithm that generates it and that will make the successive partitions in the space of explanatory variables, using in each partition a single variable. There are numerous algorithms to elaborate a decision tree, but one of the most used in the literature is the one developed by Quinlan (1993) and implemented in C4.5 (as an example, see Díaz-Martínez, Segovia-Vargas and Fernández Menéndez, 2005; Gelashvili, Segovia-Vargas and Camacho-Miñano, 2015). This algorithm generates a decision tree from the data using recursive partitions, partitions supported by a series of concepts from information theory (Reza, 1961). The basic idea is to take in each branch of the tree, to make the corresponding partition, that variable that provides more information. It uses a heuristic technique known as a gain ratio which is a measure based on information that considers different numbers and (different probabilities) of the test results. Thus, the algorithm generates a rule structure and evaluates its goodness using criteria that measure the precision in the classification of cases.

Results and discussion

1. Principal component analysis

First, a preliminary analysis of the data was made using the statistical technique known as principal component analysis. The following criteria will be used to select the components:

- Kaiser criterion: This criterion mentions that the eigenvalues have to be greater than 1, since these are the ones that explain greater variance. The average of all these values is equal to 1.

- Choose a minimum of variance that you want to explain. For this study, we set a target between 65% and 75%.

Taking into account these criteria, we have chosen 4 components for each of the years analyzed, observing which variables saturate each factor in each of the years (those that have more weight within each of them).

In the space of the variables, the analysis makes sense if there are positive variabilities of the variables, since this is indicative of their greater incidence on the total absolute variability, and therefore the other factors will have little incidence.

Figure 1 shows the variables that saturate each factor for each of the years and for the 4 main components selected. Figure 2 includes a summary considering the frequency of appearance of these variables:

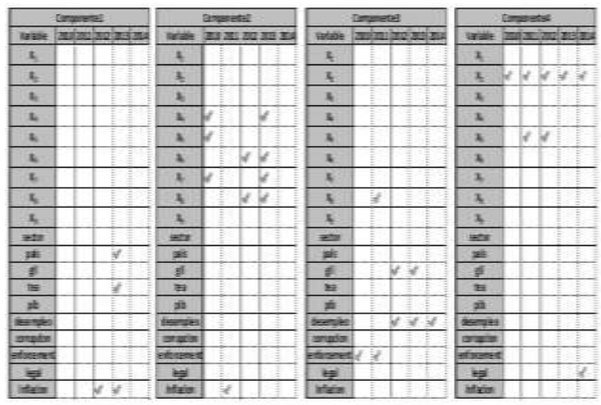

Figure 1 Principal Component Analysis
Source: Own elaboration

Variable	Comp 1	Comp 2	Comp 3	Comp 4	Total
X_1	0	0	0	0	0
X_2	0	0	0	5	5
X_3	0	0	0	0	0
X_4	0	2	0	0	2
X_5	0	1	0	2	3
X_6	0	2	0	0	2
X_7	0	2	0	0	2
X_8	0	2	1	0	3
X_9	0	0	0	0	0
Sector	0	0	0	0	0
Pais	1	0	0	0	1
GII	0	0	2	0	2
TEA	1	0	0	0	1
PIB	0	0	0	0	0
Desempleo	0	0	3	0	3
Corruption	0	0	0	0	0
Enforcement	0	0	2	0	2
Legal	0	0	0	1	1
Inflacion	2	1	0	0	3

Figure 2 Frequency summary of variables by component
Source: Own elaboration

2. Generalized estimating equation model

The analysis of main components gives us an idea of the independent variables that could form part of the model without losing information from the rest of them, and from them, the iterations of the GEE model have been carried out:

Wald X^2= 93.13		
Variable	**p-value (P>|z|)**	**Coeficient**
X_2	0.000	7.114
X_5	0.049	-1.073
X_8	0.000	-30.904

Wald X^2 (6) = 107.83		
Variable	**p-value (P>|z|)**	**Coeficient**
X_1	0.000	-1.932
X_2	0.000	6.742
X_5	0.007	-1.501
X_8	0.000	-33.829
Unemployment	0.007	3.566
Inflaction	0.095	13.185

Wald X^2 (4) = 116.96		
Variable	**p-value (P>|z|)**	**Coeficient**
X_1	0.000	-1.91
X_2	0.000	6.88
X_5	0.019	-1.24
X_8	0.000	-31.39

Figure 3 Iterations of GEE model
Source: Own elaboration

As regards the interpretation of the coefficients in financial terms, it should be pointed out that the main variables explaining business failure in the sample of listed companies used are the following:

- The negative coefficient of variable X_1 (liquidity ratio): Indicates that a company is more likely to go bankrupt when, for each monetary unit of debt, it has fewer liquid assets to meet its obligations.

- The positive coefficient of variable X_2 (global debt-solvency): Indicates that a company is more likely to go bankrupt when it is more dependent on its debt. In other words, for each monetary unit of the total asset, more depends on external resources.

- The negative coefficient of variable X_5 (return on capital): Indicates that a company is more likely to go bankrupt when for each monetary unit of capital invested by shareholders generates less profit before taxes and interest.

- The negative coefficient of variable X_8 (ROA or return on assets): Indicates that a company is more likely to go bankrupt when less operating profit is generated for each monetary unit invested in assets.

After the third iteration, the same variables are maintained as significant within the GEE model, and its predictive capacity was improved by adding variable X_1. Thus, we can conclude that the variables within the third iteration are those that would have greater predictive power in relation to the dependent variable, i.e. the possible bankruptcy of a company. In this way, we demonstrate that macroeconomic variables do not have sufficient weight in the prediction of possible insolvency in listed companies as the sample used.

3. Decision Tree Model

As a robustness analysis, we are going to contrast the results obtained previously with the decision tree methodology. Although the data we have presents the characteristic of panel data, for the application of these models only two cross sections will be made, one for 2010 and another for 2014, so we can analyze the beginning and end of the time series.

The obtained results[2] of the C4.5 decision tree for 2010 are shown in the following figure (figure 4):

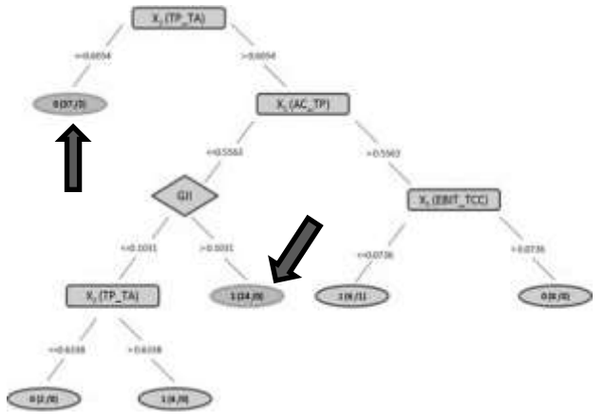

Figure 4 C4.5 Decision Tree year 2010
Source: Own elaboration. Note: The arrows point to the strongest branches.

The 10 k-fold cross validation result (which the most common)[3] of this model is 77% of correct classifications.

[2] WEKA is the data mining package developed by the University of Waikato (Witten and Frank, 2005) with which we performed our analysis.

[3] In cross validation, a random partition (usually 10 parts) of the development group (the entire sample data) is performed and a subgroup (9 parts) is used recursively to generate the tree and another (1 part) for validation.

The branches that verify more companies (stronger) are those that we must analyze and interpret since they would reflect certain patterns since they are supported by the majority of the cases. To analyze bankruptcy (class 1) we have the following branches that represent the strongest rule:

- Branch 1. All companies, according to the classification criteria provided by the response variable (bankruptcy or no bankruptcy), can be classified according to first to the microeconomic variable known as the global solvency ratio X_2. The higher the result of this quotient, the more the company depends on outside resources. For values higher than 0.6054 in this ratio, the tree suggests the analysis of another additional variable, i.e. the microeconomic variable X_1.

- Branch 2. This branch corresponds to the analysis of variable X_1, the financial ratio of current liquidity that measures the share of total financing in short-term investments, the greater the ratio, the greater the short-term liquidity of the company. The decision tree suggests the analysis of the Macroeconomic variable GII for values lower than 0.5563.

- Branch 3 refers to the analysis of the variable GII (global insolvency index). The higher this indicator, the lower the level of solvency of a company. For values greater than 0.1031 the company would be classified as bankruptcy, a situation that is fulfilled in 24 cases, i.e. a total of 30% of the sample.

In the same way, we will analyze the healthy companies (class 0- no bankruptcy) we have the following branches that represent the strongest rule. In this case, we have a single branch that, following the same criterion, shows that all companies can be classified by first taking into account variable X2.

Analyzed inversely, the lower the result of this quotient, the less the company depends on external resources. That is why the tree suggests that for values lower than 0.6054 of this variable, the company would be classified directly as healthy without the need for any other additional variable, a situation that is fulfilled in 37 cases, that is, a total of 46% of the sample.

The results obtained after the application of a tree C4.5 for the year 2014 are shown in the following figure 5:

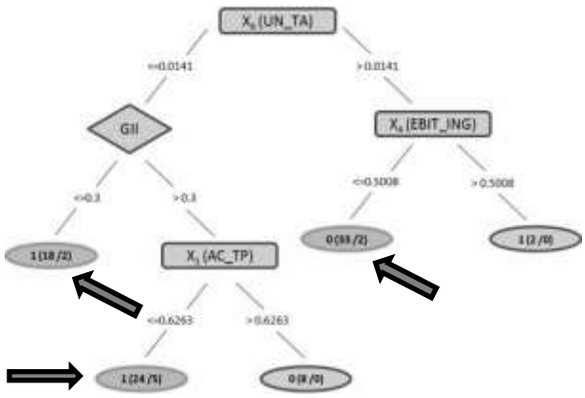

Figure 5 C4.5 Decision Tree year 2014
Source: Own elaboration. Note: The arrows point to the strongest branches

The 10 k-fold cross validation result of this model is 71.76% of correct classifications. In the same way, we will analyze and interpret the branches that present greater force.

To analyze bankruptcy (class 1) we have two rules. The first rule for bankrupt enterprises contains two branches:

- Branch 1. All companies, according to the classification criteria provided by the response variable (bankruptcy or no bankruptcy), can be classified according to microeconomic variable X_8, profitability ratio known as ROA (return on assets). A low ratio is associated with low productivity or the inefficiency of its assets. For values lower than 0.0141 in this ratio, the tree suggests the analysis of another additional variable, i.e. the macroeconomic variable GII.

- Branch 2. Corresponds to the analysis of the variable GII, (global insolvency index). For values lower than 0.3, the company would be classified as bankruptcy, a situation that occurs in 18 cases, i.e. in a total of 21% of the sample.

The second rule for bankrupt enterprises contains three branches:

- Branch 1. All enterprises can be classified by first looking at the microeconomic variable X8 known as the economic profitability ratio or ROA.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

For values lower than 0.0141 in this ratio, the tree suggests the analysis of another additional variable, i.e. the macroeconomic variable GII.

- Branch 2. It corresponds to the analysis of the macroeconomic variable GII (global insolvency index, the higher this indicator, the lower the level of solvency of a company). For values greater than 0.3 in this indicator, the tree suggests the analysis of another additional variable, i.e. microeconomic variable X_1.

- Branch 3. It corresponds to the analysis of variable X_1, (current liquidity coefficient). For values lower than 0.6263 in this variable, the company would be classified as bankruptcy, a situation that is fulfilled in 24 cases, i.e. a total of 28% of the sample.

Similarly, we will analyze healthy enterprises (class 0-no bankruptcy) for which we only have one strong rule with two branches:

- Branch 1. All enterprises can be classified first by the microeconomic variable X_8, i.e. by the ROA. As mentioned above, a high ratio is synonymous with very efficient and productive assets. For values greater than 0.0141, the tree suggests the analysis of another additional variable, i.e. microeconomic variable X_4.

- It corresponds to the analysis of the microeconomic variable X_4 or net profit margin or profitability of income; it indicates how much profit is obtained by each monetary unit of sales and therefore, the lower the indicator, the less profit is obtained by the sales made. For values lower than 0.5008, the company would be classified as bankrupt, a situation that is fulfilled in 33 cases, i.e. a total of 39% of the sample.

From the analyses carried out, it can be inferred that in order to identify the micro and macroeconomic variables that are most significant for analyzing the probabilities of early business failure, the ratios X_1 (current liquidity coefficient), X_2 (global solvency ratio) and X_8 (ROA) are the variables to be taken into account and with the patterns shown by the rules.

4. Results and discussion

The results show that increasing the predictive capacity or power of business failure prediction models can be approached from two different approaches. The first of these approaches relate to the appropriate choice of variables and the second relates to the appropriate choice of methodology or application technique used. In general terms, the research work carried out in this sense indicates that the precision of bankruptcy models cannot be appreciably improved by the choice of one or another classification algorithm. For example, in the work carried out by Karas and Režňáková, (2014) for the case of companies in the Czech Republic, a parametric vs. a nonparametric method applied to the same initial sample was tested and obtaining as results for the case of the parametric methodology (discriminant analysis) 8 significant ratios and 7 for the case of the nonparametric (trees), obtaining 3 ratios in common. At the same time, Olmeda and Fernández (1997) compare the precision of parametric and non-parametric classifiers suggesting that an optimal system for risk classification should combine two or more different techniques.

The results presented in this research work show that the application of parametric and nonparametric techniques does not show significant differences for the variables with the best predictive capacity. As can be seen in Table 6, under these two approaches, the microeconomic variables or financial ratios that present greater predictive power X_1, X_2, X_8 are coincident. Variable X_2 (overall solvency ratio) and variable X_8 (return on assets - ROA) have been present in most of the research work related to business failure.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

It is to be expected that these variables will have great relevance in the study since, on the one hand, the global solvency ratio relates the totality of assets that a company has to meet its total obligations, the same relationship that indicates that the more dependent the company is on external resources, the greater the possibility of filing for bankruptcy.

On the other hand, the ROA or profitability on assets shows how much cash the company's assets are being and, therefore, they generate greater profitability, causing at the same time that the company has the capacity to solve the financing that the company has from external resources.

The X_1 ratio (current liquidity ratio) is part of the liquidity factors and its presence as a significant ratio within the models is more than justified because these indicators demonstrate the overall ability of a company to pay its debts (short and long term), if necessary by liquidating the assets quickly or converting them into cash.

Method/variable	Microeconomics (financial ratios)					Macroeconomics
	X_1	X_2	X_4	X_5	X_8	GII
EEG (parametrics) 2010-2014	✓	✓		✓	✓	
Decision trees (non-parametrics) 2010	✓	✓			✓	✓
Decision trees (non-parametrics) 2014	✓		✓		✓	✓

Table 6 Coincidence of Micro and Macroeconomic variables in the analysis
Source: Own elaboration

The results obtained by applying both techniques (Table 6) show that macroeconomic variables do not have the same presence as financial variables.

This may be largely due to the fact that the diverse macroeconomic conditions presented by each of the countries may pose problems of comparability of information and, therefore, place greater weight on internal variables. In other words, macroeconomic variables are diluted in an environment of listed companies.

Therefore, the hypothesis put forward is not accepted, demonstrating that in a context of listed companies, macroeconomic variables would not condition business failure.

Conclusions

The aim of this study is to analyze the role that macroeconomic variables can play in predicting business failure. The results obtained in the empirical application of the two techniques used allow us to conclude that the most significant ratios in terms of predicting business failure or bankruptcy are the short-term liquidity ratio (X_1), the solvency ratio (X_2) and economic profitability (X_8), which in turn are associated with factors of liquidity, indebtedness, and profitability, respectively.

The methodologies used, GEE and decision trees, offer the opportunity to use longitudinal designs for response variables that do not necessarily have a normal distribution.

The present research work presents as a novelty with respect to other empirical studies the application of a model that allows working with panel data that considers the specification of the form of correlation of the variables as well as the inclusion of macroeconomic variables, whose results have been contrasted with the artificial intelligence methodology known as decision trees. In our case, given the difficulties indicated and the type of sample we had in which companies from different countries participated and therefore the legal classification criteria vary within each country, we opted for the application of the economic approach, establishing as its definition to classify failed companies the score obtained through the application of the model known as Altman's Z-score.

This paper presents some limitations. Although we worked with all the companies for which financial statements were available for the period 2010 - 2014, thus increasing the size of the sample, due to the limitations of the information, there were accounting items for which data were not available and therefore it was not possible to estimate the ratio for that particular period; however, this limitation in the estimation of the model is attenuated through the consideration of several periods for each company.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

However, we consider that all financial models for the prediction of business failure should only be taken as a reference parameter, that is, only as an indicator and as a support tool for the business diagnosis, and should be complemented with the different types of corresponding financial analysis as well as with the experience observed through the years and the socioeconomic environment in which the company under study performs.

There is no doubt that in the last few decades the analysis of business solvency has become a key piece and an issue of concern worldwide, mainly due to the increase in the number of business bankruptcies (which are more frequent day by day regardless of geographical location or developed economic activity), the development of new financial instruments and, in general, to the globalization that has great importance for companies since it allows free trade and opens up competition in international markets.

With what has been said so far and after having tackled the problem of a business bankruptcy or failure from two different perspectives, we can conclude that there are great survival challenges that companies face worldwide and that would be the object of future lines of research.

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ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

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Investigation of the effect of the brand equity on the repurchase intention by mediation of the brand attractiveness and brand trust

Investigación del efecto del valor de la marca en la intención de recompra por mediación del atractivo de la marca y la confiabilidad de la marca

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Abstract

The objective of the present research is evaluating the effect of the brand equity on the repurchase intention by mediation of the brand attractiveness and brand trust. The present research is applied and descriptive- survey. The population of this study include 188 staff of Iran insurance company in Hamedan city. The volume of sample considering the Morgan table equals to 127 people. The sampling method is simple random method. Data gathering tool is standard questionnaire. The conformity factor analysis method was used in order to validity examination. The Cronbach's alpha was used for reliability evaluation LIZREL Software was used for date analysis of the structural equations modeling. the obtained results indicated that the brand equity, the brand attractiveness and brand trust have a positive and significant effect on the repurchase intention of Iran insurance company of Hamedan.

Brand equity, Repurchase intention, Brand attractiveness, Brand trust

Resumen

El objetivo de la presente investigación es evaluar el efecto del valor de la marca en la intención de recompra mediante la mediación del atractivo y la confianza de la marca. La presente investigación es aplicada y descriptiva-encuesta. La población de este estudio incluye 188 empleados de la compañía de seguros de Irán en la ciudad de Hamedan. El volumen de muestra considerando la tabla Morgan equivale a 127 personas. El método de muestreo es un método aleatorio simple. La herramienta de recopilación de datos es un cuestionario estándar. El método de análisis del factor de conformidad se utilizó para el examen de validez. El alfa de Cronbach se usó para la evaluación de confiabilidad. El software LIZREL se usó para el análisis de fechas del modelado de ecuaciones estructurales. Los resultados obtenidos indicaron que el valor de la marca, el atractivo de la marca y la confianza de la marca tienen un efecto positivo y significativo en la intención de recompra de la compañía de seguros iraní de Hamedan.

Valor de marca, Intención de recompra, Atractivo de marca, Confianza de marca

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Introduction

Brand equity is defined as desirability and more value that a brand give to a product compared to a similar product. Some factors such as the perceived quality of brand, the perceived value of brand based on cost, uniqueness of brand tendency to pay more price, awareness of brand name, brand popularity organizational links and stability of brand image are some of dimensions that form the brand equity.

The brand is a relationship tool in the management of relating to the customer and it is valuable from two aspect: first, it decrease the risk for consumer, the second one is that it reduces the decision making cost. Also the brand is one of the effective signals in the market that the company due to information asymmetry use of it.

The information asymmetry can be existing in the services customers. (Sweeney and Swait 2008) and it leads to customer loss. So the company in order to preventing of customer uncertainty satisfies his needs and perform its commitments in front of the customer. If the customers be disappointed of a brand all of the investments and future benefits of the company will be at risk. Thus the brand act as a leverage and encourage the company to act to its commitments. Brand in a long – term relationship leads to commitment between the buyer and the seller.

Therefore brand can be used as a defensive tool of marketing that maintains the present customers and also acts as a aggressive tool that attracts new customers. The importance of the defensive market in the field of services is determined through this knowledge that the cost of attraction of the new customer is very more than maintaining the present customers. Brand is a signal of the product situation. The most important characteristic of a brand as a signal of the product situation is its credibility (Ardem and Swait 2004). The brand equity and its effect on the customers is discussed in the marketing field the performed studies in the service sections indicate that brand dimensions influences on the satisfaction and attitude of the consumer and finally on the repurchase intention in the services section (Samadi, et al. 2009).

Such that a brand with more equity increases the preferences and repurchase intention of the customer (Kim, et al. 2008). what is formed in the mind of the customer with direct(personal usage) and indirect (through advertisement) experience is regarded as the bases of purchase decision (Washbern, et al. 2004). It is a manner that a positive perception of a brand creats a apportunity for the customer that selects a brand among different kinds of a special brand and it encourage buying a brand and its services (Dewoys 2010). The general objective of the present study is investigation and determination of the brand equity on the repurchase intention by mediation of the brand attractiveness and brand trust (case study: Iran insurance company in Hamedan city).

