



Cognitive evaluation of capital structure: Effect of cognitive factors on the debt ratio in Mexican construction industry

Evaluación cognitiva de la estructura de capital: efecto de los factores cognitivos en la razón de apalancamiento de la industria de la construcción en México

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Abstract

This study analyzes the impact of the construct of the capital structure on the observed debt ratio of an organization, in terms of the new approach of Cognitive Finance (Pérez et al, 2019) within the construction industry in Mexico. Using exploratory factor analysis and structural equation model (SEM), latent variables of capital structure from the responses to an instrument applied to 154 CFOs of construction companies in Mexico. Then a non-parametric correlation test is performed, to measure the impact of each latent variable on the observed debt-to-equity ratio. The study finds that concerns about the political environment, the trust from clients and suppliers, among other variables, have an impact in the decision-making process of construction CFOs related to the debt-to-equity ratio, in addition to those variables established by Traditional Financial Theory. The results suggest that unobservable variables must be considered to gain a deeper understanding of the decision-making process and that an integral vision to consider the study of the motivations that are behind of the observable financial behavior is necessary.

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Keywords: capital structure; cognitive finance; cost of capital; debt ratio; decision-making process; leverage

Resumen

El estudio analiza el impacto del constructo de la estructura de capital en la razón de apalancamiento de un grupo de empresas de la industria de la construcción en México, en términos del nuevo enfoque de Finanzas Cognitivas (Pérez et al, 2019). A través de un análisis factorial exploratorio y un modelo de ecuaciones estructurales (SEM), se obtuvieron las variables latentes del constructo de la estructura de capital por medio de un cuestionario aplicado a 154 directores financieros de empresas constructoras mexicanas. Posteriormente, se elaboró una prueba de correlación no paramétrica para medir el impacto de cada variable latente en la razón deuda-capital observada. Los resultados muestran que la preocupación por el entorno político y la intención de incrementar la confianza de las partes interesadas a través de la limitación del nivel de apalancamiento, tienen un efecto directo en la toma de decisiones que impacta la razón deuda-capital, en adición a las variables establecidas por la Teoría Financiera Tradicional. Esto sugiere que variables no observables de psique ajena deben ser consideradas para profundizar en el entendimiento del proceso de toma de decisiones, lo que demuestra la necesidad de generar una visión holística que considere el estudio de las motivaciones que están detrás del comportamiento financiero observable.

Código JEL: C38, G32, G40, G41

Palabras clave: estructura de capital; finanzas cognitivas; costo de capital; razón deuda capital; proceso de toma de decisiones; apalancamiento

Introduction

In the development of economic theory, many authors have proposed that decision-making process of the economic agents is aimed at maximizing profits and reducing the associated costs (Huang, 2018). The neoclassical stream of economics is based on the efficient market theory (Shiller, 2003), which implies that economic agents consider all possible scenarios and all relevant information, and act on a rational manner when making economic decisions. The traditional economic current, which was prevalent until the second half of the last century, defends rationality as the center of the decision-making process (Soufian et al, 2014). However, this lacks the mediation of different contexts and their consequences on decisions. According to Henrich et al (2001), “Homo Economicus” have limited rationality during investment decision-making since they are unaware of all the circumstances that affect their decisions. Tversky & Kahneman (1974), observed that investors are hostile to the possibility of a series of small losses, but indifferent to the minimal probability of a huge loss. As a result, the concept of ‘Behavioral Finance’ has been formally recognized, and it has determined that some financial phenomena can be better explained using models, where individuals are not totally rational, leading to a conclusion that there is no

“financial logic” observed in their decision-making process. Behavioral finance refers to the influence of psychology on the behavior of financial agents and its effect on the market (López & Lazcano, 2014).

Pérez et al (2019) proposed an approach to complement the economic theory and outline the information about the economic behavior of agents and their judgments, which need not be true or false. The study proposes that the thinking process of economic agents, prior to observable behavior, is relevant in defining the latter, and will be valuable to study such processes. This approach has been named as “Cognitive Finance”. Pérez et al (2019) propose that the cognitive finance approach may help in determining the biases originating in the economic agents’ minds, and their repercussions in decision-making process. This implies that decisions are subject to the individual’s personality and the existing status quo, leading to a quantifiable effect. Pérez et al (2019) explored the first step through application of a questionnaire to CFOs of Mexican companies and showed the existence of a construct with respect to financial decisions involving the capital structure of the company.