Theoretical literature review

Brand equity is defined as an increased brand value for company, business and the consumers that brand gives to a product (Farquhar,1989), from late of 1980s after presenting the value based management philosophy the brand equity became a marketing key concepts in the managerial theories and managerial task field.(Srinivasan et, al 2005). The brand is a valuable asset that through time we can see that many investment have been done on it. The movements that showed for the first time the brand equity were two unusual movements. One of them occurred in 1985 and the other occurred in 1987. In 1985, Reckitt Colman payed high cost for Air wick good will of ciba – Geigy and this cost is related to some unexplainable cases such as name value and symbol. (Aaker, 1991) This value can be reflexed in customer's attitude, Feeling and action toward a brand and is showed in the prices, market stock and the benefit that a bring for a company. The brand equity is an intangible and very important asset for companies that has financial and psychological value (katler keller 2007).

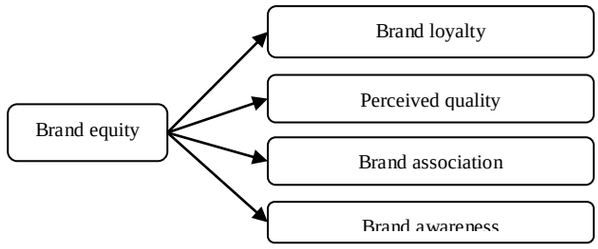


Figure 1 The conceptual model of Aaker brand equity 1996

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Awareness of the brand is the ability of the buyer in distinction and reminding a brand that is placed in a special class of products. It means the informational nodes strength about a brand in individuals mind (Keller, 2008).

Association of the brand is defined as something that guides the brand toward the customers mind. When a brand is stabled in the customers mind creating linkage between associations and the brand will be easier and accordingly the customers can understand the difference between brands and decide to purchase (Aaker, 1991).

The perceived quality is defined as the customer's judgment about preference of the services. Services quality has an abstract and intangible structure from identity point of view and it is not identifiable easity (Bamert,wehrli, kim 2005).

Brand loyalty is defined as customer's attachment to the brand.The strong attachment is the customer's resistance against brand changing and brand sustainability in stormy environments.

Purchase intention: the intention is an important factor in the attitude structure and can predict the actual behavior. when the purchase intention is high the purchase probability will be increased (Kheyvi, Fathali, 2015). Repurchase intention is repetitative purchasing of special goods and services from a shop (Hellier, 2003) and the main reason of it is the experiences after purchasing. the companies can instead of new customers attraction with lower assessment cost maintain their previous customers (Zeithaml, 1996). In the marketing literature there are many studies that mostly have examined the relationship between the repurchase intention and the perceived quality (Alexndris, 2002). In other words the perceived quality has a positive effect on the repurchase intention. In a study that has been done in internet shops and websites kuo stated that the online services quality has a positive correlation with continuous using of web, referring other people and customer loyalty.

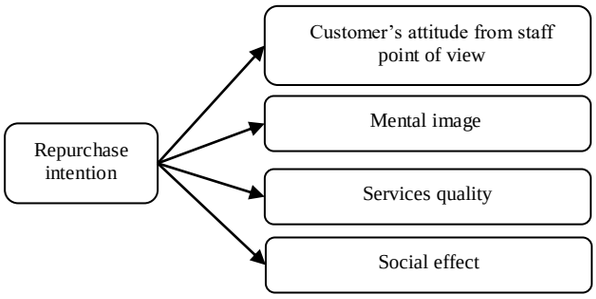


Figure 2 The conceptual model of the repurchase intention khayeri
Source: Fatahli (2015)

The consumers attitude toward the products. The marketing approach for identify the attitudes to the products, brands and services is used to matching the marketing strategies for reflecting the product. Ajzan and Fishbin (1980) stated that the marketer can through creating ideas of the norms and their definition with new concepts that is resulted in evaluations changing has influence on the customer intention (Kheri, Fathali, 1994)

Mental image: An image that a person has of the objective and subjective phenomena is defined as mental image (Kheyri, Fathali, 2015).

Perception of the shop brand: The perception is a canal and viewpoint that we can observe and understand the external world. The perception is more complex than feeling. The conceptual process includes the effect of selection and organizing and interpreting:

1. The factors of the characteristic of the preceptor such as attitudes, expectances interests,experiences and personality (internal factors).

2. The factors that are related to the subject, situation, purpose and context (external factors).

Social effect: Awareness from this subject that the consumer status is depended on other people presence can effect on the consumers performance. The social effect on purchase intention of merchandises and services has been discussed and supported by many of researchers in an experimental method. The consumers that is adaptable socially are excited for obtaining a product for showing their social situation and obtaining social groups.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Self – conceit: Is defined as over pride (physical self-conceit) or performance (the pride as a result of success). Mir, et al, in 1995 divided the self – conceit in to four categories:

1. Physical attachment
2. Physical viewpoint
3. Attachment to success
4. Success viewpoint

The first case means that the individual care his physical appearance. The physical viewpoint means that the individual has a positive (perhaps false) to his physical appearance. Attachment to the success means having a positive understanding of success. In addition the individual believes that other people wish his success. The success viewpoint means that an individual has a positive viewpoint of his success (perhaps false) (Kheyri, Fathali, 2015).

Services quality is one of the most important factors for the next reference of the customer. The managers are successful that can guarantee the quality for the customers.

It is possible that the customers can bear bad treatment, time wasting and promise breach but it is expected from you to present high quality services.

Brand attraction is defined as existing a randomly, long–term behavioral response as a result of psychological process of purchasing a brand, that is performed by a person among other brands (Crosno, et al, 2009).

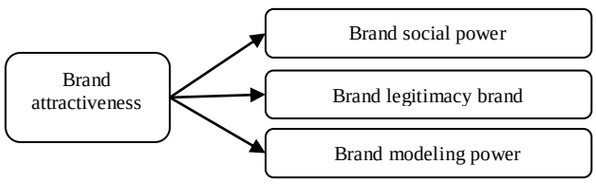


Figure 3 The conceptual model of the brand attractiveness of crosno, et al (2009)

Brand social power: brand forcible social power emphasis on the brand ability in effecting on the consumer behavior through creating awareness of the negative consequences (such as dissatisfaction, rejection or unacceptance feeling, lower conceptual social situation,etc.) if the considered brand is not used.

Brand legitimate power: brand legitimate social power emphasis on the brand ability in effecting on the consumer,behavior through market stock, reputation and oldness in the related industry.

Brand modeling power: brand modeling social power emphasis on the brand ability in effecting on the consumer's behavior with strengthening the attraction or feeling create relationship to brand due to its uniqueness. When a brand has high modeling social power the consumers of a brand has uniqueness feeling and try to near to it.

Brand trust: brand trust is defined as believing this fact that other people will behave in a manner that is in favor of for the company with a special brand, or at least is not injurious for it (Gambeta, 1981). The trust in different areas such as psychology,sociology, economics and also its applied areas such as the management and marketing have attracted the researchers attention. this interest in different fields has resulted in increasing structural power, but it also have difficulted the unify of different viewpoints in trust and consensus field in its identity field. Thas the literature review indicates that the expectance of the confidence and risk are crucial components of trust definition. Accordingly the trust is defined as a confidence that a person distincts to a state that there is not any confidence (Etemadifard,et al, 2013). This subject shows the confidence that a person can not use it by victization of other person. Accordingly trusting to a brand indicates that there is high expectance or probability that a brand leads to positive results for consumer. Hiscock (2001) believed that the final purpose of the marketing is creating a strong tie between the consumer and the brand trust.

Upamannyn (2014) considering the brand trust as expectance it should be said that this fact is based on this believe of the consumer that the related brand has special qualities that leads to stability,competence, truth, responsibility, etc. and is concordant with the research about trust. considering the research of brand trust of Delgado,et al(2003) is seen that these special properties have technical identity that is according to two dimensional idea of trust that is found in managerial and marketing sources.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

As a result the first dimension of brand trust (validity) has technical or competence identity that effects on the ability and tendency to guarantee and satisfying the customer's needs. The second dimension (intention) is formed of good will to brand in relation to the consumer interests and welfare.

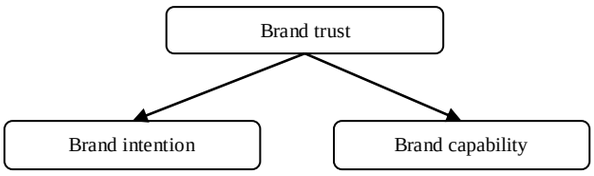


Figure 4 The conceptual model of brand trust of Bulster (2004)

Literature review: Qolipour, et al. (2015) performed a research under the title of the brand equity on the repurchase intention by mediation of the perceived value. The research results indicate that the brand equity effects on the perceived value and repurchase intention and also the perceived value has a positive and significant effect on the repurchase intention of the life policyholders. The brand awareness and brand association have not a significant effect on the perceived value and repurchase intention, the perceived quality in an indirect manner though the perceived value has a positive and significant effect on the repurchase intention and finally the brand loyalty is the only dimension that has a positive and significant effect directly and indirectly on the repurchase intention of life policyholder through the perceived value.

Danayi torabi, Talesh (2014) performed a study under the title of the investigation of the relationship between the brand equity and life insurance policyholders and the repurchase intention. the obtained results indicated that the brand equity has positive effect on the perceived value and repurchase intention and also the perceived value has appositive effect on the repurchase intention of Asia insurance life insurance policyholders the brand association, the perceived quality and the brand loyalty have a positive and significant effect on the two variables of the perceived value and repurchase intention and finally some recommendations were presented separately for each hypothesis.

Marjani et al (2014) performed a study under the title of the effectiveness of the advertisement on the brand equity in tire industry. These stated that the effectiveness of advertisements is one of the most important issues in the advertisement area.

Seyedin (2012) in his research under the title of the investigation of the relationship between the brand equity and the insurance companies performance in life insurance sale state that the brand equity is one of the concepts that distinct the brand from each other. What attracts the consumer toward a brand and leads to its selection is its value the is identified as brand equity.

Dehdashti, et al (2010) in their study under the title of a model examination of the effect of the trust ability of banks state that increase in competition in services section leads to more attention to maintaining the present customers and effort to attracting new customers.

Hossein. et al (2009) in their investigation under the title of the investigation of the effect of brand equity on the consumers response state that one of the most valuable assets of a company is its brand.

Sahin. et al (2013) performed a study under the title of creating commitment, trust relationship and satisfaction for a brand: What is the role of transfer cost in mobile market this research present some reasonable evidences for the future studies by obtaining more attitude toward transfer cost,satisfaction, trust and commitment of a brand and include several concepts for managerial measures and future researches. Transfer cost have a positive effect on the relationship between the trust, satisfaction and the commitment of the brand. This empirical research presents a new method for understanding the effects of the transfer cost on the relationships between satisfaction, trust and commitment of a brand.

Perepelkin and Dizhang (2011) in their study under the title of brand personality and customers trust in pharmacies obtained this result that there is a significant difference from brand personality point of view between different kinds of the pharmacies.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

In other words the consumers have ranked the independent pharmacies to some extent more trustable than multinational merchandises and national chain pharmacies they also concluded that the truth and competence have the most significant effect on the customers trust attraction. They found that the organizations with creating brand personality that has truth and competence can distinct themselves from other organizations that leads to customers trust attraction.

They also have found that the organizations should try to cruet brand personality that is coordinate with the company purposes in best form.

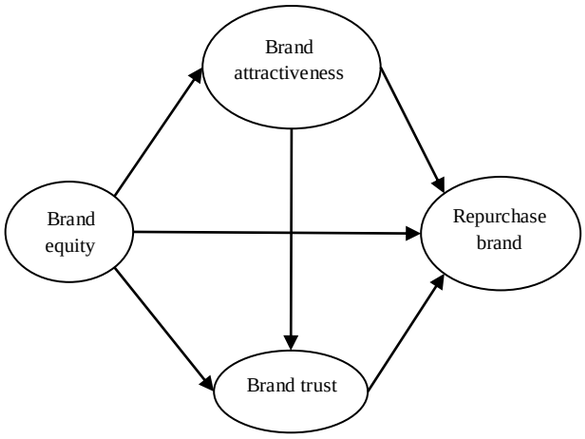


Figure 5 Research operational model

Research hypothesis of the research

The brand equity has a positive and significant effect on the repurchase intention with mediation of brand attractiveness and brand trust of Iran insurance company in Hamedan.

1. The brand equity has a positive and significant effect on the repurchase intention in Iran insurance company in Hamedan city.

2. The brand equity has a positive and significant effect on the brand attractiveness in Iran insurance company in Hamedan.

3. The brand equity has a positive and significant effect on the brand trust in Iran insurance company in Hamedan city.

4. The brand attractiveness has positive and significant effect on the repurchase intention of Iran insurance company in Hamedan city.

5. The brand trust has a positive and significant effect on the repurchase intention in Iran insurance company in Hamedan city.

6. The brand attractiveness has a positive and significant effect on the brand trust in Iran insurance company in Hamedan.

Research methodology

The present research is an applied study from purpose point of view and is a descriptive survey from data gathering point of view. The population of this study includes 188 staff of Iran insurance company in Hamedan city and they also are regarded as the customers of this company.

The sample volume of this research estimated as 127 people according to the Morgan table. The simple – random method was used for sampling. The standard questionnaire was used as data gathering tool. the conformational factor analysis method was used for validity examination that its results indicated that the factor analysis is suitable for identifying the factor model structure. The Cronbach's alpha was used for reliability analysis that is more than 0/7 for each one of the research questionnaire components. The structural equations modeling was used for data analysis by LIZREL software.

In order to validity examination the conformational factor analysis test was used. In doing the factor analysis of this issue should be assured that whether. The existing data can be used for data analysis or not?

In other words whether the number of the considered data for factor analysis is suitable or not? At this regard the KMO index and Bartlett test were used.

According to these tests the data are suitable for factor analysis if the KMO index is more than (0/6) and near to and Bartlett test sig is less than (0/05)

The output of this examination is presented in the following.

0.803		**Test KMO**
540.542	Chi-squre	**Bartlet test**
91	Freeedom degree	
0.000	(sig)	

Table 1 The results of KMO test and Bartlett test

Considering table 1, the KMO index rate is equal to 0/803 and is more than 0/6 rate, thus the sample number (the number of respondents is sufficient for factor analysis. Also Bartlett test sig is less than 0/05 that indicates that the factor analysis is suitable for factor model structure and the assumption of being recognized of the correlation matrix is rejected. All of four questionnaires have validity. The researcher choose the Cronbach's alpha method among the reliability determination methods because the alpha coefficient for all of the four questionnaires is more than 0/7, it has an acceptable reliability (Momeni and Faal Qayoomi 2010, 2012).

Research results

The descriptive statistics show that the age mean of the respondents is equal to 34/29, 104 people (81/9 %) of the respondents were male and 23 respondents were female. (18/1 %). Educational level of them were as follows 6 of them had diploma (4/7%). 17 had an undergraduate degree (13/4 %), had bachelor's degree (54/3 %) and finally 35 were masters and higher (27/6).

In the inferential statistics at first the normality of the research variables distribution was examined. Accordingly in the present study the Kolmogorov – Smirnov was used for examination of the research data normality assumption. In this examination the significance level for all of the variables is more than test level (0/05), thus data distribution is normal and the parametric tests can be used. In this section by means of the structural equation modeling method we will evaluate the research hypotheses. The basis of analysis in the structural equation is the existing correlations between the research variables. Table 2 shows the correlation between the research variables and their significance level.

The correlation snows the relationship kind and the direction of the relationship between two variables. And this fact that this increasing or reducing have what effect on the other variable increasing or decreasing. But this correlation does not mean that there is not a causal relationship between variables. The following table shows the correlation between the research variables and their significance level:

(4)	(3)	(2)	(1)	Variable
			1	Brand equity
		1	0.499**	Brand attractiveness
	1	0.571**	0.655**	Brand trust
1	0.721**	0.642**	0.670**	Repurchase intention

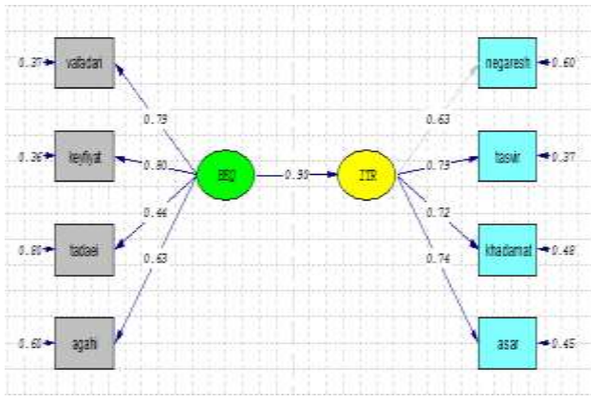
Correlation in the level of70/05
Significant correlation**

Table 2 The internal correlation of the variables

The first hypothesis test

The brand equity has a positive and significant effect on the repurchase intention in Iran insurance company in Hamedan city.

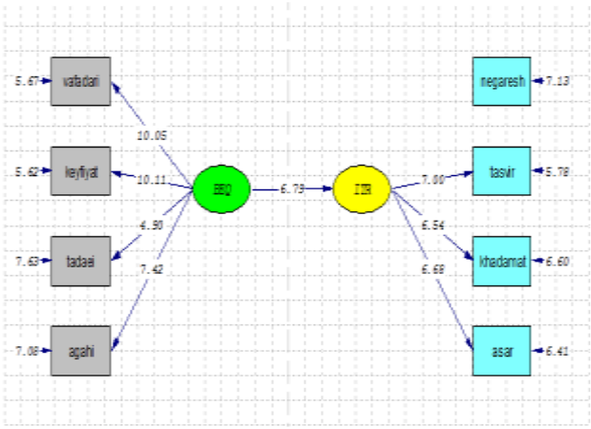
Graphs 1 and 2 show the research models in estimation and significance state of the factor loads and path coefficients. Considering these models we can estimate the factor loads and then test them. The existing coefficients in these graphs are divided in to two categories. The first category includes the relationships between the hidden variables (elliptical) and obvious variables (rectangular) that they are called factor loaded the second category include the relationships between the hidden variable and they are hidden that are called the structural equations and are used for thy hypotheses testing. All of the path coefficients are tested by means of T statistics.



Graph 1 The research model in estimation state with the standard coefficients of the first hypothesis

CFI	NFI	AGFI	GFI	RMSEA	x^2/df	FD	Chi-squre
0/1	0/97	0/92	0/96	0/039	2/18	19	22/72

Table 3 The summary of the goodness of fit for the conceptual model of the first hypothesis



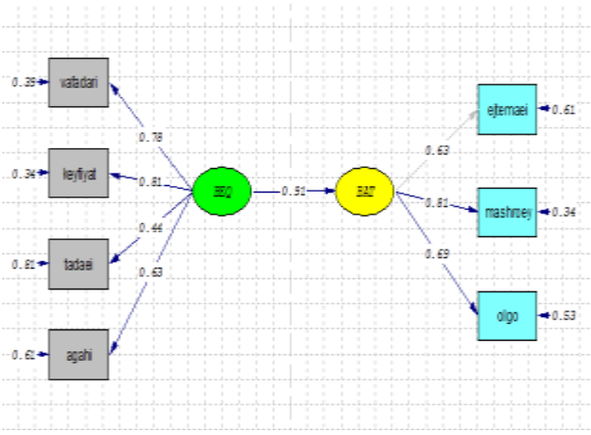
Graph 2 The research model in the significance state (t rates) of the first hypothesis

Result	-Statistic t	Path coefficient (ß)	The first hypothesis
Confirmed	6.79	0.9	

Table 4 The results of the examination of the first hypothesis of the research

The second hypothesis test

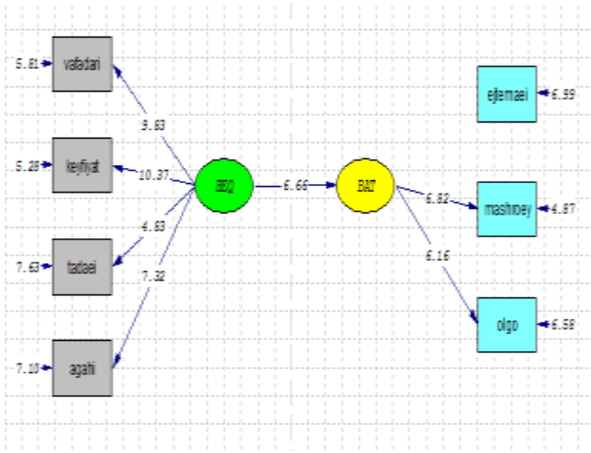
The brand equity has a positive and significant effect on the brand attractiveness of Iran insurance company in Hamedan city.



Graph 3 The research model in estimation state with the standard coefficients of the second hypothesis

CFI	NFI	AGFI	GFI	RMSEA	x^2/df	FD	Chi-squre
0/1	0/97	0/93	0/97	0/04	2/22	13	15/62

Table 5 The summary of the goodness of fit for the conceptual model of the second hypothesis



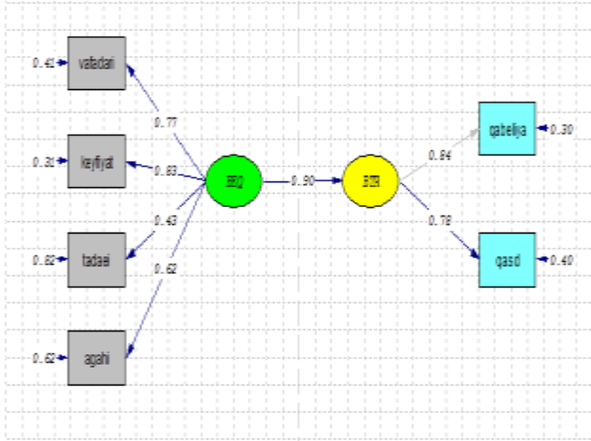
Graph 4 The research model in the significance state (t-vates) of the second hypothesis

Result	-Statistic t	Path coefficient(ß)	The second hypothesis
Confirmed	6.66	0.91	

Table 6 The results of the examination of the second hypothesis of the research

The third hypothesis test

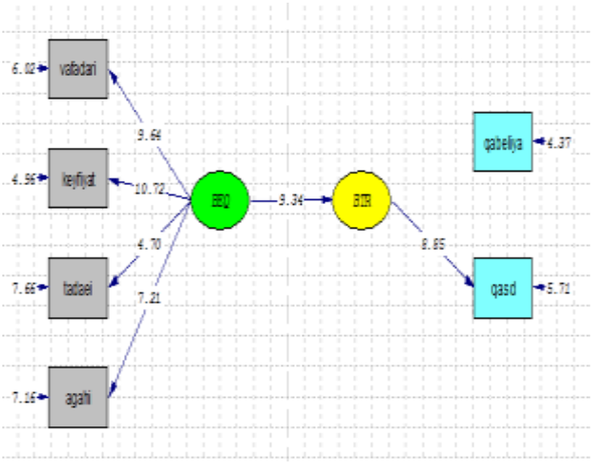
The brand equity has appositive and significant effect an the brand trust in Iran insurance company in Hamedan city.



Graph 5 The research model in the estimation state with standard coefficients of the third hypothesis

CFI	NFI	AGFI	GFI	RMSEA	x^2/df	FD	Chi-squre
0/99	0/98	0/92	0/97	0/058	2/26	8	11/42

Table 7 The summary of the goodness of fit for the conceptual model of the third hypothesis



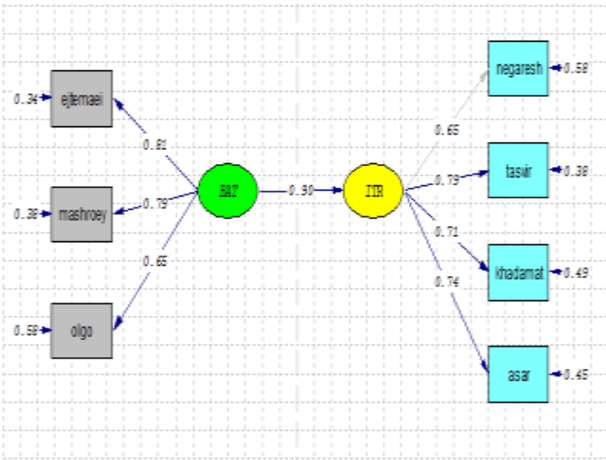
Graph 6 The research model in the significance state (t – rates) of the third hypothesis

Result	-Statistic t	Path coefficient(ß)	The third hypothesis
Confirmed	9.34	0.90	

Table 8 The results of the examination of the third hypothesis of the research

The fourth hypothesis test

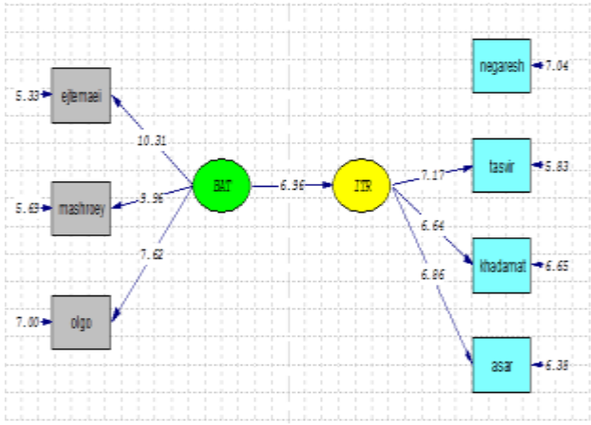
The brand attractiveness has a positive and significant effect on therepurchase intention in Iran insurance company in Hamedan city.



Graph 7 The research model in the estimation state with standard coefficient of the fourth hypothesis

CFI	NFI	AGFI	GFI	RMSEA	x^2/df	FD	Chi-squre
0/98	0/97	0/89	0/95	0/079	2/35	13	23/10

Table 9 The summary of the goodness of fit for the conceptual model of the fourth hypothesis



Graph 8 The research model in the significance state (t – rates) of the fourth hypothesis

Result	-Statistic t	Path coefficient(ß)	The fourth hypothesis
Confirmed	6.96	0.90	

Table 10 The results of the examination of the fourth hypothesis of the research

The fifth hypothesis test

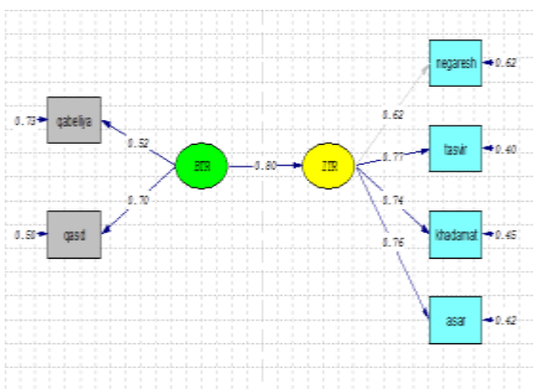
The brand equity has a positive and significant effect on the repurchase intention in Iran insurance company in Hamedan.

CFI	NFI	AGFI	GFI	RMSEA	x^2/df	FD	Chi-squre
0/98	0/96	0/91	0/97	0/073	2/48	8	13/37

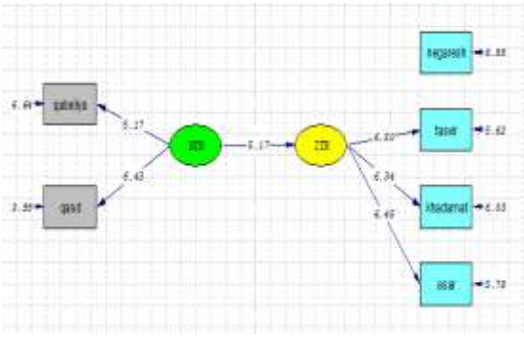
Table 11 The summary of the goodness of fit for the conceptual model of the fifth hypothesis

Result	-Statistic t	Path coefficient(ß)	The fifth hypothesis
Confirmed	5.17	0.80	

Table 12 The results of the examination of the fifth hypothesis of the research



Graph 9 The research model in the estimation state with standard coefficient of the fifth hypothesis



Graph 10 The research model in the significance state (t-rates) of the fifth hypothesis

The sixth hypothesis test

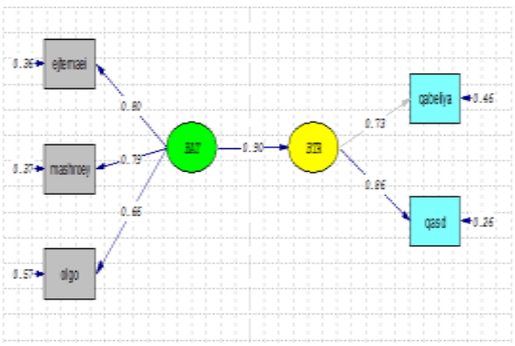
The brand attractiveness has a significant and positive effect on the brand trust in Iran insurance company in Hamedan.

CFI	NFI	AGFI	GFI	RMSEA	x^2/df	FD	Chi-squre
0/1	0/99	0/97	0/99	0/000	2/52	4	2/31

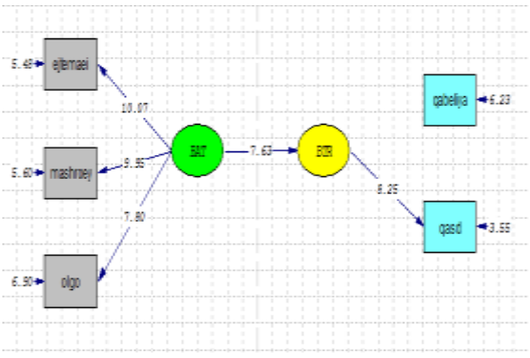
Table 13 The summary of the goodness of fit for the conceptual model of the sixth hypothesis

Result	-Statistic t	Path coefficient (ß)	The fifth hypothesis
Confirmed	7.63	0.90	

Table 14 The results of the examination of the sixth hypothesis of the research



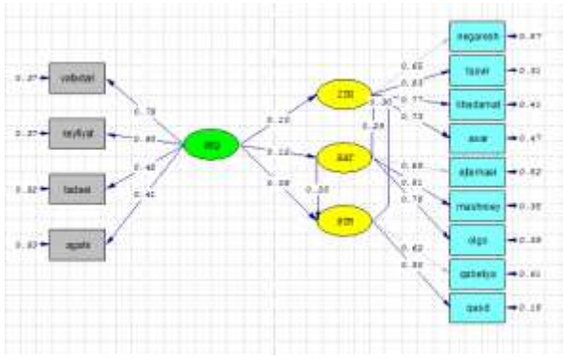
Graph 11 The research model in the estiuation state with standard coefficients of the sixth hypothesis



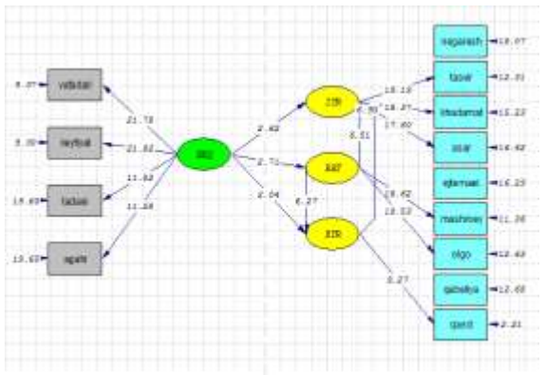
Graph 12 The research model in the significance state (t-rates) of the sixth hypothesis

The general hypothesis test

The brand equity has appositive and significant effect on the repurchase intention with the mediation of the brand attractiveness and brand trust of the Iran insurance company in Hamedan city.



Graph 13 The research model in the estimation state with standard coefficients



Graph 14 The research model in the significance state (t-rates)

CFI	NFI	AGFI	GFI	RMSEA	x^2/df	FD	Chi-squre
0.88	0.87	0.84	0.90	0.11	2.81	59	635.36

Table 15 The summary of the goodness of of the final model

Considering the obtained results of the examination of this hypothesis it can be said that the brand equity has a positive and significant effect on the repurchase intention. With mediation of brand attractiveness and brand trust in Iran insurance company in Hamedan city.

Conclusion and discussion

The obtained results of the first hypothesis analysis indicated that the brand equity has a positive and significant effect on the repurchase intention in Iran insurance company in Hamedan city.

According to the results of model calculations the value of chi – square goodness of fit index of 35/32 x^2 with degree of freedom 19 and significance level of p= 0/0127 was obtained.

Other attributes of model fitness include the root index of the mean error of approximate squares (RMSEA =0 /039), the goodness of fit index (GFI = 0/92), the modified goodness of fit index (AGFI = 0/92) the normed index of the fitness (NFI = 0/97) and adaptive fitness index (CFI = 0/01) that indicate that models fitness is suitable.

The obtained results indicate that considering the path coefficient (0/9) it is certain that the effect of brand equity on the repurchase intention in Iran insurance company is positive and Ho is rejected And its opposite hypothesis H1 is confirmed.

The value of t- statistic between the variables of brand equity and repurchase intention is equal to 6/79 that is more than 1/96 and it indicates that the relationship between the brand equity and the repurchase intention in confidence level of 95% is significant. thus, it can be said that considering this fact that the t-statistics rate of the first hypothesis (6/79) is out of the range of – 1/96 and +1/96, therefore the first hypothesis is confirmed. In other words it can be said that the brand equity can justify 90% of the changes in the repurchase intention.

Therefore, the first hypothesis is confirmed. In other words it can be said that the brand equity has a positive and significant effect on the repurchase intention in Iran insurance company in Hamedan city. Therefore any evidence for rejection of the first hypothesis was not observed and this hypothesis cannot be rejected.

The obtained results of the second hypothesis indicated that the brand equity has a positive and significant effect on the brand attractiveness in Iran insurance company in Hamedan city. According to the calculated results of the model the value of the chi-squad goodness of fit index of 15/62x^2 with degree of freedom 13 and signifance level of p = 0/33 was obtained.

Other attributes of model fitness include the root index of the mean error of approximate squares (RMSE = 0/04), the modified goodness of fit index (AGFI = 0/93), the normed index of the fitness (NFI = 0/97) and adaptive fitness index (GFI = 0/1) that indicated that the models fitness is suitable. The obtained results indicate that considering the path coefficient (0/91) it is certain that the effect of brand equity on the brand attractiveness in Iran insurance company is positive and Ho is rejected and its opposite hypothesis is confirmed. the value of t – statics between the variable of the brand equity and the brand attractiveness is equal to 6/60 that is more than 1/96 and it indicates that the relationship between the brand equity and brand attractiveness in the confidence level of 95% is significant thus it can be said that the t-statistics rate of the second hypothesis (6/66) is out of the range of 1/96 to + 1/96, these the second hypothesis is confirmed, In other words it can be said that the brand equity can justify 91% of changes in brand attractiveness. Therefore the is confirmed. In the other words it can be said that the brand equity has a positive and significant effect on the brand attractiveness in Iran insurance company in Hamedan city. Therefore, can evidence for rejection of the second hypothesis was not observed and this hypothesis cannot be rejected.

The obtained results of the third hypothesis of the hypothesis indicated that the brand equity has a positive and significant effect on the brand trust in Iran insurance company in Hamedan. According to the results of model calculations the value of chi-square goodness of fit index of 11/42 x^2 with degree of freedom 8 and significance level of p = 0/22 were obtained. other attributes of the model fitness include the root index of the mean error of approximate squares (RMSEA = 0/058), the goodness of it index (GFI = 0/98) and the modified goodness index (AGFI = 0/92), the normed index of the fitness (NFI = 0/98) and the adaptive fitness index (CFI = 0/99) that indicate that the models index is suitable. The obtained results indicate that considering the path coefficient (0/90) it is certain that the effect of brand equity on the brand trust in Iran insurance company in Hamedan is positive and Ho hypothesis is rejected and its opposite hypothesis is confirmed.

The value of t-statistics between the variables of the brand equity and brand trust is equal to 9/34 that is more than 1/96 and it indicates that the relationship between the brand equity and brand trust in confidence level of 95% is significant. Thus it can be said that t-statistics rate of the third hypothesis (9/34) is out of the range of -1/96 and +1/96 there for the third hypothesis is confirmed. In other words it can be said that the brand equity can justify 90% of changes in the brand trust. Therefore the first hypothesis is confirmed. In other words it can be said that the brand equity has a positive and significant effect on the brand trust in Iran insurance company in Hamedan city. Therefore any evidence for rejection of the third hypothesis was not observed and this hypothesis cannot be rejected.

The obtained results of the fourth hypothesis analysis indicate that the brand attractiveness has a positive and significant effect on the repurchase attractiveness in Iran insurance to the results of model calculations, the value of chi- square goodness of fit index of 23/10 x^2 with degree of freedom 13 and significance level of p = 0/041 was obtained.

Other attributes of model fitness include the root index of mean error of approximate square (RMSEA = 0/079), the goodness of fit index (GFI = 0/92)

The modified goodness of it index (AGFI = 0/98), the normed index of the fitness (NFI = 0/97) and adaptive fitness index (CFI = 0/98) that indicate the models fitness is suitable. The obtained results indicate that considering the path coefficient (0/90) it is certain that the effect of brand attractiveness on the repurchase intention in Iran insurance company is positive and Ho hypothesis is rejected and its opposite hypothesis (H1) is confirmed. The value of t – statistic between the variables of brand attractiveness and repurchase intention in the confidence level of %95 is significant.

Thus it can be said that considering this fact that the t – statistics rate of the fourth hypothesis (6/96) is out of the range of -1/96 and +1/96. there four the fourth hypothesis is confirmed. In other words it can said that the brand attractiveness can justify 90 % of change in the repurchase intention.

Therefore the fourth hypothesis is confirmed. In brand attractiveness has a positive and significant effect on the repurchase intention in Iran insurance company in Hamedan city. There four, any evidence for rejection of the fourth hypothesis not observed and this hypothesis cannot be rejected.

The obtained results of the fifth hypothesis analysis indicated that the brand trust has a positive and significant effect on the repurchase intention in Iran insurance company in Hamedan city. According to the results of model calculations the value of chi – square goodness of fit index of 13/37 x^2 with degree of freedom 8 and significance level of p = 0/069 was obtained other attributes of model fitness include the root index of the mean error of approximate squares (RMSEA = 0/073), the goodness of fit index (GFI = 0/79), the modified goodness of fit index (AGFI = 0/91), the normed index of the fitness (NFI = 0/98) and adaptive fitness index (GFI = 0/98) that indicate that models fitness is suitable. The obtained results indicate that considering the path coefficient (0/80) it is certain that the effect of brand trust on the repurchase intention in Iran insurance company is positive and Ho is rejected and its opposite hypothesis (H1) is confirmed. the value of t – statistics between the variables of brand trust and repurchase intention is equal to 5/17 that is more than 1/96 and it indicate that the relationship between the brand trust and repurchase intention in confidence level of 95% is significant.thus it can be said that considering this fact that the t – statistics rate of the fifth hypothesis (5/17) is out of the range of -1/96 to +1/96. Therefore the fifth hypothesis is confirmed In other words it can be said that the brand trust can justify 80% of changes in the repurchase intention.

There four, the fifth hypothesis is confirmed. In other words it can be said that the brand trust has a positive and significant effect on the repurchase intention.

In Iran insurance company in Hamedan city. Therefore, any evidence for rejection of the fifth hypothesis was not observed and this hypothesis cannot be rejected the obtained results of the sixth hypothesis analysis indicated that the brand attractiveness has a positive and significant effect on the brand trust in Iran insurance company in Hamedan city.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

According to the results of model calculations the value of chi – square goodness of fit index of $2/31x^2$ with degree of freedom 4 and significance level of p = 0/68 was obtained. other attributes of model fitness include the root index of the mean error of approximate squares (RMSEA = 0/0), the goodness of fit index (GFI = 0/99), the modified normed index of the fitness (GFI = 0/99) that indicate that models fitness is suitable.

The obtained results indicate that considering the path coefficient (0/90) it is certain that the effect of brand attractiveness on the brand trust in Iran insurance company is positive and Ho is rejected, and its opposite hypothesis (H 1) is confirmed the value of t – statistics between the variables of brand attractiveness and brand trust is equal to 7/63 that is more than 1/96, it indicates that the relationship between the brand attractiveness and the brand trust in confidence level of 95% is significant.

Thus it can be said that considering this fact that t – statistics rate of the sixth hypothesis (7/63) is out of the range of -1/96 to +1/96, therefore the sixth hypothesis is confirmed. In other words it can be said that the brand attractiveness can justify 90 % of the changes in the brand trust. therefore the sixth hypothesis is confirmed. In other words it can be said that the brand attractiveness has a positive and significant effect on the brand trust in Iran insurance company in Hamedan city. There four any evidence for rejection of the sixth hypothesis was not observed and this hypothesis cannot be rejected.

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The effect of marketing mix on export development with regard to the mediating role of market competition

El efecto del marketing mix sobre el desarrollo de las exportaciones con respecto al papel mediador de la competencia en el mercado

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Abstract

This study aimed to investigate the effect of marketing mix on developing product exports with regard to the mediating role of market competition. The present research was applied in terms of objective, and a descriptive survey in the form of field study regarding the research method. The statistical population of this study encompassed all furniture show exhibitors and manufacturers (N=1150) in Malayer, Hamadan Province, Iran. Using Cochran's alpha formula, 288 persons were selected through using convenient sampling method and three questionnaires were distributed among the samples. The results of the study showed that the marketing mix (product, price, promotion and place (distribution)) has a positive and significant effect on boosting export and competition in Malayer's furniture market. Market competition has a positive and significant effect on furniture export development in Malayer as well.

Marketing mix, Export development, Market competition

Resumen

La presente investigación se aplicó en términos de objetivos y una encuesta descriptiva en forma de estudio de campo sobre el método de investigación. La población estadística de este estudio abarcó a todos los expositores y fabricantes de exhibiciones de muebles (N = 1150) en Malayer, provincia de Hamadan, Irán. Utilizando la fórmula alfa de Cochran, se seleccionaron 288 personas mediante un método de muestreo conveniente y se distribuyeron tres cuestionarios entre las muestras. Los resultados del estudio mostraron que la combinación de marketing (producto, precio, promoción y lugar (distribución)) tiene un efecto positivo y significativo en el impulso de la exportación y la competencia en el mercado de muebles de Malayer. La competencia en el mercado también tiene un efecto positivo y significativo en el desarrollo de la exportación de muebles en Malayer.