In this study, a questionnaire has been used to evaluate the formulation of the capital structure and the factors describing the environmental conditions. The integration of the capital structure construct that leads to study the variables of corporate financial decisions has been explored using factor analysis and structural equation models (SEM). Subsequently, through an analysis of covariations, the resulting construct has been compared with the debt-to-equity ratio of the same sample of companies, which allowed to observe the existence of changes in the estimation of the variables. The variables considered in the analysis affect the financial decisions in determining the competitive advantage in an organization. The independent factors affecting the capital structure are complex to study as they frequently interact with other determinant variables (Kumar et al, 2017).

The research instrument was applied to CFO’s in the construction industry in Mexico. Most of the contracting agreements for this type of company is public, and the current tendency of the government is to achieve a greater participation of the private sector, aimed at maintaining efficient public spending, lower taxes, and the distribution of execution risks and administration of each project. In this context, according to Lombardo & Pérez (2016), the risk elements associated with the construction contract are primarily attributed to political, social, and cultural factors. By exploring this particular industry, the present work not only contributes to the body of knowledge of the financial theory, but also makes an important contribution to a sector crucial for the development of one of the largest developing economies.

Findings of the study are consistent with financial theory. This new technique allowed to observe the consequence of cognitive valuation on the debt-to-equity ratio and, particularly, the effect of variables unrelated to conventional financial calculation as the derivation caused by the cognitive appreciation of the environment. The study finds that the propensity to ponder the political, economic,

and social environment has an adverse effect on the debt-to-equity ratio. Companies, in which the CFO is more aware of the environment, show a lower debt-to-equity ratio.

The present work serves as evidence that when trying to explain the financial reality, knowledge, and perceptions of actors in the financial markets are worth considering. The structure of the paper is as follows: in Section 2 we present a literature review relevant to the topic. In Section 3 the research hypotheses are detailed, and the methodology is described. Section 4 presents the data used and how it was obtained, as well as the results and the discussion about them. Finally, concluding remarks are made in Section 5.

Literature review

The capital structure of a company is the combination of capital and debt that finances the operations. The principal objective of senior managers of a company is to ensure the achievement of the highest possible value for the company, based on their capital structure, which in turn defines the debt-to-equity ratio.

Modigliani & Miller (1958) propose that, without taxes: P_1 , the value of the company and the weighted average cost of capital are independent of the financial structure of the company. P_2 , the expected profitability of the shares of indebted company grows proportionally to its degree of indebtedness. When taxes are considered, Modigliani & Miller (1963) suggested that companies should borrow to take the tax advantage of debt. Assaf (2005) proposes that a company can achieve its optimal capital structure if its level of indebtedness achieves minimum level of its Weighted Average Cost of Capital (WACC). Myers (1984) establishes the need for a balance between tax savings from debt and agency cost, financial distress cost.

Gaytán, & Bonales (2009) indicate that political and economic environments of a country intervene with the explanation of debt contracting decisions in a company, also reflected in the structure of the national financial sector and in the accounting practices of each company. According to Gaytán et al (2014), there are some factors that can determine a firm's capital structure such as total assets, operating profit, capital, and net sales. Firms that succeed in maintaining balanced leverage can control the direction of the deviation from the target market and correct the course reducing the impact of the trade-offs performed during this process (Abdeljawad & Mat Nor, 2017).

Fan et al (2012) explore how institutional environment impacts capital structure and debt maturity choices in companies in 39 countries. They find that the legal system, the tax code, corruption level, and the availability of capital suppliers largely explain the choices on the amount and maturity of debt. In countries with higher corruption levels and weaker laws, there is a higher level of short-term debt.