Marketing mix, Desarrollo de exportaciones, Competencia en el mercado

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Introduction

Product exports as an aspect of foreign trade represent the production capacity of different countries and provide a special ground for the realization of economic policies. Exports are considered as the engines of economic growth in developing countries. One of the most important economic issues that many countries are now facing is a balance of payments deficit and the lack of currency. Although there are several ways to secure a currency deficit, the most systematic and the most appropriate way is to increase exports (Ranjbarian et al., 2012: 16).

According to some experts, marketing is regarded as a key to the success of industrial development in developing countries; hence, any serious move towards a country's industrial development requires not only national macro policies but also the implementation of scientific marketing principles as a logical link between producers and consumers (Ahmadi & Virginiari, 2003: 173).

Nowadays, production and exports in the global economy play a critical role in the framework of any healthy economy. Almost all successful economies spare their efforts to empower themselves in any export area in which they have a comparative advantage. On the other hand, there are new challenges in today's world, including the increasing rise of competition, with which the industries are tackling. With the inclusion of countries into the World Trade Organization, the gap existing among the countries is decreased, and as a result, the products can easily be sent to different markets in the most remote parts of the world and reach the consumers. Due to the expansion of globalization and the increasing activities of various industries at the international level, determining the degree of competition and matching the marketing mix elements of export goods are of paramount importance.

Finally, each industry must decide which strategy to select in order to be able to achieve the best possible export performance, depending on the features of the market or target markets and their similarity and differences with the domestic market (Jalali, 2011: 52).

In Iran, due to the existence of rich oil resources and its revenues, the export industry has always been concentrated on the oil, and the existence of these oil revenues has downgraded the other sectors. Given the disadvantages of relying on oil exports as a source of foreign exchange earnings, such as single-product dependence, resulting in fluctuations in world prices or demand for oil, there is an urgent need for replacing oil and developing non-oil exports. At the moment, non-oil exports play a vital role in Iran's economy. Meanwhile, Iran has many potential capabilities in exporting goods and services and enjoys many comparative advantages in different sectors (Jalali, 2011: 53).

The problem is that the environment where industries are now operating is highly competitive and growing, and firms and industries are compelled to compete with multiple factors at national and international levels and expand their export activities (Setayesh & Kargarfard Jahromi, 2011: 14). Market orientation and attention to the features of each export-oriented market is one of the basic and most important principles in exports (Sarreshteh, 2015: 48).

This study was to examine the effect of marketing mix one the development of Malayer's furniture exports with regard to the mediating role of market competition due to lack of expected success in this industry at the international level.

This industry was considered since the products of this industry enjoy high and acceptable quality on the one hence, and on the other hand, despite such a high quality, it has reached little success compared to its competitors at the international level. Accordingly, the following research question was raised: Does Marketing mix have any impact on the development of Malayer's furniture exports with regard to the mediating role of market competition?

Considering the conditions and competition among companies, their interactions and the dimensions of business performance are considered as a critical factor due to changes in conditions and environmental opportunities of export performance, according to which the companies' success rate in exports can be assessed (Rezaei, 2017: 130).

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Literature and Background of the Study

A. Marketing mix

The marketing mix components are sets of controllable marketing variables mixed by companies to achieve their marketing goals in the target market and to generate the required response. It involves any form of measure adopted by the company to its product in order to affect demand. These elements are commonly known as (4P's): Product, price, place (distribution), and promotion (Kotler, 2006: 132).

The concept 'marketing mix' was first introduced in the 1950s by Neil Borden and became known as 4P's. The marketing mix dominated on the traditional models and methods of market management, such as Alderson's dynamic functionalism as well as other systematic methods and Parameter Theory developed by the University of Copenhagen in Europe. The same happened to the new methods such as product vision, functional vision, and geographical vision. Only a small number of these models have managed to survive against 4P's. Marketing mix encompasses a set of intervening tools in the market that are interdependent, so that they cause the necessary or desired impact on the market. Marketing mix represents the fundamental activities of marketing managers. After selecting a target market, marketing managers must develop a systematic plan to sell their products to customers and establish long-term relations. Marketing plan consists of decisions regarding product, price, promotion, and place, as the most significant elements to which marketing managers allocate the company's resources to achieve the sales and profitability objectives (Sehat et al., 2012:76).

The terms mixture, mix, or combination imply that there should be a systemic and coordinated approach to these components in order to be effective in empowering and convincing customers. In other words, a suitable product with a reasonable price for the customers is associated with proper place and appropriate promotion methods, and if any of these components are inconsistent with the others, the effectiveness and efficiency of the whole set is decreased, thus preventing the company from reaching its goals.

Tactics or tools refer to companies' tools and instruments to compete in the market and to gain more success than competitors (Jalali Farahani, 2013: 16).

Product: In a marketing mix, a product is something presented to the market for attention, purchase, utilization, or consumption, which may meet a need or desire. The product might include a physical object, a service, a place, an organization, and even an idea or thought (Moheb Ali, 2002: 58).

Price: In the marketing mix, the price is the payment to a person or organization for a product or service. From a wider perspective, the price is equal to the sum of the values the consumer loses in return for the benefits of having a product or service (Kotler& Amstrong, 2007: 31).

Promotion: Advertising or promotion in the marketing mix is to connect with the customers to be informed of and affect their attitudes and behaviors. Promotion contains any presentation and offering of ideas, goods, or services provided by an advertising unit, individual or institution, which requires payment (Mohammadian, 2002: 26).

Place (Distribution): In simple words, distribution or place refers to the delivery of a desired product to a desired place at the desired time (Alodari, 2005: 236).

B. Exports

Exports encompass connecting and working with the professional markets and market professionals across the borders. Scientific reviews have proved that the economic growth in countries is associated with their exports from several perspectives. The growing trend of global trade has been accelerated by the use of active business strategies, the revolution in information communication technology (ICT), and the removal of barriers at the international level; therefore, active participation in global trade needs no justification (Sadeghi et al., 2012: 63). Export development has some important benefits, including mass production, foreign exchange earnings, employment growth, quality improvement, and lower prices for manufactured products.

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Evidently, the use of appropriate models is essential to maximize the benefits of exports in order to achieve economic growth and development. These are some success factors that can be used to determine the direction of exports with regard to their thematic scope (Ghorbani, 2002: 43).

C. Competition

Competition is expressed in terms of business activity and as a balanced position, and this, in fact, is an ultimate to the firm's efforts to dominate the market (Khodadkashi, 2009: 19). Shleifer and Vishny (1977) argue that competition in the product market is likely to be the strongest force driving the world's economy towards effectiveness. Competition is one of the most significant and the most critical economic concepts. In today's world, competition has emerged as an intrinsic phenomenon in financial and commercial activities and is one of the important factors determining the fate of organizations and enterprises in the field of economic activities. Begsou and Betbegnice (2007) claim that market competition is a key criterion in assessing the success rate of countries, industries, and enterprises in the political, economic, and business fields; indicating that each country, industry, or firm with a high competitive capability in competitive markets is likely to be more competitive. Accordingly, the companies reveal behavioral characteristics that are commensurate with the level of competition in their industry as competition leads to strong corporate leadership and reduced representation problems between managers and shareholders. On the other hand, the high level of competition in the product market reduces information asymmetry and control costs (Setayesh & Kargarfard Jahromi, 2011: 15).

- Research Background

Mohtaram Ghalati and Movasegh (2018) conducted a study entitled "The Effect of Export Market Orientation and Adaptation of the Marketing Mix on Export Performance." The results of their study revealed that export companies in turbulent environments and close competitive markets psychologically align their marketing mix with the needs of better foreign markets.

Export market orientation has a positive impact and marketing mix has a negative effect on the company's export performance. Furthermore, market orientation moderates the relationship between the two variables 'marketing mix alignment' and 'export performance' and plays a supportive role in making strategic decisions in export companies.

Rezaei (2017) in his research entitled "The Impact of International Marketing Strategies on Export Performance" states that the selection of the entry method is one of the most important and critical strategic decisions for companies seeking to expand globally and to select their target market. The results of data analysis indicate that international marketing strategies have a significant effect on export performance. Secondary hypotheses also show that the fully- and relatively- standardized strategies have no significant effect on export performance; however, a fully adaptive strategy has a significant effect on export performance and a relatively adaptive strategy has no significant effect on export performance as well.

In his research entitled "The role of marketing mix in developing product exports," Zeynabi (2016) states that exports play a crucial role in economic independence and boosting, and that export development policy forms a part of foreign trade policy in different countries, whose achievement is the goal of all countries.

Hedayati Dezfuli et al. (2015) conducted a research entitled "The Effect of Marketing Mix Elements on the Sale of Companies in Iran's Textile Industry". The research findings suggest that 'price' and 'place', among the other marketing mix elements, have the greatest and lowest impacts on the sales of the companies involved in this industry, respectively.

In his research, "The Impact of Uncertainty on Marketing Mix Strategy of Exports," Sarreshteh (2013) suggested that export is now one of the most important tools for economic growth in developing regions. The findings of his study suggest that international entrepreneurship and the use of networks ensure the better matching of the marketing mix elements through reducing the uncertainties.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Keyvani et al. (2013) conducted a study entitled "The Impact of Marketing 4P's on Increasing the Sales of Pakdis Drinks". They found out that the marketing mix and its four elements had a direct effect on sales growth. Moreover, promotion, price, place, and product had the greatest impacts on sales growth, respectively.

Ranjbarian et al. (2012) in their study entitled "The Role of Marketing Mix in Developing the Export of Automobile Components," conclude that marketing is one of the critical fields in the export development. The results of their data analysis indicate that the automotive industry has failed to offer new products and to compete with similar foreign products in terms of component quality and design. On the contrary, the a automotive industry has the capability to reduce the cost of components and have a timely delivery. An emphasis on promotion in the marketing mix strategy can increase exports in the automotive industry.

Fakhimi Azar et al. (2011) conducted a study entitled "The Effect of Marketing Mix on Increasing the Sales of Ghaynarkhazar Water Heaters" and found that the marketing mix and its four elements had an effect on increasing the sales of Ghaynarkhazar Water Heaters. The priority of these four elements in terms of their impact on sales was as follows: Product, promotion, Place, and price.

Jalali (2011) in his research entitled "The Impact of the Export Marketing Mix on Export Performance" states that, in the current global economy, production and exports play an important role in the framework of any healthy economy.

Ardil and Özdemir (2016) conducted a study entitled "On the Relationship between Marketing Mix Strategy and Export Performance Stimulators in Foreign Markets: An Applied Case in Turkey's Garment Industry" in order to investigate the effects of company features and marketing mix strategy on export performance. Experimental results showed that the company features, environmental characteristics, experience, and international commitment were correlated with higher export performance in garment companies in Turkey. Other findings also indicated that the marketing mix strategy played a mediating role in this regard. Findings can be generalized and provide useful insights for export managers.

In their research, "A New Conceptual Framework for the Integration of Marketing Mix Elements", Paul et al. (2014) mentions that the distribution of interactive media essentially changes the promotion concept.

- **The operational model of the study**

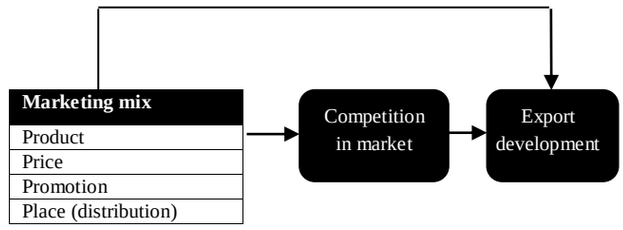

Figure 1 Operational model of the study

Research hypotheses

1. Marketing mix has a positive and significant effect on the development of Malayer's furniture exports.

1.1. Product has a positive and significant effect on the development of Malayer's furniture exports.

1.2. Price has a positive and significant effect on the development of Malayer's furniture exports.

1.3. Promotion has a positive and significant effect on the development of Malayer's furniture exports.

1.4. Place (distribution) has a positive and significant effect on the development of Malayer's furniture exports.

2. Marketing mix has a positive and significant effect on the competition in Malayer's furniture market.

2.1. Product has a positive and significant effect on the competition in Malayer's furniture market.

2.2. Price has a positive and significant effect on the competition in Malayer's furniture market.

2.3. Promotion has a positive and significant effect on the competition in Malayer's furniture market.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

2.4. Place (distribution) has a positive and significant effect on the competition in Malayer's furniture market.

3. Competition in the market has a positive and significant effect on the competition in Malayer's furniture market.

Research Methodology

The present study was a descriptive survey in terms of method and applied in terms of objective. The statistical population of this study encompassed all furniture show exhibitors and manufacturers (N=1150) in Malayer, Hamadan Province, Iran. Sampling was used to collect data from all furniture show exhibitors and manufacturers in Malayer using the Cochran's formula with a 5% error rate and the sample size was estimated to be 288. The data were collected by questionnaires. The first, second, and third questionnaires were on marketing mix (Fakhimi Azar et al., 2011), export development (Tavakoli & Dehghani Sanij, 2010), and competition in market (Aghazadeh et al., 2007), respectively. The three questionnaires encompassed 29 items scored based on a 5-point Likert scale (I totally disagree, I disagree, I have no idea, I agree, and I totally agree). In this study, Cronbach's alpha was used to measure the reliability of the questionnaires with the SPSS software. And since the Cronbach's alpha value was >0.7, the research variables were reliable. In order to assess the validity of the questionnaires, the researcher first submitted the questionnaires to some experts in the field of management. After examining and matching the questions with the measured variables, they commented on the items. After making the necessary modifications, the researcher distributed the questionnaires among 30 participants in order to enhance the face validity of the questionnaires. Afterwards, the final questionnaire was prepared. Furthermore, the confirmatory factor analysis was also run to confirm the findings. To this end, KMO index and Bartlett's test were used. According to these two tests, the data are suitable for factor analysis when the KMO index is > 0.6 and close to one, and when the significance level of Bartlett's test is <0.5. The following table presents the output of this test.

	Test KMO	0/672
Bartlett's test	Chi-square	782/955
	df	406
	Sig.	0/000

Table 1 Results of the KMO and Bartlett

Accordingly, factor analysis is appropriate to identify the model's factorial structure.

Findings

A. Descriptive statistics

The research findings showed that the mean age of the participants was 36.54 years; there were 286 males (99.3%) and 2 females (0.7%) with the mean work experience of 8.18 years.

Descriptive statistics of the research variables

The mean, standard deviation, variance, kurtosis, and skewness of the research variables are presented in Table 3. According to the results of Table 3, the mean values of the variables 'marketing mix', 'product', 'price', 'promotion', 'place', 'exports', and 'market competition' are 3.35, 3.20, 3.54, 3.59, 3.20, 3.19, and 3.16, respectively.

Variable	N	Mean	SD	Variance	kurtosis	skewness
Marketing mix	288	3/35	0/887	0/787	-0/130	-0/034
Product	288	3/20	0/989	0/979	-0/312	-0/029
Price	288	3/54	0/754	0/556	-0/023	-0/042
Promotion	288	3/59	0/883	0/779	-0/472	0/044
Place	288	3/20	0/757	0/573	-0/141	0/133
Export development	288	3/19	0/804	0/647	-0/254	-0/051
Market competition	288	3/16	0/870	0/757	0/033	-0/227

Table 2 Descriptive statistics

B. Inferential statistics

Here is tested the normality of the research variables. To this end, Kolmogorov-Smirnov test was used. According to the results of the following table, since the significance level for all the research variables was >0.05, the normal distribution of the sample is accepted so that structural equation modelling was used to test the effect of variables on each other and the fit of the conceptual model.

Variables	Sig
Marketing mix	0/231
Product	0/194
Price	0/198
Promotion	0/201
Place	0/192
Export development	0/208
Market competition	0/200

Table 3 Normality test

The graphs below show the estimated models of the research when the factor loads and path coefficients are significant. According to these models, factor loads or path coefficients can be estimated and then tested.

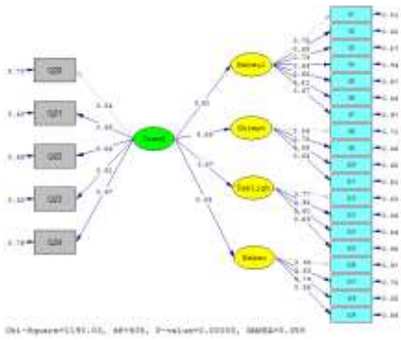

Figure 2 The estimated model of the study with standard coefficients (Hypothesis 1 and its sub-hypotheses)

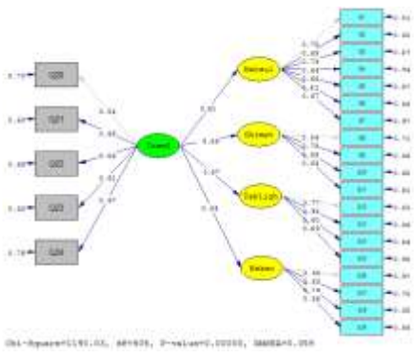

Figure 3 Research model in a meaningful mode (t-values) (Hypothesis 1 and its sub-hypotheses)

x2	*df*	*x2/df*	RMSEA	GFI	(AGFI)	Normed fit index (NFI)	Comparative fit index (CFI)
1190/03	404	2/946	0/059	1/03	1/10	1/05	1/21

Table 4 Goodness of Fit (Hypothesis 1 and its sub-hypotheses)

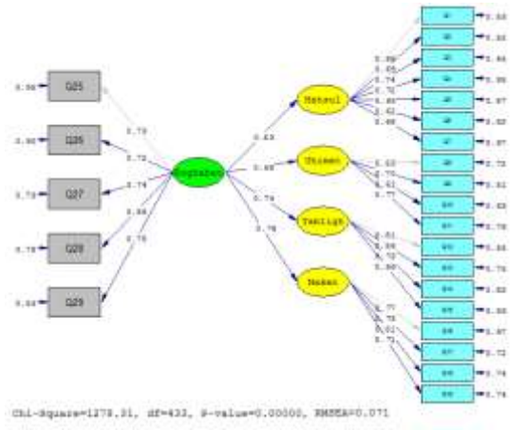

Figure 4 The estimated model of the study with standard coefficients (Hypothesis 2 and its sub-hypotheses)

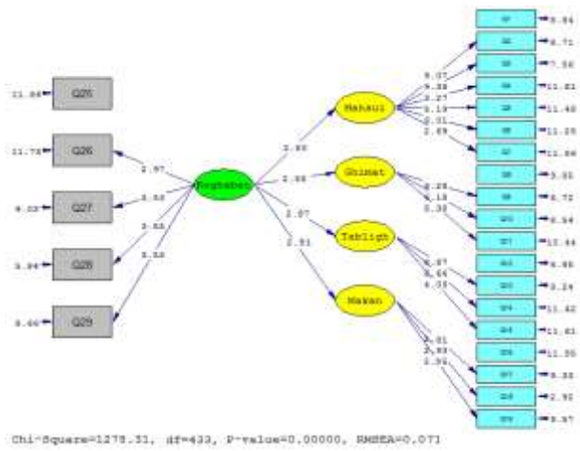

Figure 5 Research model in the meaningful mode (t-values) (Hypothesis 2 and its sub-hypotheses)

x2	*df*	*x2/df*	RMSEA	GFI	(AGFI)	Normed fit index (NFI)	Comparative fit index (CFI)
278/31	433	2/952	0/071	1/00	1/02	1/20	0/99

Table 5 Goodness of Fit (Hypothesis 2 and its sub-hypotheses)

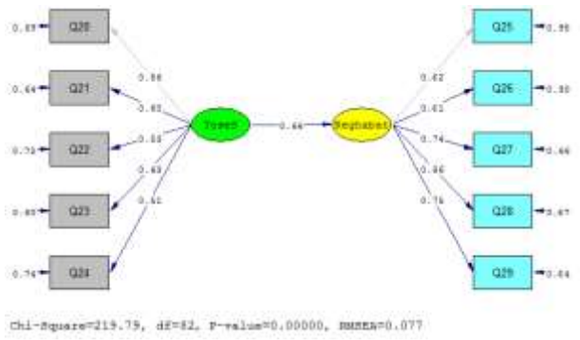

Figure 6 The estimated model of the study with standard coefficients (Hypothesis 3)

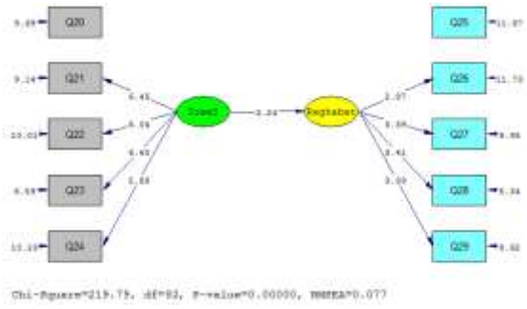

Figure 7 Research model in a meaningful mode (t-values) (Hypothesis 3)

x2	*df*	*x2/df*	RMSEA	GFI	(AGFI)	Normed fit index (NFI)	Comparative fit index (CFI)
219/79	82	2/680	0/077	1/32	1/27	1/16	1/28

Table 6 Goodness of Fit (Hypothesis 3)

Fit index	Accepted value	Results
x2/df	<3	2/946
RMSEA	<0/08	0/059
GFI	>0/90	1/03
AGFI	>0/90	1/10
NFI	>0/90	1/05
CFI	>0/90	1/21

Table 7 Fit indices of the research model

Research hypotheses	Path coefficient	t-value	Result
1-Marketing mix has a positive and significant effect on the development of Malayer's furniture exports.	**0/60**	**3/00**	**Confirmed**
1-1. Product has a positive and significant effect on the development of Malayer's furniture exports.	0/61	3/36	**Confirmed**
1-2. Price has a positive and significant effect on the development of Malayer's furniture exports.	0/59	2/87	**Confirmed**
1-3. Promotion has a positive and significant effect on the development of Malayer's furniture exports.	0/57	2/20	**Confirmed**
1-4. Place (distribution) has a positive and significant effect on the development of Malayer's furniture exports.	0/64	3/57	**Confirmed**
2-Marketing mix has a positive and significant effect on the competition in Malayer's furniture market.	**0/70**	**2/73**	**Confirmed**
2-1. Product has a positive and significant effect on the competition in Malayer's furniture market.	0/63	2/50	**Confirmed**
2-2. Price has a positive and significant effect on the competition in Malayer's furniture market.	0/68	2/66	**Confirmed**
2-3 Promotion has a positive and significant effect on the competition in Malayer's furniture market.	0/74	2/87	**Confirmed**
2-4. Place (distribution) has a positive and significant effect on the competition in Malayer's furniture market.	0/76	2/91	**Confirmed**
3. Competition in the market has a positive and significant effect on the competition in Malayer's furniture market.	**0/66**	**3/24**	**Confirmed**

Table 8 Testing result of the research hypotheses

Discussion and Conclusion

Test analysis of the first hypothesis and its sub-hypotheses:

Given that the t-values of the hypotheses are beyond the range of +1.96 and -1.96, all the research hypotheses are confirmed at 95%.