Frank et al (2020) state that the pecking order theory establishes the order in which companies choose sources of capital based on the difficulty of their availability, being internal funds the first choice and external equity the last one. As a result, it can be observed that there is no general theory that explains how companies select their level of financial leverage and prescribes, when it should be changed, and under what conditions (Zhang, 2013). Which was first stated by Rajan & Zingales (1995), who explore the determinants of capital structure in the G-7 countries and conclude that the theoretical underpinnings for the data observed remain unresolved.

This vast literature is all in the framework of the Efficient Markets Hypothesis (Fama, 1970; Shiller 2003) and the idea that economic agents make rational decisions. However, empirical evidence shows that individuals do not necessarily follow rationality (Kahneman and Tversky, 1972, 1979, 1983). Asch (1956) demonstrated that the environmental pressure can generate biases in perception, affecting person's behavior. Milgram (1973) showed that humans, in general, repress their ethical principles when there is a conflict of their loyalty to another person considered as their superior. Tversky et al (1988) demonstrated that to distinguish between different alternatives in the decision-making process, an individual will select the alternative to which he attributes the greatest subjective value. This assumption is known as "value maximization" in financial theory. De Bondt & Thaler (1985) provide empirical evidence that human prejudices were directly interconnected with financial decision-making. These studies spawned the behavioral finance paradigm, which makes use of economics, sociology and psychology to explain financial decision making.

With respect to capital structure, behavioral finance literature is not vast. Many studies focus on exploring overconfidence of the individuals and its impact on capital structure. Hackbarth (2009) uses a real options framework and finds that overconfident managers tend to take more debt. Chen & Chen (2009) find that in China overconfident managers take more debt, and the maturity of it is shorter. Seo et al (2017) use the generalized method of moments with instrumental variables technique to analyze panel data of the US restaurant industry and find that the overconfidence of the CEO leads to more long-term debt. Marwan & Sedeek (2018) survey 47 managers of Egyptian firms and apply hierarchical regression to find that managerial overconfidence has no significant impact on the capital structure. Heizer & Retting (2020) develop an optimism measure and show that corporate policies are influenced by the CEO's optimism.

On a wider perspective, Michaelas et al (1998) interviews small business owners to identify financial, non-financial, and behavioral factors that impact capital structure decision applying management theory. They find that the need for control, risk propensity, experience, and knowledge impact the decision of capital structure. Sen & Oruc (2009) use panel data analysis to explore behavioral factors in the determination of the leverage level of different sectors in the Istanbul Stock Exchange.

Cronqvist et al (2012) find that enterprises act consistently with the behavior of their CFOs in their personal finance. Kaur & Singh (2020) use a panel regression to show that characteristics of a CFO, such as age and tenure, have impact on the capital structure. Bao & Gong (2017) use prospect theory to explain the capital structure of Real Estate Investment Trusts (REITs) and find that firms with gains behave differently than firms with losses when choosing a target capital structure.

As mentioned, behavioral finance goes one step ahead in decision making, stating that not only the characteristics of assets play a role in the process, but also the behavior of economic agents. Behavior is the observable outcome of a thought process. However, this process is also impacted by what the individuals know, i.e., cognitive factors, which are inherently unobservable and play a role in the thought process. Therefore, it makes sense to ask whether discussed cognitive factors have an implication in financial decision-making process.

The evaluation of behavior as a consequence of cognition can be made from the building of a construct, a set of latent variables that have an impact in observable behavior (Cronbach and Meehl, 1955). Bunge (1973) states that a construct is a non-observational concept, contrasting with observational or empirical concepts that cannot be demonstrated, neither can be directly manipulated, but can be inferred from behaviors. Tolman (1951) said that constructs use intervening variables to address non-observable internal psychological processes that account for behavior. According to Pérez et al (2019), the construct is a non-observational concept made up of dimensions, formed from the influence of observable variables that determine certain interdependence structures that explain the systematic relations among latent variables. This approach has been widely used in other fields, from Psychology and Social Research, to Marketing, Entrepreneurship, and even Medicine. But it is relatively new to the Finance field of knowledge, the academic research found on the topic is, at most, scarce.

We might consider that discussed approach belongs to the field of neuroeconomics, since this field proposes that many systems guide choice from a neuroscience perspective, and that given systems might differ from economically rational choice. Camerer (2013) reviews the state of the art in neuroeconomics and provides evidence in which utility maximization might benefit from behavioral constructs. Yet, according to Konovalov & Krajbich (2019) research in the field remains limited and the approach has not managed to penetrate mainstream economics.

Outside of the field of neuroeconomics, the contributions by the following authors can be discussed. Koshla et al (2006) discusses a very interesting example on how cognitive constructs can model behavior. They show how cognitive constructs and emotional attitudes of a user in a data mining system can impact the interpretation of meaning in hidden patterns, in the context of banking and finance application, sales recruitment, and benchmarking application. Sunderaraman et al (2020) state that little is known about how to assess the integrity of financial awareness. In the study presented by the authors,

they build a construct with the goal of applying a metacognitive framework to financial decision making by healthy adults.

The study by Harris (2000) best approaches the corporate finance decisions and links the results of the use of financial evaluation techniques Net Present Value and Shareholder Value Analysis to strategic factors and the risk profile of projects. The study discusses the logistics industry in Europe, builds a construct that managers may use for assessing risk using a grid technique, and suggests that the framework is transferable to other organizational contexts. Following this suggestion and the statement by Jenkins (1994), that cognitive theory is an alternative theoretical framework for management theory (the author tests the construct of managerial self-efficacy in predicting compliance and finds that self-efficacy is significantly related to compliance). The contribution presented in the study add enormous value both to the financial body of knowledge and to the financial industry. Namely, the contribution is: applying a cognitive framework by validating a construct and showing its relationship with the debt-to-equity ratio, in a sample of construction companies in Mexico.

Recently, Pérez et al (2019) have proposed the term cognitive finance for the approach, that financial behavior can be evaluated from a cognitive construction through latent variables that make up a construct. This construct represents an opportunity for understanding the non-observable internal psychological processes variables that intervene with the valuation of the capital structure and that they are outside the recent field of corporate finance. The current study is based on the contributions of op. cit. authors.

Methodology

Research hypothesis

The traditional financial theory discusses that the analysis of capital structure implies different kinds of accounting techniques such as alternative funds, profit determinants, investment projects in order to induce an appropriate effect on the debt-to-capital ratio aimed at boosting the financial performance. In view of the above discussion, behavioral finance theory aggregates to the discussion on the determination of debt-to-capital ratio, that the behavior of individuals play an important role in it. Furthermore, cognitive finance considers that the mental process of individuals affects the observed debt-to-capital ratio. Hence, this study contributes to these techniques, which are associated with cognitive evaluation through developing a series of hypotheses focused on cognitive finance, which has an effect on the debt-to-capital ratio of the sample size presented in this study. Therefore, a psychometric approach has been adopted that seeks the conformation of the construct of the capital structure for the sample of companies. The construct

is elaborated in two phases: an exploratory phase, and a confirmatory factor analysis. Based on the above discussion, the proposed model has been developed and an exhaustive analysis and adaptation of the scale developed in the work of Pérez et al (2019) has been done, that focuses on the conformation of the capital structure construct used to propose the cognitive dimensions in this study.

The methodology based on cognitive approach used in this study highlights the importance of mental processes (Bietti, 2012) such as perceptions, planning, and interpretation of experiences to emphasize on the decision-making process. Due to the above, the financial agents gain understanding of the analytical process in lieu of the acquired experience and individual's traits leading to a global behavioral pattern. The framework of hypotheses evaluates not only, the cognitive factors such as individual's attitude, but also social phenomenon derived by the socio-political and cultural environment. Hence, the approach discussed above has a direct impact on the debt related decisions of the respondents.

Barclay & Smith (1995) point out that debt decisions are made based on the maturity of the company, investment opportunities, and credit risk. Diamond (1993) shows that companies with favorable information on their profitability are prone to borrowing due to low refinancing costs. Nevertheless, considering that the construction industry tends to have a high rate of indebtedness due to its nature of operation (suppliers and prolonged financial cycle), the proposed hypothesis tends to determine the cognitive criteria for the emission of debt. It also aims at determining the existence of a propensity of the construction industry towards its indebted nature. Therefore, from the point of view of a cognitive appraisal and its perception elements, the following hypothesis is proposed:

H1: The cognitive propensity to leverage has a direct effect on the implementation of debt-to-equity ratio.