Regarding the path coefficient (0.60), it is also confirmed that marketing mix has a positive and significant effect on export development. In other words, marketing mix can explain 60% of variation in export development. Hence, the following recommendations are set forth:

- The marketing mix required for this product should be well recognized and product exports shall be planned accordingly.
- There should be attempts to expand the economic and commercial relations between the importers and exporters of this product.
- Investments on the export development of this product should be enhanced purposefully.
- The target export markets are recommended to be identified by the Iran's Trade Development Organization in cooperation with the Chamber of Commerce, Industries, Mines, and export associations.
- Target markets shall be prioritized according to different criteria such as their commonalities, neighbors, agreements, economic advantages, political relations, etc.

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Regarding the path coefficient (0.61), the product has a positive and significant effect on export development. In other words, the product can explain 61% of export development variation. Here are some relevant suggestions:

- There should be branding for export products at three product, firm, and national levels.
- The process of temporary arrival of raw materials required for exporting products and restituting their primary rights needs to be facilitated and accelerated.
- High-quality raw materials should be used.
- Products should be tailored to individuals' demands.

With regard to the path coefficient (0.59), the price has a positive and significant effect on export development. In other words, this variable can explain 59% of export development variance. Here are some suggestions in this regard:

- Depending on the final price, determine the profit and the total price of the product.
- Note that the product price is one of the key factors in export development.
- There should be more production to reduce the product costs and set better prices.

Based on the path coefficient (0.57), the promotion has a positive and significant effect on export development. In other words, this variable can explain 57% of export development variance. Here are some recommendations:

- There should be macro-level advertising and marketing in the target markets for brands of this product by the government.
- Use new technologies such as cyberspace to promote advertising.
- Employ individuals with high communication skills as marketers.

Considering the path coefficient (0.64), the place (distribution) has a positive and significant effect on export development. In other words, this variable can explain 64% of export development variation. It is thus recommended:

- Conclude free trade agreements and preferential tariff agreements with different countries.
- Improve the business environment through reducing documents, time, and export costs.
- Select appropriate distribution channels.

Test analysis of the second hypothesis and its sub-hypotheses:

Given that the t-values of the hypotheses are beyond the range of +1.96 and -1.96, all the research hypotheses are confirmed at 95%.

Regarding the path coefficient (0.70), the positive and significant effect of marketing mix on market competition is also confirmed. In other words, marketing mix can explain 70% of variation in market competition. Hence, we recommend:

- Liquidity and working capital of manufacturing and export units should be provided by the banking system, especially development banks such as the Bank of Industry and Mine and the Export Development Bank at a one-digit, competitive rate.
- There should be efficient export subsidies for sent business delegations and units participating in international and specific exhibitions of the Islamic Republic of Iran held in other countries, as well as for the transportation of export goods.
- During the trips of high-ranked authorities of the country to target export markets, in addition to including the exporters in the composition of the expeditions, exports should be given serious attention and support in the negotiations.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Based on the path coefficient (0.63), the product has a positive and significant effect on market competition. In other words, this variable can explain 63% of market competition variation. Here are some recommendations:

- The laws and regulations as well as processes and procedures of exporting goods and services shall be modified to facilitate exports, provide transparency, and establish stability.

- There needs to be cautions regarding product packing.

- Provide the customers with product warranties for quality, price, and so on.

With regard to the path coefficient (0.68), the price has a positive and significant effect on market competition. In other words, this variable can explain 68% of variation in market competition. Here are some suggestions in this case:

- Postpone payments until the product approval.

- Provide the mass buyers with a great deal of discounts.

- Buyer's credit conditions should be considered with regard to cash payments.

Regarding the path coefficient (0.74), it is inferred that promotion has a positive and significant effect on market competition. That is, promotion can justify 74% of variation in market competition. Tt is thus suggested:

- Offer new ideas in product promotions.
- Promotion budget should be provided by the government.
- Introduce the real product and avoid exaggeration.

Considering the path coefficient (0.76), it is found that the distribution place has a positive and significant effect on market competition. In other words, this variable can justify 76% of the variation in market competition. Here are some recommendations set forth based on this findings:

- Boost the culture of exports using different tools in the country.
- Promote the social status of economic activists, including producers and exporters.
- Use appropriate tools in transporting products.
- Inventory of goods should be satisfying.

Test analysis of the third hypothesis:

Regarding the path coefficient (0.66), market competition has a positive and significant effect on export development. In other words, market competition explains 66% of variation in export development. Hence, we recommend:

- Influence and sustainability strategies should be developed in the target export markets by the Ministry of Industry, Mine and Trade in consultation with the Chamber of Commerce, Industries, Mines, etc. (Chambers in different provinces, export associations, and joint councils and chambers).

- Exports shall be completely exempted from value-added tax since the procedure of paying value added tax as well as the process of its refund to exporters has caused serious challenges for the exports.

- Using the resources of the National Development Fund, the required currency credits should be paid to the manufacturing and export units, in addition to increasing the funds of the Export Development Bank of Iran and the Export Guarantee Fund of Iran.

- Provide the exporters of goods, technical and engineering services, ICT and economic operators in the field of tourism with an award and effective export incentives directly and indirectly.

Discussion

The study findings indicated that the marketing mix has a significant impact on the development of Malayer’s furniture exports with regard to the mediating role of market competition. Hence any change in the marketing mix would change the export development of Malayer’s furniture, and market competition also has an impact on this variable.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

The findings of this study were consistent with those of other research studies (Mohtaram Ghalati & Movasagh, 2018; Rezaei, 2017; Zeynabi, 2016; Hedayati Dezfouli et al., 2015; Sarreshteh, 2015; Keyvani et al., 2013; Ranjbarian et al., 2012; Fakhimi Azar et al., 2011; Jalali, 2011; Jindul et al., 2018; Ardil and Özdemir, 2016; Paul et al., 2014; and Burdrich & Touva, 2008).

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Financial viability and environmental aspects in the selection of energy sources for sanitary hot water (SHW) and heated swimming pools

Viabilidad financiera y aspectos ambientales en la selección de fuentes de energía para agua caliente sanitaria (ACS) y piscinas climatizadas

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Abstract

Sustainability and energy efficiency are topics of great interest, especially in the sports facilities management sector, due to the high energy costs. One of the most relevant costs is derived from the consumption of Sanitary Hot Water (SHW) and swimming pool. The objective of this work is to study new ways to manage and reduce these costs through the valuation of the use of traditional and renewable energy sources and the necessary investment to contribute to the promotion of a more sustainable vision of business management. Four alternative energy installations (Natural Gas, Biomass, Solar Thermal Combined with Natural Gas or Biomass) are proposed, it is verified which is more suitable in terms of financial viability and one of them is selected. For this purpose, we start from a hypothetical business-case and a 20-year forecast of the energy consumption, the costs and initial investment of each alternative is made; viability analysis are performed with the Net Present Value (NPV) and the obtained results are compared. The conclusion is that the most appropriate solution, from a financial point of view, for sports centers similar to the business-case and with the considered circumstances, is the installation of Biomass, an option that, in addition, can be considered respectful with the environment.

Sanitary Hot Water, Renewable Energies, Sports Facilities, Financial Evaluation, Business Sustainability

Resumen

La sostenibilidad y la eficiencia energética son temas de gran interés, especialmente en el sector de gestión de instalaciones deportivas, debido a que presentan elevados costes energéticos. Uno de los costes más relevantes es el derivado del consumo de Agua Caliente Sanitaria (ACS) y piscina. Este trabajo tiene como objetivo estudiar nuevas formas para gestionar y reducir estos costes a través de la valoración del uso de fuentes de energía tradicionales y renovables y de la inversión necesaria para contribuir al fomento de una visión más sostenible de la gestión empresarial. Se proponen cuatro alternativas de instalación energética (Gas Natural, Biomasa, Solar Térmica combinada con Gas Natural o con Biomasa), se comprueba cual es más adecuada en términos de viabilidad financiera y se selecciona una de ellas. Para ello se parte de una hipotética empresa-caso y se hace una previsión a 20 años de los consumos energéticos y de los costes y desembolso inicial para cada alternativa; se realizan análisis de viabilidad con el Valor Actual Neto (VAN) y se comparan los resultados. Se concluye que la solución más adecuada, desde un punto de vista financiero, para centros deportivos similares a la empresa-caso y con las circunstancias consideradas, es la instalación de Biomasa, una opción que, además, puede ser considerada respetuosa con el medio ambiente.

Agua Caliente Sanitaria, Energías Renovables, Instalaciones Deportivas, Evaluación Financiera, Sostenibilidad Empresarial

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1. Introduction

In recent years, energy prices have been subject to a gradual increase that has caused companies to consume energy from a marginal item in Their cost structure to a considerable part (ATECYR, 2011). This has led them to Rethink Their management, without losing the advantages it grants (higher productivity and quality) Because business Efforts Have Been traditionally based on the overall efficiency of Processes neglecting consumption, something the current economic Necessary Given situation.

In sports facilities, energy consumption is one of the Most Important items of the company's expenses, Representing the Sanitary Hot Water (SHW) and the heating of the pool water (Pool), 25% of the total energy consumption (Ministry of Economics and Technological Innovation, 2005). This makes its management look demeanor if it is not accompanied by appropriate thermal conditions in showers and heated pools (Municipal Sports Foundation, 2011). The choice of a suitable energy installation can allow the company to reduce its consumption, making it more competitive in costs, improving its efficiency and contributing to a business model that is respectful of the environment and more sustainable, Which will have a better brand image and will grant a competitive and differentiating advantage.

These questions make interesting the study of the selection of a SHW installation and pool water heating, and therefore it was chosen as the subject of this work.

What is intended is to make a comparison of four alternatives of ACS and pool facilities: a conventional installation of Natural Gas (non-renewable energy), a Biomass installation (renewable energy based on the consumption of organic fuel, such as pellets) and two Solar Thermal installations (combined with each of the first alternatives, giving rise to two hybrid installations). The objective is to select the most appropriate for a sports center considering the financial evaluation of the various alternatives and commenting on the impacts and environmental aspects of each of them.

The work is structured as Follows: section 2 presents the state of the art and description of the business-case; Section 3 shows the methodology; Section 4 sets out the results; Section 5 comments on the conclusions; Section 6 collects the bibliography used and Appendix 1 collects some of the tables With the data and calculations made, which for reasons of space, and to facilitate reading, could not be incorporated into the text

2. State of the art and description of the company-case

2.1. State of the art

Sports facilities are characterized by special energy needs different from those of any other type of business. This peculiarity is due to its high loads of heat and electricity consumed (Artuso & Santiangeli, 2008) since they are usually used by a large number of people who consume resources, mainly water and energy.

Applying measures that, in addition to reducing consumption, reduce the environmental impact, such as the installation of SHW systems and heating of pool water with clean energy, will mean responsible action that, if it is also feasible and economically viable, can be applied to other types of environments or sports centers. In Addition, the construction and rehabilitation of These sports facilities is a good opportunity for the introduction of environmental criteria, especially in terms of energy efficiency, with the impact That These types of Measures Have on the economic expenses of the facilities operation (Fraguas Herrero, 2010).

It becomes interesting to value the installation of innovative equipment, with high energy efficiency; maintain these equipment regularly and change them depending on the performance evolution and provide energy supply systems such as active or passive solar energy, wind engines, heat pumps, etc. (Fraguas Herrero, 2010). Likewise, regulations Have Been established, Such as document HE4 of the Technical Building Code (CTE), Which Encourage the use of clean energy in new buildings, When the main source of energy is not renewable (Natural Gas), of such that there must be a minimum solar contribution to SHW and pool water heating.

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Some of these projects to be evaluated by companies, and which represent an important decision that will have an impact on their future costs, are investment projects in energy facilities. Probably, The most used decision rule to choose The most efficient alternative Among the different projects, to ASSESS and analyze the viability from a financial point of view is the net present value (NPV) or the present value of the benefits less the present value of the costs used by economists to defend the adoption of Energy Efficiency Measures by Individuals and Organizations (Galan Gonzalez Leal & Varela, 1999; Dhavale & Sarkis, 2015).

Nikolaidis, Chatzis & Poullikkas (2018) performed a life cycle cost analysis, a NPV analysis and an uncertainty analysis to assess the impact of intermittent renewable energy sources. In order to obtain the components of the NPV, they considered that the general expenses of an electrical energy storage facility include the investment costs or initial cost of the project or installation, the operation and maintenance costs.

Chakrabarty and Islam (2011) and Palit, Malhotra and Kumar (2011) also consider similar VPN components as those of Nikolaidis, Chatzis & Poullikkas (2018), although Chakrabarty and Islam (2011) complement their study with an eco-efficiency analysis and Palit, Malhotra and Kumar (2011) approach it from the perspective that if the present value of the cost (CPV) of an energy project based on biomass gasifiers (BGPP) is less than or at least equal to the present value of the benefits accrued by the Project Implementation Agency (PIA) of the electricity sale (BPV) throughout the life of the project, this will be financially viable.

There are several studies in esta area. Some authors focus on a specific type of energy that usually includes some energy considered renewable and analyze the viability of Said project. This is the case of authors: such as Brittany (2007), Which Focuses on the financial valuation of a biomass installation, Condori Yucra (2010) and Corral (2011) That focus on solar installation, or Noguera (2011) That Focuses in analyzing a project, which combines several types of energy: solar thermal, geothermal and biomass.

On the other hand, other authors choose to compare several alternatives that allow selecting among different types of energy the most appropriate for a given case. This is what Martínez Sánchez (2011) and Moreno (2012), which focus, respectively, on comparing a microgeneration system of thermal energy and electricity with conventional systems and a diesel installation with a biomass installation to consider replace it. O Chakrabarty & Islam (2011) who Carried out a financial feasibility analysis of domestic Solar Systems with six case studies, comparing previous expenditures on conventional energy sources before implementing the system.

In any case, the procedure is similar defining in the first place the Characteristics of the building or place Where the installation to be EVALUATED is going to be Implemented, making calculations of a technical nature and, subsequently, of a financial nature, Such as the NPV, to ASSESS the installation, and exposing the Appropriate conclusions in view of the results.

There are both real case studies (Chakrabarty & Islam, 2011; Corral, 2011), Where the feasibility analysis will be used to determine Whether to Maintain or change the Existing facility, Such as business-case studies Arising from academic projects, business projects not Carried out yet or studies that are based on real data of buildings, swimming pools or sports centers that can serve as a base (Noguera, 2011), Where analyzing the feasibility will be used to choose what type of installation to perform. Some studies focus on urban buildings (Martínez Sánchez, 2011; Moreno, 2012), homes (Chakrabarty & Islam, 2011) transferable to the sports field and others in sports centers or swimming pools (Cloquell, Artacho and Santamarina, 2009; Condori Yucra, 2010; Corral, 2011; Noguera, 2011).

Regarding environmental aspects, projects related to energy facilities can generate costs borne by Also society, called external costs, external effects or externalities (Delacámara, 2008; European Investment Bank, 2013). These externalities can influence When selecting a type of SHW installation or another. In the case study, for example, using the solar energy or a renewable energy source will reduce negative flows by reducing consumption and Avoiding costs.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

However, a financial analysis does not include the external effects Usually That the presence of the resource Generates on economic agents other than ITS owner and / or user, That is, on society (Delacámara, 2008). With This in mind, not only financial but environmental issues Also would come into play.

To make more complete decisions, externalities should be duly quantified and taken into account in the analyzes, counting them as costs of the decision if their impact is negative or as benefits thereof, if it is positive. It could be considered, for example, that externalities in facilities that use renewable energy sources above the mandatory percentage would have a positive impact as the reduction of pollution is greater, or that the reduction in fuel consumption or the use of the solar energy sources, would lead to avoided costs in the generation of energy, while Maintaining The Possibility of fully covering the demand (Delacámara, 2008).

The European Investment Bank (2013) to Evaluate the costs and benefits for society, it considers That is Necessary to take into account externalities and Such, For This, They must be added Together with the operation and maintenance costs. This requires an estimate of the volume of externality (for example, tons of greenhouse gas Emissions per year) and an Appropriate unit price, or a marginal estimate of external cost. Although it may be difficult to estimate, the European Investment Bank (2013) has made valuations in euros of some externalities in the sectors in which it operates and considers them a negative flow when calculating the NPV.

Infrastructure Sustainability Council of Australia (ISCA) (2016) starts from the fact That the cost-benefit analysis (CBA) is a financial analysis process to calculate the net costs and benefits of the options Expressed in monetary units and That the results can be express, Among other forms, with the net present value (NPV). From there, the complete economic analysis (CEA) is a tool That Allows expanding the CBA by Including externalities in the evaluation and calculating the net benefits (benefits minus costs) of the options Expressed in monetary units.

However, in the private sector the cost-benefit analysis and the NPV do not Usually include externalities When Evaluating some investment projects, in part, due to the lack of Relevant data and the limited time, but Also due to the little emphasis on the external effects (Karmokolias, 1996). This Makes Incorporating externalities into the financial feasibility analyzes can be complicated by the difficulty to be valued monetarily, in some cases being Considered as intangible effects (Delacámara, 2008); other environmental effects do not lend themselves easily to quantification due to their nature (Karmokolias, 1996) and, although significant progress has been made in refining the estimates of values and methods to integrate them into the analysis, it is still necessary to expand the range of externalities considered, not only harmful emissions, but also others such as loss of biodiversity and ecosystem services (European Investment Bank, 2013).

Taking into account the considerations mentioned, this work will focus on the financial evaluation of various alternatives for an ACS installation and heated pool, without considering externalities and environmental costs at the empirical level. However, the environmental aspects and impacts of each alternative will be Discussed by Describing the level of pollution and CO2 Emissions of the different alternatives based on the investment decision in traditional or renewable energy projects.

2.2. Business-case description

In the present study, a hypothetical business-case is used, which have the following characteristics: construction of 3,984 m2 (not counting the fuel silo, if applicable) located in lugo. It consists of several units, on two floors, and special attention will be given to those involved in the management of shw and pool water, listed in table 1 below:

	Sheet of water	Height	Pool volume	Glass surface (walls and floor)
Indoor pool or Pool 1	312.5 m2	1.5 m high at the front 2.5 m high at the rear Average height of 2 m	625 m3	462,50 m2
Splash Pool Indoor - Pool 2	70 m2	1.2 m average height	84 m3	104 m2
Changing rooms	318 m2 for users and monitors With showers, toilets and sinks) and auxiliary services (12 m2 With toilets and sinks).			

Table 1 Dependencies involved in the management of hot water and pool water
Source: Self made

Company profile-event is geared to be a market leader. The sports center begins to be built in year 0, opens its doors at 21 months of beginning to be built, that is, on October 1 of year 1 and Year 2 it is the first full year of operation and considered as the base year. The monthly inflow for a total of 12,476 uses / month, according to forecasts for year 2, based on guidance from professionals. It is based on the characteristics of a sports center with a wide range of courses and supervised activities, taught at various times to a maximum of people per session, and free activities (swimming pool, fitness, paddle, tennis ...).

Uses are considered not sales, because, for example, a person enrolled in a course of 2 days per week is considered as a single sale, but as 8 uses per month. For courses and supervised activities, applications were set at 40% of the maximum number of people per session that could come to be, because in the first years of operation it is usually the common influx and for free activities are directly estimated the number was directly estimated of monthly uses, in accordance with the guidelines of sports center managers (table 2.1 APPENDIX 1). In the case of number of subscribers (sales, no use) is expected up to 5,000 customers as a stop, growing from 2,000 subscribers (40% of 5,000) is in year 2 50% for year 3 , 33% for 4, 15% for 5 and 5% to 6 reaching 4,817 subscribers.