Traditional financial theory has shown that capital structure valuation involves the techniques that have an adequate effect on the debt-to-equity ratio with the intention of increasing the profit (Astrachan & Jaskiewicz, 2008). In view of the traditional financial theory, the evaluation of investment projects assumes the disbursement of resources to gain benefits that grant the capacity to observe the variability in expected returns. Generally, the decision to accept high risk projects are associated with emphasis on high profitability. Therefore, in reference to the construction sector, this hypothesis assumes that there exists a direct relationship between the economic evaluation and the debt ratio of the companies considered in this study. In view of the above discussion, the degree of profitability considered by the chief financial officers can be based on a cognitive bias based on experiences, which is associated with the importance assigned to the investment projects in terms of a specific debt level. Considering that these elements or techniques are represented in cognitive assessment, an effect on the debt-to-equity ratio could also be witnessed. Under this new premise, the following hypothesis was proposed:

H2: The cognitive propensity for the value of investment projects has a direct effect on the debt-to-equity ratio.

Gaytán et al (2014) showed that the main factors that determine capital structure in the construction sector are: total assets, operating profit, capital and net sales. This industrial sector is characterized by long periods of payment to suppliers and collection from customers. On the other hand, it is strongly linked to contracting of public works, which depends mainly on demonstrating appropriate financial standing. With regards to the shareholders, the expectation resides in obtaining a return, in the short or long term, depending on the profit or loss of the invested capital. However, the return is subject to the payment of interest for the volume of contracted debt. Therefore, the following hypothesis is framed:

H3: The cognitive propensity to limit the level of leverage has an inverse effect on the debt-to-capital ratio.

According to Muhammad (2015), the key function of Cost of Capital is to ascertain that firm can increase the size of the business and continue operating in a large scale. Eventually, it involves crucial decisions on multiple aspects including managing Long Term Debt, Retained Earnings, Asset Management, and Capital Management. Therefore, the following hypothesis has been framed that considers that the propensity to incorporate these factors in the valuation of the cost of capital entails an effect on the debt-to-equity ratio of the company:

H4: The cognitive propensity to use techniques for capital cost valuation has a direct effect on the debt to capital ratio.

Pérez et al (2019) discuss that the mental processes and the relative information of the environment have an influence on financial decision-making process. The construction sector undertakes different levels of risk arising from the type of its business activity, which is strongly associated with highly fluctuating operations in the country's political, economic, and social environments. Therefore, the experience within their environment and the individual's own personality give a structural understanding and a global meaning to behavior:

H5: The cognitive propensity to value the environment has an inverse effect on the debt to capital ratio.

The quantitative research model explaining dimensions of the study, relevant variables, and hypotheses is exhibited in Figure 1. The research model suggests that the "cognitive" approach is an alternative for the valuation of the capital structure. In order to demonstrate this, the effects of the latent variables of the construct on the debt-to-equity ratio will be sought and the results obtained will be contrasted with the premises of traditional financial theory.

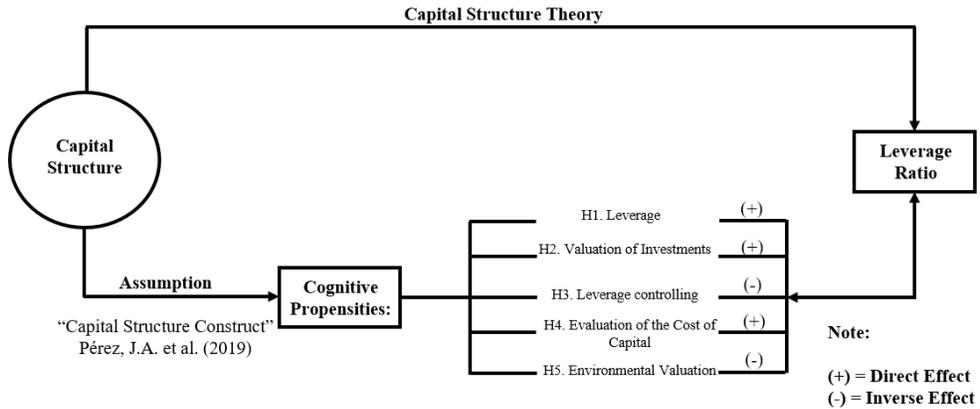


Figure 1. Research Model.
 Source: Author’s own.

Methodology

As a first step, we aimed to confirm the construct of capital structure, by conducting an exploratory factor analysis and then a structural equations analysis. As a second step, we use non-parametric measures of correlation to explore the hypothesis H₁ through H₅. The exploratory factor analysis was conducted to determine the factor loadings of the latent variables comprising the construct. According to Hair (1999), factor analysis allows us to determine which set of variables have important interrelations through a correlation matrix. The aim is to calculate these factors by reducing the excessive information, clarifying the variables, and without excessive loss of information. Hence, it is possible to provide an internal structure or a set of underlying dimensions of a wide set of variables, which allows us to develop a simpler structure to understand the phenomena. Principal components method was chosen because it explores all the variance of each variable and allows data reduction. To facilitate interpretation, the "VARIMAX" rotation method was used since it was sought that each rotated component presented correlations with the least number of variables and these were representative of a reduced number of components. The data reliability test comprising Cronbach Alpha Lambda (Cronbach, 1951) was conducted for the items of each component.

In a second stage, we performed a structural equations analysis to confirm the findings of the factor analysis. According to Hooper et al (2008), the Structural Equations Model (SEM) has become a very important technique for researchers in the social sciences. SEM explains the relationships between multiple variables and examines the structure of the interrelations expressed in a series of multiple regression equations and can be considered a combination of factor analysis and multiple linear regression

models (Schumacker & Lomax, 2010). The result is expressed through a path diagram that shows the relationships between the variables and the research model.

In this study, SEM was performed to confirm the “FIT” index, and to compare the covariances of the relationships proposed in the model with the covariance data matrix. The main objective of the SEM model was to confirm the structure previously found in the exploratory factor analysis, or, to guarantee that the obtained construct is truly representative. The Chi-Square is used to evaluate the general fit of the model. A good fit would be represented by a level of statistical significance <0.05 . The degrees of freedom (CMIN) serves to evaluate the fit of the model, its value should be less than 5.0; and desirably less than 2.0 (Hu & Bentler, 1999; Wheaton et al 1977; Tabachnick & Fidell, 2007). Finally, the RMSEA index indicates how well the model fits the covariance matrix. According to MacCallum et al (1996), values higher than 1.0 indicate a poor fit; less than 0.08 indicates an adequate fit, and less than 0.05 indicates an excellent fit.

Finally, the study uses non-parametric measures of correlation, namely Kendall Tau-b test and Spearman's Correlation Coefficient, to verify the hypotheses proposed in the conceptual framework of this study. The use of these methods is recommended where it cannot be assumed that the data fits a known probability distribution. In this case, the sample obtained is small, 42 data points, thus making the use of non-parametric statistics suitable, according to Gómez-Gómez et al (2003). According to Morales & Rodríguez (2016), the use of Kendall's Tau-b makes sense to determine the degree of linear association between two quantitative variables when they do not follow normal behavior. They indicate that Spearman's Correlation Coefficient is useful when the linear relationship between variables that do not follow normal behavior needs to be determined. One of the attributes of the Kendall coefficient is that it reports lower values with respect to the Spearman coefficient where linear associations are analyzed with the same intensity. The coefficients can be interpreted as follows:

- (\pm) 0.00 to 0.19 Very low correlation
- (\pm) 0.20 to 0.39 Low correlation
- (\pm) 0.40 to 0.59 Moderate correlation
- (\pm) 0.60 to 0.79 Good correlation
- (\pm) 0.80 to 1.00 Very good correlation