3. Methodology

The methodology for performing this study is divided into three phases:

- Calculate power in kilowatts (kW) that is required to have the facility for hot water and pool water heating and annual energy consumption in kilowatt hours (kWh).
- Investment, initial or installation costs and operation and maintenance costs of each type of installation.
- NPV calculation of each type of installation.

In addition, relevant environmental aspects of the alternatives considered, such as the estimated CO2 emissions for each type of SHW installation and heated pool valued at work, will be discussed.

Since the study focuses primarily on a financial level, not on an assessment of environmental costs or impact of emissions, were considered only economic variables such as prices and investment costs or initial and installation costs, operating costs and maintenance costs of each type of installation in the financial analysis and were complemented with appropriate justifications according to which some alternatives are considered more sustainable than others, based on their CO2 emissions and environmental aspects.

To determine the power and energy consumption, the formulas of power and energy contained in Albarracín, Sanabria and Maíllo (2007), the "Technical Guide Hot Water Central" ATECYR (2011) and expert technical advice were used. Likewise, information on similar academic works was obtained and the procedure used in these, or any of its steps, was followed for the different sections (Britain, 2007; Cloquell, Artacho and Santamarina, 2009; Condori Yucra, 2010, Corral, 2011; Noguera, 2011; Martínez Sánchez, 2011; Moreno (2012), Also, it was used an energy efficiency manual by Escobar (2009) and an audit by Creara (2011), studies that also served as guidance for financial analysis, in addition to Chakrabarty and Islam (2011), Palit, Malhotra and Kumar (2011) and Nikolaidis, Chatzis and Poullikkas (2018), to determine the components of the NPV.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

All calculations were made based on year 2, as it is the first full year of operation of the sports center, except for the NPV calculation for which a 20-year forecast is applied. Although in the future the number of clients increases, energy facilities should be based on the most conservative and the early data, as if estimates are met they can always be increased. Data used were obtained from various sources are discussed in detail below, together with the methodology used in each phase.

Traditionally assessing the viability of projects has been carried out based on financial aspects. However, at present, it is important to assess how well a project is able not only to generate profit or be viable, but also to reduce negative impacts on the environment, and see how they can take into account the issues and environmental costs.

To determine the environmental impacts and CO2 emissions data were applied and indications and formulations of the Practical Guide for calculating emissions of greenhouse gases (ghgs) by the Generalitat de Catalunya (2011) and IDAE (2019) were followed in the stage of energy consumption, as well as the method to value economically CO2 emissions from European Investment Bank (2013).

3.1. Methodology for calculating power and energy consumption

To determine the thermal power and energy consumption, on the one hand, it was calculated the consumption of liters of SHW and thermal energy demand which will involve the locker room and on the other hand, the power and energy demand of swimming pools, since in each case will be obtained differently. The power for hot water, hot water consumed for health services (showers and toilets, mainly) was calculated from daily water consumption, which is given by the daily influx of people to the center and liters each person consumes. The daily influx is determined from the monthly influx. Since it varies every month, especially in summer, due to the seasonality of use of sports centers, guidance influx rates were established, taking 12. 476 uses as the months in which the monthly inflow level is 100% of the expected (Table 2.2 Appendix 1).

Subsequently, the monthly uses were added to know the annual ones and, from these, the average monthly and daily uses (345 people/day) were obtained.

In respect of pools, they consume hot water due to 2 main causes: constitute the first time the pool glass is filled and the heat losses of the glass due to five factors: evaporation, radiation, convection, transmission and water renewal. This will mean having to use hot water to maintain the temperature at the appropriate levels (between 24 ºc and 30 ºc, according to the RITE Wellness and Health Requirement IT 1.1). A temperature of 28ºc was chosen for pool 1 and 30ºc for 2, because according to the RITE and orientations of real sports centers, pool 2 if used by babies, senior citizens and pregnant women, should have a higher temperature.

Energy consumption will be given in kilowatt hours (kwh). On the one hand, we have the energy consumption of SHW and, on the other hand, those of swimming pools. The annual energy consumption (kwh) shall be calculated by the product of the installed power (kw) for the hours that power is expected to be used annually.

3.2. Methodology for calculating investment costs or initial installation, energy costs and maintenance costs

Once the power to be installed was calculated, the installation costs were determined for each alternative (Natural Gas, Biomass and Solar combined with Natural Gas or Biomass), based on estimates of professionals and catalogs of boilers and solar panels such as Vaillant rate catalog or the Herz price generator.

The facilities are adapted to document HE4 of the Technical Building Code (CTE) which, since 2006, establishes that, in new buildings, when the main source of energy is not renewable (Natural Gas), there must be a minimum solar contribution to SHW and pool. In SHW this contribution will depend on the solar zone (Lugo is Zone II) and the hot water consumer (between 5,000 and 10,000 liters / day) that will be 40% of the energy demanded for SHW. For swimming pool heating it will depend on the solar zone and will be 30% of the energy demanded for swimming pools.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

To determine the number of solar panels required, the required contribution will be calculated according to the percentages mentioned, the heat exchanger savings will be taken into account and the auropro3.0.1 program of Vaillant will be used to calculate the number of solar panels needed for SHW and pool.

In addition, it will be taken into account in the cost of facilities the subsidies for renewable energy projects of INEGA 2018, which for the Biomass boiler is € 360 / kw of installed power, with a 50% maximum aid percentage, and for Solar Thermal energy installations, for the non-mandatory part of the CTE and being combined with conventional energies, of € 1500 / kw with a 50% maximum aid percentage.

From the energy consumption data with fuel prices biomass set by the IDAE (Institute for Saving and Energy Diversification), prices of Natural Gas Endesa (2018) for consumptions between 100,000 kwh / year and 3 gwh / year with Rate 3.4. Recommended by Endesa professionals and document HE4 Building Technical Code for solar panels, the annual energy cost of each type of installation is determined.

To determine the energy cost of "Natural Gas" annual energy consumption savings exchanger was used, minus the mandatory minimum solar contribution, since this contribution is free. When installing a condensing boiler must be noted that the yield is 104%, so that with each kwh produced will be covered 1.04 kwh and therefore consumption will be covered with less energy production (Production = Consumption / Performance). The production result obtained was multiplied by the price of the most economical Natural Gas in the market for consumption between 100,000 kwh / year and 3 gwh / year with the rate 3.4. (Endesa, 2018), taking into account the monthly fixed term.

For the cost of consumption of "biomass", the price of wood pellets in bulk (one of the fuels of this type of boiler) in € / kwh with an average price of the A1 certified pellet in bulk is € 0.0366 / kwh and uncertified pellet bulk € 0.0352 / kwh, according to the IDAE liberalized energy prices report (2017-2018) and professionals in the sector.

The average of both is 0.0359 € / kwh. It was multiplied by the production of energy needed to cover annual energy consumption with savings of discounted exchanger (production will be greater than consumption, since it has a Biomass boiler with a yield of 93% that covers 0.93 kwh for each kwh produced).

For installations with voluntary solar contribution, the corresponding solar contribution was subtracted from the annual energy consumption with exchanger savings. In the case of the "Solar combined with Natural Gas" installation, the energy costs were determined as indicated for installation "Natural Gas", and for "Solar Biomass" installation, as in the case of installation "Biomass ".

And, based on estimates of professionals in the sector, maintenance costs were calculated. There are common maintenance costs for any of the alternatives analyzed. On the one hand, there are the mechanical maintenance costs related to monthly preventive operations of checking the energy equipment (12h / month), of daily operations of temperature control of the deposits and pool (2h / day), and of corrective operations for assistance or unforeseen events (200h per year) and, on the other hand, chemical maintenance costs, performed by an approved laboratory, such as legionella and PH analysis of SHW and swimming pool (€ 6,000). The first ones will be given by the cost / hour of the necessary personnel and by the hours that are in the center and the second ones have a fixed price. Moreover, in the biomass installation there will have to be a person in charge of removing the ashes from the fuel weekly (52 hours per year) and a monitoring plan will be carried out in the thermal solar installation (cleaning of panels and control of collectors and circuits) and maintenance of the collection, accumulation and exchange systems, hydraulic circuit and electrical system.

3.3. Methodology for feasibility analysis (NPV)

Depending on the results, it made a comparison of the alternatives, paying particular attention to costs and initial investment, and financial viability of each option was studied using an NPV analysis.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

For the calculation of the NPV, a time horizon equal to the useful life of the facilities was established, 20 years, setting as down payment the cost of the installation (with subsidy) and as cash flows the annual energy costs added to the costs of maintenance. Being disbursement flows will be negative and therefore the result of NPV too, so that one with a higher NPV will be proposed as a more adequate installation, despite being all negative.

To make temporary projections of 20 years the increase in the influx of people to SHW was taken into account. In year 1 the flow is the fourth part of year 2, the center being open for only a quarter. Since the flow 2 increases by 50%, 33%, 15% and 5% in years 3, 4, 5 and 6, respectively, with the same ACS consumption being maintained since it will vary in these proportions. The pool will consume the same every year, except for losses the first year, to work only during the opening three months since October, will be the fourth of the year 2. The first cup filling is made in October and the following filled year in December. Other years are filled alternately. After the first filling of swimming pools in October of the opening year 1, and of the filling of the year 2 calculation base, the entire pools will be emptied only when repairs are required, and only a part is usually emptied for minor repairs. As the company of this study is a quality benchmark and to anticipate possible repairs, it was considered a commissioning every two years.

The NPV formula is shown in table 9 of Appendix 1. The effect of inflation has not been considered, since when applying a rate g multiplying the price of each year n by (1 + g)^n, in the formula of the NPV the discount factor (1 + g)^-n must be added, and the same result would be obtained as without an inflation rate (Garrido, 2001). The WACC (Weighted Average Cost of Capital) is considered a discount rate, based on an estimate of the total cost of building a sports center with the characteristics of the business-case and and from the costs of debt according to orientations of experts of the sector of management of sports facilities and advisers of banking entities. Upgrading to a discount rate of 8.40% WACC offers the same conclusions as to consider inflation at 3% and upgrade to a rate of 11, 65% (taking into account the effect of inflation, (1 + 0.084) * (1 + 0.03)).

This WACC value is appropriate, used in studies of similar nature in which for an energy project to be carried out in the company can be used as the discount rate WACC of this (Noguera, 2011).

3.4. Methodology for calculatingenvironmental impacts and CO2 emissions

The analysis of external costs and environmental externalities means greater transparency in the management, more information about the activities to be analyzed and less discretion of some decisions. The literature on the economic valuation of environmental external costs, agrees on the need to match two unequal but consistent methodological approaches: the approach path impact and life cycle analysis (LCA) and although sometimes not easy to estimate externalities by technical ignorance or lack of means, in any case, it is good to reflect on them (Linares Llamas, 2002. European Investment Bank, 2013; Infrastructure Sustainability Council of Australia (ISCA), 2016).

For energy the life cycle analysis (LCA) comprises the extraction of fuel, transport, preparation, construction, operation and decommissioning of generation, energy transmission and management of waste produced. All these steps have environmental consequences, higher or lower depending on the type of energy.

In the case of natural gas, emissions from extraction, transport and generation, occupation of land, noise and pollutant discharges are generated. In the case of biomass it produces emissions in the cultivation, collection, transportation and generation, waste, residues and occupation of terrain and in the case of solar energy it generates solid waste such as heavy metals in its generation and land occupation and visual impact, however, it does not generate CO2 emissions (Linares Llamas, 2002).

In addition, for economic evaluation of externalities, there are various applicable methods to quantify in monetary terms damage, such as the "top-down" method Hohmeyer (1988), using aggregate data emission and impacts to estimate external costs of certain contaminants.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Approach "bottom-up" using specific values for each unit of production or energy demand (Bernow & Marron, 1990; Ottinger et al., 1991; Pearce et al., 1992); damage function, a succession of steps following the impact from the activity that generates it until the damage that occurs independently for each activity and impact considered; a methodology applied by the European Commission (1995, 1999) for the externe project (Linares Llamas, 2002) or as the European Investment Bank (2013) that estimates the volume of an externality and an appropriate unit price, or a marginal estimate of external cost.

In the consumption stage, which this study focuses on, natural gas is a fuel that contributes to increasing CO2 emissions. The Practical Guide for the calculation of greenhouse gas (GHG) emissions (Generalitat de Catalunya, 2011) involves the emission of 2.15 kg CO2 / Nm3 of natural gas.

Biomass is a fuel with emissions considered practically neutral (Generalitat de Catalunya, 2011), a zero-emission factor will be applied (t CO2 / TJ Nm3).

Solar energy means less CO2 emissions, covering part of the need to produce energy with other non-renewable sources and is considered to have zero emissions.

In this paper, to analyze the environmental impact, it has chosen to focus on CO2 emissions at the consumption stage only since when it comes to incorporating the valuation of externalities in an economic or financial analysis there are usually several difficulties. Some difficulties may be of a technical nature, related to the risk of incurring double counting of securities, ie incorporate two or more times the same welfare loss, then overestimating the externality, and can be complementary and competitive features for the same resource (Turner et al., 2003) or problems with the scale data, since in order to analyze economically externalities, it may be used estimations obtained for similar analysis, in other places or circumstances, and that could mean not transferring the results properly to context of the analysis being developed (Delacámara, 2008).

To determine CO2 emissions at the consumption stage, the following considerations were taken into account:

- Natural gas, according to the Practical Guide for calculating emissions of greenhouse gases (GHGs) (Generalitat de Catalunya, 2011) involves the issuance of 2.15 kg CO2 / Nm3 of natural gas.
- Biomass is a fuel with emissions considered practically you neutral (Generalitat de Catalunya, 2011), are subject to a zero emission factor (t CO2 / TJ Nm3).
- Solar energy means less CO2 emissions, covering part of the need to produce energy with other non-renewable sources.

In addition, according to the European Investment Bank (2013), CO2 emissions could be economically valued in EUR / t CO2e. The European Investment Bank (2013) makes a central estimate of the damage associated with an emission in 2010 of 25 euros per tonne of carbon dioxide equivalent, plus a high and low estimate of 40 euros and 10, respectively (all measured in constant euros of 2006). Reflecting a common finding that the marginal damages of emissions increases as a function of atmospheric carbon concentrations, annual "adders" are applied after 2010, ie, an absolute increase in value per year (measured in prices constant 2006). Therefore, an issue in 2017, the year of the study, according to the central estimate would be equal to 25+ (2017-2010) = 32 (Euro 2006). Thus reducing the consumption of natural gas and bet on hybrid systems combining solar energy, beyond legally binding, or betting on biomass installations, you can assume greater sustainability for the business-case and a positive impact on the consumption stage for the environment.

4. Results

4.1. Results of power and energy consumption

Power

Table 3 summarizes the powers necessary for hot water and pool and the power to be installed is collected and then explained as calculated.

	Installed power (kW)
SHW power	71.05
Power evaporation	63.22
Power radiation	6.62
Convection power	0.00
Power per transmission	13.91
Renewing water power	29.53
Commissioning power pool	196.89
Total	**381.23**
(Power evaporation + renewal + radiation)	-99.37
Total installed	**281.85**

Table 3 Power installed
Source: Self made

First, the thermal power needed for the production of SHW was determined by finding the one hand consumption liters of water and the thermal energy demand which will provide the locker and on the other, demand for pools, since power in kw is obtained differently.

Knowing, therefore, that a month come to the center 345 people / day and each person consumes 21 liters of water at 60 ° C (according to the document HE4 "Power Saver" CTE) would consumption SHW of 7,245 liters / day. Therefore, 1 SHW tank of 2,500 liters of capacity will be installed and a time of 2 hours will be considered each time the tank is filled, leaving a necessary power to heat the water at 60ºc of 71.05 kw (Albarracín, Sanabria and Maíllo, 2007; ATECYR, 2011). As in the base year it is forecast consumption of 7,245 liters and the tank is 2,500 liters if the boiler works 6 hours / day for SHW will produce 7,500 liters in total and, therefore, to 7,245 liters will work 5.8 hours / day. In the event that would increase the flow to the center, if the same percentages apply subscriber growth,

As for the pools, the consumed hot water comes from 2 main causes: constitute the first time the pool is filled and the heat losses from the pool vessel. The heat losses of the pool vessels were calculated (Albarracín, Sanabria and Maíllo, 2007; ATECYR, 2011) adding a necessary power of 113.28 kw and, after filling the pool glasses for the first time, the power to cover the set-up to be consumed each time, for repairs, the pools have to be refilled, it adds a power of 196.89 kw.

The total power required would be 381.23 kw (table 3), considering the commissioning, the renewal of the water and the losses power due to evaporation or radiation (Albarracín, Sanabria and Maíllo, 2007; ATECYR, 2011). If one takes into account the punctual use of the commissioning power of the pool and, thinking that when it is produced, the renewal power of the water is already covered and there are practically no losses due to evaporation or radiation, a boiler would be installed to covering a power equal to 281.85 kw. The choice is, therefore, a boiler of 300 kw.

Energy consumption

In terms of energy consumption, on the one hand, if we consider that the SHW power is 71.05 kw and 5.8 hours a day working in year 2 (calculation basis) a daily demand of 412 kwh will occur and, as the center will be open 365 days a year, there will be an energy demand of 150,309.12 kwh per year. On the other hand, pools work the following hours:

- Renovation and transmission (24 hours a day, 365 days a year) and radiation (24 hours a day, 362 days a year, 3 days of setting up the pool vessel) are discounted.

- Commissioning: at the end of year 2 a pool filling, as it is the basis of calculation. Year 1 is the initial warming, and the other years, from 2 *, one will be filled and no.

- Evaporation: only the hours that the center is open (4,888 hours) minus 72 hours of commissioning are considered, because at that time the water will not evaporate, the pools will be covered with a thermal blanket the rest of the hours that the center is not open.

In this way, 907,001.17 kwh would be consumed in the base year (table 4 and table 4.1 complete Appendix 1).

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

	Installed power (kW)	Total working hours /year	Energy consumption (kWh) annually
Total evaporation power	63.22	4816	304,486.95
Total radiation power	6.62	8,688	57476.09
Convection power	0		
Total power per transmission	13.91	8,760	121,834.08
Total renovation Water power	29.53	8,760	258,718.57
ACS power	71.05	2,115.54	150,309.12
Total system capacity made	196.89	72	14176.36
Total			907,001.17
Saving heat exchanger (Table 4.1)			136,586.72
Total consumed energy with saving exchanger			770,414.45

Table 4 Summary of power, operating hours and consumed energy in the base year calculation
Source: Self made

To save part of this consumption can be installed heat exchangers that can recover energy from water renewal pools, saving 136,586.72 kwh, being

An annual consumption of 770,414.45 kwh. These consumption will be affected by the performance

Boilers, requiring produce more or less kwh of which will be consumed, depending on whether performance is above or below 100% (Energy production = Consumption / Boiler Performance).

Based on the data obtained so far, the cost of each type of installation, the cost of consumption of each of them and the cost of maintenance will be sized and estimated, to make the financial assessment.

4.2. Results of installation or investment costs, energy or operational costs and maintenance costs

Installation or investment costs

Investment costs or installation required to implement each alternative were estimated according to the mentioned methodology.

Based on estimates of industry professionals and catalogs of boilers and solar panels such as the Vaillant catalog or the Herz price generator. A summary of the necessary initial investment or installation costs for each type of alternative listed in Table 5 and detailed estimates are shown in table 5.1

Natural gas (with contribution Solar Required according CTE)	
Natural gas	30971
Solar	93896
Total	**124867**
Biomass	
Total biomass	113635
Grant Inega	56,818
Total	**56,818**
Natural gas Solar Voluntary Contribution (plus Required)	
Total Natural Gas	30971
Total Solar	180322
Total	**211293**
Grant Inega	60,000
Total	**151293**
Biomass Solar voluntary contribution (equal to mandatory GN)	
Biomass	110135
Solar	93896
Total Solar Biomass	**204031**
Grant Inega	60,000
Total with Grant Inega	**144031**

Table 5 Investment cost or initial cost of each type of facility (€)
Source: Self made

40% of the annual energy demand for Solar Thermal ACS are 60,123.65 kWh and 30% of the annual energy demand for Solar Thermal Pools:

To determine the number of solar panels needed the minimum contribution required by the specified percentages are calculated which are 227,007.61 kWh, but saving heat exchanger are reduced to 90420.89 kWh. With the AuroPro3.0.1 program. Vaillant was calculated that 32 panels for hot water and 97 are needed for pools.

Since heat exchangers are installed in the pools, the document can be reduced HE4 considered mandatory solar minimum thereof, from 30% to 12.37%, and panels 97 to 40, representing a total of 72 solar, with ACS panels.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

In addition, taken into account in the cost of facilities, subsidies for renewable energy projects of INEGA (Table 6), which for biomass boilers are of 310 € / kW of installed capacity, with 50% of project cost maximum support (56,818 € maximum) and energy facilities Solar Thermal, for non-mandatory part of the CTE and being combined with conventional energy, 1500 € / kW, with 50% of the project cost and 60,000 € for project maximum support (105,647 and 102,016 € € is 50% in the case of solar thermal systems with more than the minimum required solar panels and maximum subsidized € 60,000).

Biomass subsidy/grant	
Maximum power assistance	**Maximum support per project**
310 € / kW - (P / 4) for additional power P of 40 kW <P ≤ 440 kW with automatic feeding and accumulation volume fuel V ≥ 250 liters and V <1,000 liters and 50 € / kW if system automatic cleaning exchanger	The aid intensity will be 50%.
	The maximum amount of aid per project will be € 60,000.
Solar Thermal Grant	
Maximum power assistance	**Maximum support per project**
1500 € / kW	The aid intensity will be 50%. The maximum amount of aid per project will be € 60,000.

Table 6 INEGA subsidies for renewable energy
Source: Self made

Installation alternatives contemplated are therefore:

- Natural Gas facility that will comply A Natural Gas facility installation that will comply with the mandatory solar minimum including 71 panels and will not have any subsidy.

- An installation exclusively of Biomass, with a subsidy of € 56,818.

- A solar installation combined with Natural Gas, with solar input higher than the mandatory one (51% to SHW and 31% to swimming pool), 142 panels, 71 volunteers, with a subsidy of € 60,000.

- And a Solar installation combined with Biomass in which the minimum amount required for conventional energy will be taken as a voluntary solar contribution, with a subsidy of € 60,000.

According to the installation costs (table 5 and table 5.1 Appendix 1) without taking into account the subsidies, the installation that requires a smaller investment is the “Biomass” installation (€ 113,635) followed by “Natural Gas” (€ 124,867), “Solar combined with Biomass” (€ 204,031) and “Solar combined with Natural Gas” (€ 211,293).

If there is no obligation for the CTE to install a minimum of solar panels when conventional energy is used, the “Natural Gas” installation would be the one that would have the lowest investment costs (€ 30,971), but this option has not been realizable since 2006.

Taking into account subsidies, the “Biomass” installation would continue to have the lowest price (€ 56,818) and the Solar combined with other energies could be interesting, since its cost is reduced by almost a third of the value without subsidy and they are the alternatives with the highest solar input. In principle, if we only based the analysis on the cost of the investment (CAPEX or Capital Expenditure), the most economical installation would be the “Biomass”.

However, it should be seen if it compensates for a larger investment depending on whether in the long term it allows reducing the costs of energy consumption and even other operating expenses (OPEX or Operational Expenditure), for example, the annual maintenance of facilities, before settling on one considering only the investment. In this case, they consider disbursements arising from operating expenses.

Energy costs

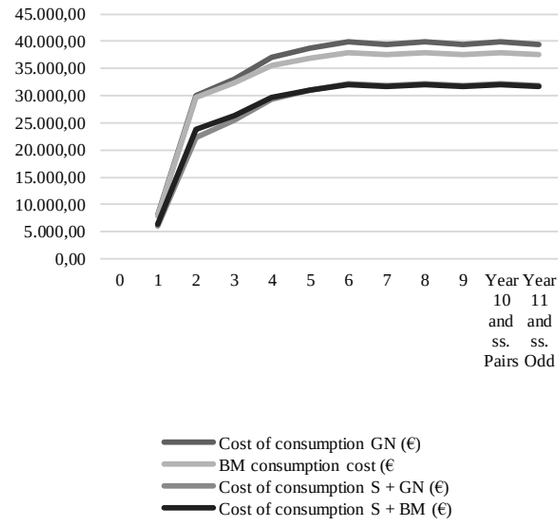
To determine energy costs indicated methodology was followed. These costs for the base year calculation, are shown in Table 7 and Table 7.1 of Annex 1 of more detailed and disaggregated form. Accordingly, the facility would consume less "Solar with Natural Gas", with a cost of € 22,327.87 in the base year, very close to the running costs of the "Solar Biomass" installation.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

	Natural gas
Annual Natural Gas Cost	**29,966.30 €**
	Biomass
Annual cost Biomass	**29,739.65 €**
Solar combined	
	Solar with Natural Gas
Annual cost Solar + Natural Gas (€)	**22,327.87 €**
	Solar Biomass
Solar + Biomass annual cost (€)	**23,854.95 €**

Table 7 Energy costs of each type of facility
Source: Self made

This is due to the fact that the solar contribution is high, exceeding the mandatory minimum, and that the Natural Gas condensing boilers have a higher yield than those of Biomass. The installation with the highest consumption costs is "Natural Gas" (€ 29,966.30) because the mandatory solar contribution does not mean considerable savings, followed by the installation of biomass (€ 29,739.65), which despite being the most energy must produce has a cheaper fuel than natural gas, so it might be interesting, knowing that over the years the influx of people will increase and, therefore, the energy to be produced. Therefore, although in terms of installation costs, "Biomass" would be the option with the lowest investment, at the level of consumption costs, for this company, the most appropriate would be the "Solar with Natural Gas" installation, if its high installation costs are amortized (figure 1). This will be seen in the NPV analysis.



Graphic 1 Consumption costs of each type of facility (€)
Source: Self made

Maintenance costs

They were calculated according to the methodology discussed. There are, on the one hand, common costs for any of the alternatives analyzed, some of which, such as costs of mechanical maintenance, daily operations temperature control of deposits and pool and corrective operations for assistance or unforeseen will be given by the cost / hour of the necessary personnel and for the hours that they are in the center and on the other hand, chemical maintenance costs, have a fixed price.

A major in the installation of biomass will have to be a person in charge of removing the fuel ashes weekly and it will be carried out in the thermal solar a monitoring plan (cleaning of panels and control of collectors and circuits) and maintenance of the accumulation and exchange systems, hydraulic circuit and electrical system that were estimated at 1.400 € / year for installation "Natural Gas" and 2.775 € / year for "Solar with Natural Gas" on the grounds that the maintenance cost of solar panels is 8.3 € / m2 installation (25 € / h would mean 56 and 111 hours per year, respectively). The overall maintenance costs are shown in Table 8 and shown in Table 8.1 of Annex 1

	Natural gas (NG)	Biomass (BM)	Solar + GN	Solar + BM
Annual maintenance	33,650	33,550	35,025	34,950

Table 8 Maintenance costs of each type of installation base year (€)
Source: Self made

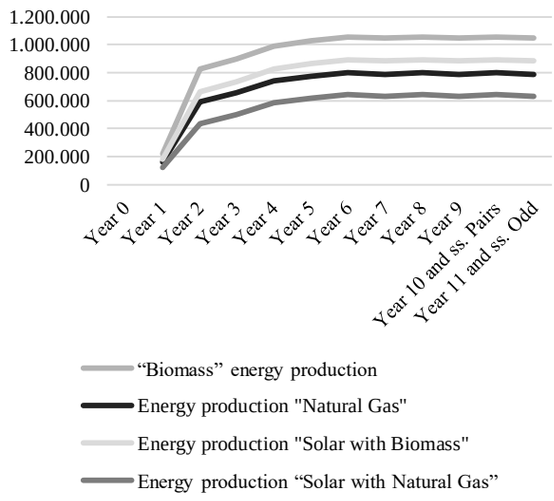
According to these costs, the "Solar with Natural Gas" installation is the one with highest maintenance costs, compared to "Biomass", the most economical. It remains to be seen whether the increased investment and maintenance costs of the "Solar with Natural Gas" installation are assumable to compensate with lower consumption cost.

4.3. VAN analysis

To estimate the VPN, the commented methodology and the formula included in table 9 Appendix 1 First, before applying the NPV, energy consumption (kwh) and the production of energy required was estimated to cover the claimed consumption depending on the performance of each type of installation.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

During a time horizon of 20 years as the average useful life of the facilities (Figure 2 and table 10 Appendix 1), applying the percentages of growth for SHW discussed in the methodology (50% year 3, year 33% 4 15% 5% 5 year year 6). From year 6, the consumption of SHW number of users, and to make visual tables, columns 12 to 20 were removed, and put "10 and following (ss) pairs" and "11 and following (ss)", understanding that there would be the same consumption alternately.



Graphic 2 Energy production of each type of installation (kWh)
Source: Self made

After the first filling swimming pools in October of 1 (opening) and filling of year 2 (calculation basis) only complete pools will be emptied when required repairs, and is usually emptied only a portion for minor repairs. As the business-case is a benchmark of quality and to anticipate potential repairs it was considered a commissioning every two years. The years when the pools are not empty, should take into account evaporation losses and radiation 72 hours excluded in the years that emptied itself. The annual energy consumption results are those listed in table 10 Appendix 1, ranging between € 203,127 and a maximum of 982,194 in the 20 years considered. They suppose an increasing consumption until year 6, from which there will be only small declines in the years when the pools are not emptied.

Based on the above data, and taking into account the performance of each type of boiler, energy producing and energy costs for each type of installation were calculated.

By adding the maintenance costs (equal for all years), the total annual costs of each installation were obtained. The total and disaggregated costs are shown in Tables 10.1 (Natural Gas), 10.2 (Biomass), 10.3 (Solar with Natural Gas) and 10.4 (Solar with Biomass) of Appendix 1.

From the initial investment and total costs, all negative as disbursements, the updated cash flows were obtained at 8.40% (discount rate according to the WACC formula). And by adding the discounted cash flows of each installation, the npvs of each of them were obtained. And by adding the discounted cash flows of each facility the NPV of each were obtained. In Tables 10.1, 10.2, 10.3 and 10.4 APPENDIX 1 all cash flows data that serve as the basis for calculations of VPN and Table 11 below, the results are collected.

	Value (€)
NPV Natural Gas	755,418.55
NPV Biomass	672,403.49
Solar NPV with Natural Gas	726,471.05
NPV Solar Biomass	719,968.79

Table 11 NPV values
Source: Self made

As shown in the above table, the NPV of greater value is the installation "Biomass" (€ 672,403.49). Therefore, this type of installation will be the most convenient and profitable for the company. It is because, although "Biomass" has a low energy consumption slightly lower than "Natural Gas" and higher than the installations with voluntary solar contribution ("Solar with Natural Gas" and "Solar with Biomass"), these energy costs are compensated with an initial investment and with lower maintenance costs than other types of installation, due in large part to subsidies that considerably reduce their installation costs (Table 10.2 Appendix 1). Even if a higher pellet cost (€ 0.0366 / kwh of the certified category A1 was used instead of the € 0.0359 / kwh used as the average price) and gave a higher energy cost in the base year (30,319 , € 54 versus € 29,737.2), the NPV would remain the highest (-678,623.1 €), compensating to spend a little more on the cost of producing energy than investing a very large amount in hybrid solar installations, since which will mean lower consumption and lower cash flows (tables 10.3 and 10.4 Appendix 1) but not enough to make the initial outlay better than "Biomass".

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

The VPN closest to that of "Biomass" is that of "Solar with Biomass". Keep in mind that this installation has higher cash flows and therefore less costs, a difference that will be reduced over time, as it will increase the consumption of SHW with the influx of people, so that the difference will be reduced, and it presents a higher initial outlay and higher maintenance costs (table 10.4 APPENDIX 1). The way to finance the installation, except for subsidies, was not taken into account in the VPN analysis in order to see the VPN of the project itself.

4.4. Environmental impact

As mentioned, and according to the criteria of the Practical Guide for calculating emissions of greenhouse gases (ghgs) (Generalitat de Catalunya, 2011), it is considered that biomass and solar energy does not produce CO2 emissions at their stage of consumption, or they are hardly significant. However, natural gas does (2.15 kg / Nm3 emissions of CO2, considering that each represents 1 kwh Nm3 / 10.65 kwh (Generalitat de Catalunya, 2011)). Therefore, the most sustainable installations would be those that use biomass (exclusively or combined with solar energy), followed by installations that use natural gas (combined with more solar energy than the mandatory or compulsory).

The implementation of the "Biomass" installation, the most appropriate for the business-case according to the financial feasibility analysis, is a neutral issue and, as can be seen in table 12 of APPENDIX 1, when opting for the installation " Biomass "against" Natural Gas with Solar ", it is avoided to emit between 24,131.28 kg and 129,463, 92 kg of CO2 per year (minimum and maximum estimates) a and against the installation" Natural Gas" it is avoided to emit between 32,031.77 and 161,065.48 kg kg of CO2 per year (minimum and maximum estimates). It is seen, therefore, that the¬installation "Biomass" pollutes less.

If CO2 emissions are valued economically according to the European Investment Bank (2013) method with a central estimate of the associated damage, it is obtained that they would be equal to 25 + (2018 - 2010) = € 33 / t CO2.

Knowing this, the external environmental costs could be calculated by multiplying this figure by the CO2 emissions obtained in Table 13. As it has been seen, only the installations with Natural Gas will suppose emissions in the consumption stage, therefore, they will be the only ones that add external costs and the only ones that suffer modifications in their VPN that will suppose more negative flows (tables 14.1 and 14.2 of Appendix 1). According to this, the NPV of the "Natural Gas" and "Solar with Natural Gas" installation will be more negative and will continue to be lower than those of "Biomass" and "Solar with Biomass" (table 14). The installation chosen according to these NPV would continue to be "Biomass".

	Value (€)
NPV Natural Gas	-799,717.13
NPV Biomass	672,403.49
Solar NPV with Natural Gas	761549.2
NPV Solar Biomass	719,968.79

Table 14 NPV values of external costs emCO2 issions
Source: Self made

The implementation of the "Biomass" installation will mean environmental advantages for the business-case such as:

- Optimal implementation of Corporate Social Responsibility (CSR), and to be aware for the proper performance of their activities
- A competitive advantage oriented towards sustainable development by following an environmentally friendly energy management
- Reducing pollutant emissions as fuels such as natural gas are composed of different harmful gases and by opting for biomass, less pollution is created.

However, despite this study focuses on emissions and environmental impact of the consumption stage, you should be aware that the environmental impact goes beyond and encompasses the entire life cycle of the fuel or power source (LCA) to be used. So, taking the account the whole life cycle, biomass could have some negative impact on the environment and be more sustainable hybrid installation "Solar with biomasa".

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Conclusions

Based on the above, and the present case, it could be concluded that the "biomass" installation is the most appropriate because:

- It has the highest NPV of options analyzed.

- Although the costs of energy consumption of hybrid installations "Solar with Natural Gas" and "Solar Biomass" are lower than those of "biomass", the high investments required by these installations are not offset by their costs of energy consumption or maintenance costs.

The study was based mainly on financial issues and environmental impacts in the consumption stage. Between "Biomass" exclusively or "Solar Biomass", the first option is the best financially, because, even if it has a higher consumption, it would be compensated with the reduced investment that it requires in front of a hybrid installation. Therefore, the "Biomass" installation would be the chosen one, since it requires less initial outlay than the other installations and, in addition, has reduced maintenance costs.

For future studies would be interesting to note if under different circumstances, such as other characteristics of the subsidies, applying another type of analysis, including risk factors or uncertainties or considering alternative installation of hot water and pool heating, the option of "biomass" would remain the most appropriate or optimal. Some methods to include risk considerations in the analysis could be to add a risk factor in the discount rate or to quantify the uncertainty through sensitivity analysis to present a range of possible outcomes varying assumptions of risk (Galán, Gonzalez Leal & Varela, 1999).

At the environmental level, the consumption stage in which it has based the study, "Biomass" would also be the option chosen. However, it might be interesting to note the benefits of the hybrid system, combining two sources of renewable energy: solar and biomass.

In principle, both have less harmful emissions for the environment than the "Natural Gas" and "Solar with Natural Gas" installations but we see that "Biomass" has a greater need to produce more kwh of energy, not covered by solar contribution (table 12 Appendix 1).

In addition, although emissions at the consumption stage are neutral, they are not in the rest of the life cycle of the energy source therefore it could also be interesting to apply and study the usefulness of operational improvements in managing demand hot water needed to reduce consumption and analyze the environmental impact not only taking into account the emissions generated in the consumption phase, but throughout the life cycle because, in that case, the alternative choice might be different. A more sustainable option in this regard, which incorporates all externalities and environmental impact, despite assuming a higher investment cost, could be the "Solar with Biomass" alternative because with the solar contribution the saving in energy use would reduce the impact environmental, preserving non-renewable resources, avoiding the generation of more energy, not requiring the consumption of so many pellets and reducing the carbon footprint.

In short, implementing installations in which renewable energy and sustainability prevail will help companies to differentiate themselves, as actions that affect their corporate social responsibility associated with the conservation of the environment, taking into account not only growth and economic savings but also the social and environmental impact (Martí, 2012). Betting on energy such as biomass, solar or combined in hybrid systems, can be positive since it contributes to greater long-term economic savings and lower emissions in the energy consumption stage, but we must move forward to take into account not only economic and environmental aspects impact on the consumption stage, but in general

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Appendix 1

Swimming courses	Sessions / week	Users / session	User / month
Type 1	29	5	580
type 2	18	10	720
type 3	12	240	960
type 4	40	8	1280
Total	107		3,540
40% Year 2			**1,416**
Racket courses	**Grades 1 h /week**	**Users / course**	**User / month**
Tennis	8	two	64
paddle	12	4	192
Total	twenty	6	256
40% Year 2			**102**
Arts courses	**Sessions / week**	**users**	**users**
martial		**/session**	**/month**
Total	twenty-one	twenty	1680
40% Year 2			**672**
		User / month	
Tracks		**158**	
		User / month	
Free admission		**10**	
		User / month	
Swimming pool		**1,200**	
		User / month	
fitness		**5,300**	
Guided activities	**Weekly sessions**	**users**	**users /**
	1 h	**/session**	**Month**
room 1	16	17	1,088
room 2	37	17	2,516
room 3	40	17	2,720
room 4	40	17	2,720
Total			9,044
40% Year 2			**3617.6**
Total Monthly Uses			**12,476**

Table 2.1 Monthly Inflow in Year 2 with 40% coverage of the maximum number of people and 100% of the inflow to the center.
Source: Self made

Year 2	*Uses / Month*	*January*	*February*	*March*	*April*	*May*	*June*
Influx to the Sports Center	**100%**	**80%**	**90%**	**90%**	**100%**	**100%**	**90%**
courses	2,190	1,752	1,971	1,971	2,190	2,190	1,971
Tracks	158	126	142	142	158	158	142
Free admission	10	8	9	9	10	10	9
Swimming pool	1,200	960	1,080	1,080	1,200	1,200	1,080
fitness	5,300	4,240	4,770	4,770	5,300	5,300	4,770
Rooms	3,618	2,894	3,256	3,256	3,618	3,618	3,256
TOTAL (Users)	**12,476**	**9,981**	**11,228**	**11,228**	**12,476**	**12,476**	**11,228**
Year 2	*Uses / month*	*July*	*August*	*September*	*October*	*November*	*December*
Influx to the Sports Center	**100%**	**70%**	**40%**	**80%**	**90%**	**100%**	**80%**
courses	2,190	1,533	876	1,752	1,971	2,190	1,752
Tracks	158	111	63	126	142	158	126
Free admission	10	7	4	8	9	10	8
Swimming pool	1,200	840	480	960	1,080	1,200	960
fitness	5,300	3,710	2,120	4,240	4,770	5,300	4,240
Rooms	3,618	2,533	1,447	2,894	3,256	3,618	2,894
TOTAL (Users)	**12,476**	**8,733**	**4,990**	**9,981**	**11,228**	**12,476**	**9,981**

Table 2.2 Monthly Inflow Year 2 as percentages of affluence center
Source: Self made

	Installed power (kW)	*Operating hours per day*	*Days a year*	*Total hours / year*	*Energy consumption (kWh) annually*
Total evaporation power	**63.22**			**4816**	**304,486.95**
pool 1	44.66	-	-	4816	215,060.72
pool 2	18.57			4816	89426.23
Total radiation power	**6.62**	**24**	**362**	**8,688**	**57476.09**
pool 1	5.38	24	362	8,688	46751.63
pool 2	1,23	24	362	8,688	10724.46
Convection power	**0**	-	-		
Total power per transmission	**13.91**	**24**	**365**	**8,760**	**121,834.08**
pool 1	11.1	24	365	8,760	97236.00
pool 2	2,81	24	365	8,760	24598.08
Total renovation Water power	**29.53**	**24**	**365**	**8,760**	**258,718.57**
pool 1	25.68	24	365	8,760	224,931.25
pool 2	3.86	24	365	8,760	33787.32
ACS power	**71.05**	**5.8**	**365**	**2,115.54**	**150,309.12**
Total system capacity made	**196.89**			**72**	**14176.36**
pool 1	171.18			72	12325.00
pool 2	25.71			72	1,851.36
TOTAL					**907,001.17**
Saving heat exchanger (Table 46.1)					**136,586.72**
TOTAL saving exchanger					**770,414.45**

(*) Note: For calculations used the unrounded values of the powers.

Table 4.1 Power, operating hours per day, days per year and energy consumed in the base year calculation

Natural gas (with contribution Solar Required according CTE)			
You	Concept	€ / ud.	Total
one	300 kW boiler	17,000	17,000
32	Solar panels for ACS minimum	778	24,896
39	Minimum Solar panels for pool	778	30342
36	Support for 2 panels	109	3,924
two	Accumulator 2500 liters	5,772	11,544
one	Accumulator 1500 liters	4,362	4,362
one	Heat exchangers water-water	2,049	2,049
one	hydraulic equipment	6,000	6,000
one	Electric material	4,500	4,500
one	Isolating material	4000	4000
one	Labor and commissioning	12,000	12,000
one	Transportation to work	4,250	4,250
		Natural gas	30971
		Solar	93896
		Total	**124867**
Biomass			
You	Concept	€ / ud.	Total
one	300 kW boiler	55510	55510
one	Accumulator 2500 liters	5,772	5,772
one	Fuel storage silo	17,500	17,500
one	Heat exchangers water-water	2,049	2,049
one	hydraulic equipment	4,628	4,628
one	Electric material	2500	2,500
one	Gas cleaning system with insulation	7153	7.153
one	Power system	5563	5,563
one	Automatic discharge device ash and ash deposit	5160	5,160
one	Construction and commissioning	6000	6,000
one	Transportation to work	1800	1,800
		Total biomass	113635
		Grant Inega	56,818
		Total	**56,818**
Natural gas Solar Voluntary Contribution (plus Required)			
You	Concept	€ / ud.	Total
40	Solar panels for ACS	778	31,120
102	Solar panels for pool	778	79356
71	Support for 2 panels	109	7,739
one	300 kw Natural gas boiler	17,000	17,000
3	Accumulator 2500 liters	5,772	17,316
one	Accumulator 300 liters	1,363	1,363
one	Heat exchangers water-water	2,049	2,049
one	hydraulic equipment	10,800	10,800
one	Electric material	8,100	8,100
one	Isolating material	7,200	7,200
one	Labor and commissioning	21,600	21,600
one	Transportation to work	7,650	7,650
		Total Natural Gas	30971
		Total Solar	180322
		Total	**211293**
		grant Inega	60,000
		Total	151293
Biomass Solar voluntary contribution (equal to mandatory GN)			
You	Concept	€ / ud.	Total
71	Solar panels for ACS	778	55238
36	Support for two panels	109	3,924
one	300 kw Biomass boiler Policombustible	55510	55510
two	Accumulator 2500 liters	5,772	11,544
one	Accumulator 1500 liters	4,362	4,362
one	Fuel storage silo	14,000	14,000
one	Heat exchangers water-water	2,049	2,049
one	Gas cleaning system with insulation	7.153	7.153
one	Power system	5,563	5,563
one	Automatic discharge device ash and ash deposit	5,160	5,160
one	hydraulic equipment	9,428	9,428
one	Electric material	6,100	6,100
one	Isolating material	3,200	3,200
one	Construction and commissioning	15,600	15,600
one	Transportation to work	5,200	5,200
		biomass	110135
		Solar	93896
		TOTAL Solar Biomass	**204031**
		grant Inega	60,000
		TOTAL with Grant Inega	**144031**

Table 5 Cost of each type of installation

	Natural gas
Annual energy consumption SAVINGS exchanger (kWh)	770,414.45
Solar minimum mandatory contribution to ACS (40%) and pools (12%) (kWh)	152,444.87
boiler Natural gas consumption (kWh)	617,969.58
to produce actual boiler efficiency 104% energy (kWh)	594,201.52
Price Natural Gas (€ / kWh)	0.048796
fixed monthly cost	80.97
Annual Natural Gas Cost	**29,966.30 €**
	biomass
Annual energy consumption savings exchanger (kWh)	770,414.45
Energy to produce 93% boiler efficiency (kWh)	828,402.63
Pellets Bulk price (€ / kWh)	0.0359
Annual cost Biomass	**29,739.65 €**
	Solar combined
Annual energy consumption savings exchanger (kWh)	770,414.45
	Solar with Natural Gas
Solar Mandatory contribution to ACS (40%) and Pool (12%) (kWh)	152,444.87
Solar Voluntary contribution to ACS (10%) and Pool (20%) (kWh)	162,799.49
Boiler Natural gas consumption (kWh)	455,170.09
To produce actual boiler efficiency 104% energy	437,663.55
Price Natural Gas (€ / kWh)	0.048796
fixed monthly cost	80.97
Annual cost Solar + Natural Gas (€)	**22,327.87 €**
	Solar Biomass
Solar Voluntary contribution to ACS (40%) and swimming pool (30%) (kWh)	152,444.87
Biomass boiler consumption (kWh)	617,969.58
to produce actual boiler efficiency 93% energy	664,483.42
Pellets Bulk price (€ / kWh)	0.0359
Solar + Biomass annual cost (€)	**23,854.95 €**

Table 7.1 Energy costs of each type of facility

	Natural gas (NG)	*Biomass (NM)*	Solar + GN	Solar + BM
Annual maintenance	33,650.00 €	33,550 €	35,025	34,950

Concept	Working h / year	€ / h	€ per year
Monthly Preventative operations	*120*	*25*	*3,000*
Daily operations	*730*	*25*	*18,250*
Corrective operations	*200*	*25*	*5,000*
Common mechanical maintenance (1)	**1050**	**25**	**26,250**
Maintenance Chemical (2)			**6,000**
Biomass weekly Ash Removal (3)	**52**	**25**	**1,300**
Thermal Solar: Maintenance panels (4)	**56**	**25**	**1400**
Thermal Solar: Maintenance panels (5)	**111**	**25**	**2,775**

Maintenance cost of Natural Gas: (1) + (2) + (4)
Biomass maintenance cost: (1) + (2) + (3)
Maintenance Cost Solar Natural Gas: (1) + (2) + (5)
Solar maintenance cost Biomass: (1) + (2) + (3) + (4)

Table 8.1 Maintenance costs of each type of installation base year

$$\text{VAN} = \sum_{t=1}^{n} \frac{V_t}{(1+k)^t} - I_0$$

Where
Vt: Cash Flow represents in each period t.
I0: The value of the initial investment outlay (year 0)
NIs the number of periods considered.
K: Is the discount rate = 8.40% = WACC (Weighted Average Cost of Capital)

$$WACC(cpp) = K_e \frac{CAA}{CAA + D} + K_d(1-T)\frac{D}{CAA + D}$$

Where:

WACC: 8.40%

Ke: Rate opportunity cost of shareholders (must be greater than Kd)
CAA: Capital contributed by shareholders for the establishment of sports center
D: outstanding indebtedness
kd: Cost of financial debt (having various types was a weighted average)
T: Tax rate

CAA	*2,340,000 €*	*.5526*	***CAA / (CAA + D)***
D	1,894,635 €	.4474	**D / (D + CAA)**
T	0.25	0.0604 (1)	**Ke * CAA / (CAA + D)**
Ke	10.93%	0.0236 (2)	**Kd * (D / D + CAA) * (1-T)**
kd	7.03%	**8.40%**	**(1) + (2) = WACC**

Table 9 Formula NPV and WACC

Energy production "Solar with Natural Gas" (Yield 104%) = (3) / 1.04	*Energy consumption / year with higher solar contribution CTE (3)*	*Energy production "Solar Biomass" (yield 0.93%) = (2) / 0,93*	*Energy production "Natural Gas" (Rendimiento104%) = (2) / 1,04*	*Energy consumption / year solar contribution CTE (2)*	*Energy production "Biomass" (Yield 93%) = (1) / 0,93*	*Energy consumption / year (1)*	
							year 0
119534	124316	177436	158669	165015	218416	203127	***Year 1***
437663	455170	664483	594201	617969	828402	770414	***year 2***
501131	521176	735458	657669	683976	899377	836421	***year 3***
581469	604727	825298	738007	767527	989217	919972	***year 4***
615922	640559	863827	772460	803359	1027746	955804	***year 5***
641298	666950	892204	797836	829749	1056123	982,194.00	***year 6***
632502	657802	882367	789040	820601	1046286	973046	***year 7***
641298	666950	892204	797836	829749	1056123	982194	***year 8***
632502	657802	882367	789040	820601	1046286	973046	***year 9***
641298	666950	892204	797836	829749	1056123	982194	***Year 10 et seq. pairs***
632502	657802	882367	789040	820,601.60	1046286	973046	***Year 11 et seq. Impares***

Table 10 Summary of energy consumption (kWh) for each type of installation and cash flows to calculate the NPV

*= Cash flows (7) * (1 + WACC) ^ - (year)*	*Cash Flow GN = (7) = (4) + (5) + (6)*	*initial outlay (6)*	*Maintenance costs (€) (5)*	*Consumption cost (€) = (4) = (1) * (2) + (3) months a year **		*Monthly Fixed Cost (€) (3)*	*Natural Gas Cost (€ / kwh) (2)*	*Energy consumption per year (kWh) (1)*	
124867	124867	124867							**0**
15127.10	16397.80		8,412.50	7,985.30	3			158669	**one**
54138.90	63616.30		33650.00	29966.30	12			594201	**two**
52375.00	66713.30		33650.00	33063.30	12			657669	**3**
51155.60	70633.40		33650.00	36983.40	12			738007	**4**
48314.80	72314.60		33650.00	38664.60	12	80.97	0.048796	772461	**5**
45334.00	73552.80		33650.00	39902.80	12			797836	**6**
41577.00	73123.60		33650.00	39473.60	12			789040	**7**
38580.30	73552.80		33650.00	39902.80	12			797836	**8**
35383.00	73123.60		33650.00	39473.60	12			789040	**9**
32832.70	73552.80		33650.00	39902.80	12			797836	**Year 10 et seq. pairs**
30111.70	73123.60		33650.00	39473.60	12			789040	**Year 11 et seq. Impares**

Table 10.1 Summary of total costs (€) broken down for installation of Natural Gas and cash flows to calculate the NPV

= Cash flows (6) * (1 + WACC) ^ - (year)	Cash Flow BM = (6) = (3) + (4) + (5)	initial outlay (5)	Maintenance costs (€) (4)	Consumption cost (€) = (3) = (1) * (2)	pellets cost (€ / kwh) (2)	Energy consumption per year (kWh) (1)	
56818	56818	56,818				0	**0**
14971.10	16228.60		8,387.50	7,841.10	0.0359	218416	**one**
53861	63289.70		33550.00	29739.70	0.0359	828402	**two**
51687	65837.70		33550.00	32287.70	0.0359	899377	**3**
50018.20	69062.90		33550.00	35512.90	0.0359	989217	**4**
47066.30	70446.10		33550.00	36896.10	0.0359	1027746	**5**
44047.00	71464.80		33550.00	37914.80	0.0359	1056123	**6**
40433.00	71111.70		33550.00	37561.70	0.0359	1046286	**7**
37485.00	71464.80		33550.00	37914.80	0.0359	1056123	**8**
34409.40	71111.70		33550.00	37561.70	0.0359	1046286	**9**
31900.60	71465		33550.00	37914.80	0.0359	1056123	**Year 10 et seq. pairs**
29283	71111.70		33,550	37561.70	0.0359	1046286	**Year 11 et seq. Impares**

Table 10.2 Summary of total costs (€) for installation of biomass breakdown and cash flows to calculate the NPV

= Cash flows (7) * (1 + WACC) ^ - (year)	Cash Flow S + GN = (7) = (4) + (5) + (6)	initial outlay (6)	Maintenance costs (€) (5)	Consumption cost (€) = (4) = (1) * (2) + (3) months a year *	Months a year	Monthly Fixed Cost (€) (3)	Natural Gas Cost (€ / kwh) (2)	Energy consumption per year (kWh) (1)	
151293	151293	151293	0					0	0
13682.60	14832.00		8,756	6,075.70	3	80.97		119534.5	one
48808.60	57352.90		35,025	22327.90	12	80.97		437663.6	two
47457.80	60449.90		35,025	25424.90	12	80.97		501131.5	3
46619	64370		35,025	29345.00	12	80.97		581468.9	4
44130	66051.20		35,025	31026.20	12	80.97		615922.8	5
41473	67289		35,025	32264.40	12	80.97	0.048796	641298.1	6
38015	66860		35,025	31835.20	12	80.97		632502.0	7
35294.90	67289.40		35,025	32264.40	12	80.97		641298.1	8
32352.20	66860.20		35,025	31835.20	12	80.97		632502.0	9
30036	67289		35,025	32,264	12	80.97		641298.1	**Year 10 et seq. pairs**
27532.50	66860.20		35,025	31835.20	12	80.97		632502.0	**Year 11 et seq. Impares**

Table 10.3 Summary of total costs (€) disaggregated Solar Installation with Natural Gas and cash flows to calculate the NPV

= Cash flows (6) * (1 + WACC) ^ - (year)	Cash Flow S + BM = (6) = (3) + (4) + (5)	initial outlay (5)	Maintenance costs (€) (4)	Consumption cost (€) = (3) = (1) * (2)	pellets cost (€ / kwh) (2)	Energy consumption per year (kWh) (1)	
144031	144031	144031			0.0366		0
13936.80	15107.50		8,737.50	6,370.00	0.0359	177436	one
50044.40	58805.00		34950.00	23855.00	0.0359	664483	two
48166.80	61353.00		34950.00	26403.00	0.0359	735458	3
46770.20	64578.20		34950.00	29628.20	0.0359	825298	4
44070.00	65961.40		34950.00	31011.40	0.0359	863827	5
41282.90	66980.10		34950.00	32030.10	0.0359	892203	6
37883.10	66627.00		34950.00	31677.00	0.0359	882367	7
			34950.00	32030.10	0.0359	892203	8
32239.40	66627.00		34950.00	31677.00	0.0359	882367	9
29898.80	66980.10		34950.00	32030.10	0.0359	892203	**Year 10 et seq. pairs**
27436.50	66627.00		34950.00	31677.00	0.0359	882367	**Year 11 et seq. Impares**

Table 10.4 Summary of total costs (€) broken down for installation of Solar Biomass and cash flows to calculate the NPV

CO2 emissions kg (2.15 kg / Nm3) for "Solar with Natural Gas"	Natural gas m3 / year "Solar with Natural Gas" solar contribution greater than CTE = kWh (2) * 1 Nm3 / 10.65 kWh	Energy production "Solar with Natural Gas" (Yield 104%) solar contribution greater than CTE kWh (2)	Em kgCO2 issions "Solar Biomass" (Zero emission factor)	Energy production "Solar Biomass" (yield 0.93%) solar contribution CTE	CO2 emissions kg (2.15 kg / Nm3) for "Natural Gas"	Natural gas m3 / year "Natural Gas" solar contribution kWh CTE = (1) * 1 Nm3 / 10.65 kWh	Energy production "Natural Gas" (Rendimiento104%) kWh (1)	Em kgCO2 issions "Biomass" (Zero emission factor)	Energy production "Biomass" (93% yield)	
										year 0
24131.28	11223.85	119534	**0**	177436	**32031.77**	14898.5	158669	**0**	218416	*Year 1*
88354.50	41095.12	437663	**0**	664483	**119956**	55793.52	594201	**0**	828402	*year 2*
101,167.29	47054.55	501131	**0**	735458	**132,768.86**	61752.95	657669	**0**	899377	*year 3*
117,385.76	54598.03	581469	**0**	825298	**148,987.33**	69296.43	738007	**0**	989217	*year 4*
124,341.06	57833.05	615922	**0**	863827	**155,942.63**	72531.45	772460	**0**	1027746	*year 5*
129,463.92	60215.77	641298	**0**	892204	**161,065.48**	74914.17	797836	**0**	1056123	*year 6*
127,688.20	59389.86	632502	**0**	882367	**159,289.76**	74088.26	789040	**0**	1046286	*year 7*
129,463.92	60215.77	641298	**0**	892204	**161,065.48**	74914.17	797836	**0**	1056123	*year 8*
127,688.20	59389.86	632502	**0**	882367	**159,289.76**	74088.26	789040	**0**	1046286	*year 9*
129,463.92	60215.77	641298	**0**	892204	**161,065.48**	74914.18	797836	**0**	1056123	*Year 10 et seq. pairs*
127,688.20	59389.86	632502	**0**	882367	**159,289.76**	74088.26	789040	**0**	1046286	*Year 11 et seq. Impares*

Table 12 Consumos energy (kWh) estimated for each type of installation based on what is necessary to produce and CO2 emissions generated

€ Economic value of CO2 emissions t * = 25 + 18 EUR / t "Solar with Natural Gas"	CO2 emissions kg (2.15 kg / Nm3) for "Solar with Natural Gas"	€ Economic value of CO2 emissions t * = 25 + 18 EUR / t "Natural gas"	CO2 emissions kg (2.15 kg / Nm3) for "Natural Gas"	
				year 0
-796.33	**24131.28**	**1,057.05**	**32031.77**	***Year 1***
2,915.70	**88354.50**	**3,958.55**	**119956**	***year 2***
3,338.52	**101,167.29**	**4,381.37**	**132,768.86**	***year 3***
3,873.73	**117,385.76**	**4,916.58**	**148,987.33**	***year 4***
4,103.25	**124,341.06**	**5,146.11**	**155,942.63**	***year 5***
4,272.31	**129,463.92**	**5,315.16**	**161,065.48**	***year 6***
4,213.71	**127,688.20**	**5,256.56**	**159,289.76**	***year 7***
4,272.31	**129,463.92**	**5,315.16**	**161,065.48**	***year 8***
4,213.71	**127,688.20**	**5,256.56**	**159,289.76**	***year 9***
4,272.31	**129,463.92**	**5,315.16**	**161,065.48**	***Year 10 et seq. pairs***
4,213.71	**127,688.20**	**5,256.56**	**159,289.76**	***Year 11 et seq. Impares***

Table 13 Economic value (€) CO2 emissions at the consumption stage (external costs)

They are "Natural Gas" external costs CO2	Discounted cash flow = (3) * (1 + WACC) ^ - (year)	Cash Flow GN = (1) + (2) = (3)	Discounted cash flow = (2) * (1 + WACC) ^ - (year)	Cash Flow GN (2)	CO2 external costs (€) (1)	
799717.1	124867	124867	124867	124867		**0**
	16102.26	17454.85	15127.10	16397.80	1,057.05	**one**
	57507.77	67574.85	54138.90	63616.30	3,958.55	**two**
	55814.78	71094.67	52375.00	66713.30	4,381.37	**3**
	54716.36	75549.98	51155.60	70633.40	4,916.58	**4**
	51752.94	77460.71	48314.80	72314.60	5,146.11	**5**
	48609.92	78867.96	45334.00	73552.80	5,315.16	**6**
	44565.75	78380.16	41577.00	73123.60	5,256.56	**7**
	41368.17	78867.96	38580.30	73552.80	5,315.16	**8**
	37926.49	78380.16	35383.00	73123.60	5,256.56	**9**
	35205.28	78867.96	32832.70	73552.80	5,315.16	**10**
	32276.32	78380.16	30111.70	73123.60	5,256.56	**eleven**

Table 14.1 Total cost (€) for installation "Natural Gas" cash flows to calculate the NPV and NPV taking into account the external costs of CO2 emissions at the consumption stage

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December 2019 Vol.10 No.23 46-71

They are "Natural Gas" external costs CO2	Discounted cash flow = (3) * (1 + WACC) ^ - (year)	Cash Flow GN = (1) + (2) = (3)	Discounted cash flow = (2) * (1 + WACC) ^ - (year)	Cash Flow GN (2)	CO2 external costs (€) (1)	
761,549.20	151,293.00	151293	151293	151293		**0**
	14417.28	15628	13682.60	14832.00	-796.33	**one**
	51289.98	60269	48808.60	57352.90	2,915.70	**two**
	50078.81	63788	47457.80	60449.90	3,338.52	**3**
	49424.88	68244	46619	64370	3,873.73	**4**
	46871.50	70154	44130	66051.20	4,103.25	**5**
	44106.50	71561	41473	67289	4,272.31	**6**
	40411.41	71074	38015	66860	4,213.71	**7**
	37535.87	71562	35294.90	67289.40	4,272.31	**8**
	34391.15	71074	32352.20	66860.20	4,213.71	**9**
	31943.72	71561	30036	67289	4,272.31	**10**
	29267.67	71074	27532.50	66860.20	4,213.71	**eleven**

Table 14.2 Total cost (€) for installation "Solar with Natural Gas" cash flows to calculate the NPV and NPV taking into account the external costs of CO2 emissions at the consumption stage

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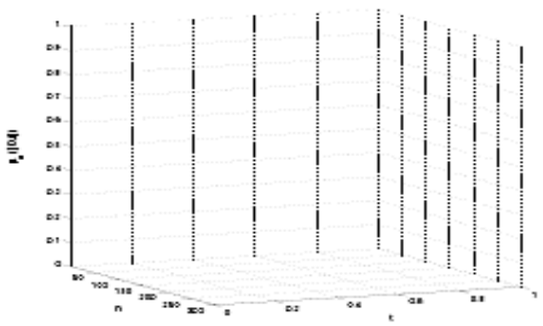

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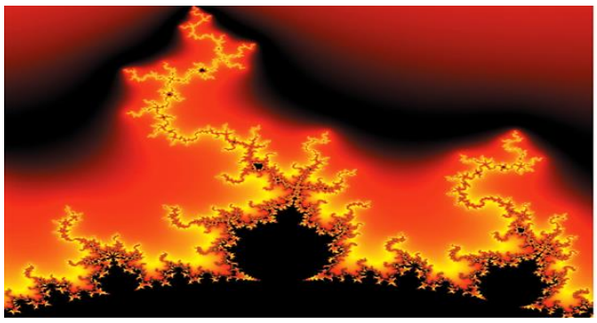

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