Analysis of results and discussion

Data collection

The study is based on the 30-items research instrument designed and implemented by Pérez et al (2019). An exploratory quantitative research approach was followed to understand the cognitive effect of debt ratio of Mexican construction industry on the capital structure. The data was collected during 2019-20 in Mexico. Contextual review of the instrument was carried out to assure the relevance of the questions, through the participation of academic experts and CFOs from the construction industry. Some additional items were added to represent particularities for the valuation of the capital structure in the construction sector. According to Gaytán et al (2014), these particularities can be the assessment of the political and economic environments of the country. A complete section was added within the questionnaire regarding the company's debt-to-equity ratio for 2018. Thus, the research instrument comprises of 30-items across eight sections: demographic information, cost of capital, transaction cost, cash flow adjustments, debt leverage, debt leverage control, valuation of the environment, and debt-to-equity ratio; with an aim to have an analytical outlook and verify the use of debt-to-equity ratio.

A pilot pre-test was carried out with the participation of 9 CFOs with the intention of verifying possible contextual or precision errors. The response from the pilot pre-test was considered to elaborate an exploratory factor analysis and the verification of the internal validity of the instrument. A post-test (second pilot test) was then applied to the same sample of CFOs, replicating the same conditions leading to the final version of the research instrument. Hence, the initial research instrument was adapted based on the characteristics of the current research study, which focused on recollection of information regarding the cognitive assessment of the capital structure for the construction sector in Mexico. The final research instrument was sent to 10 274 CFOs within the construction industry with the support of “Cámara Mexicana de la Industria de la Construcción” (Mexican Chamber of the Construction Industry). 154 respondents responded to the applied research instrument, where it was possible to identify important variables for the cognitive evaluation of the capital structure. Out of these, 42 responses were obtained especially for the debt-to-equity ratio, which was used to implement non-parametric analysis, and which results are presented next.

Exploratory factor analysis

The factor analysis results in a Kaiser-Meyer-Olkin test (KMO) with a value of 0.618 and Bartlett significance value 0.000, which show that the proposed model is valid. The results of the exploratory factor analysis are shown in Table I.

Table 1
 Factor loads for the latent variables

Latent Variable (LV)	Item (observable variables)	Factor Loads
LV ₁ . Propensity to Leverage	We issue short-term debt when short-term interest rates are lower than long-term	0.769
	We issue short-term debt with the intention of minimizing the financial risk	0.76
	We issue debt according to the feasibility for the tax deduction	0.67
	We issue debt in order to have a better credit rating	0.821
	We issue debt in lieu of the political Risk	0.729
	We issue debt based on the company's transaction cost	0.671
LV ₂ . Propensity to Value Capital Cost	Average historical returns	0.625
	Capital cost according to the investors' decisions	0.842
	Capital cost according to the regulatory decisions	0.851
	Implementation of financial Simulations	0.729
LV ₃ . Propensity to Appraise Investment Projects	Frequency of Profitability Index usage	0.778
	Valuation of Financial Assets	0.932
	Valuation of financial assets with calibration per risk factors	0.83
LV ₄ . Propensity to Limit the Level of Leverage	Frequency of Internal Rate of Return (IRR) usage	0.802
	Frequency of Net Present Value (NPV) usage	0.88
	We limit the leverage ratio to increase the trust of our clients	0.901
	We limit the leverage ratio to increase the trust of the suppliers	0.815
	We limit the leverage ratio so that the profits from future-projects can be captured by the shareholders in an efficient manner.	0.897
LV ₅ . Propensity to Assess the Environment	The political ambience intervenes in the financial decision-making	0.865
	The social environment intervenes in the financial decision-making within the company	0.701
	The national economic situation intervenes in the financial decision-making of the company	0.896

Source: Author's own

Table I shows that each observable variable has a different factor load. This helps to understand the weighting of each in the formulation of each latent variable. In this level, the cognitive approach to capital structure begins to demonstrate its usefulness as shown below. The latent variable named as "LV₁. Propensity to leverage" considers the components linked to the techniques and elements associated with

the acquisition of debt and preferences. It can be observed that decision makers are more concerned with the credit rating and less with the feasibility of tax deduction. One of the observable variables assumes the political risk, which also interferes with the debt decision; this type of variables can only be studied in the cognitive approach.

The factor analysis of the variable "LV₂. Propensity to Value Capital Cost" highlights that CFOs are mainly concerned with the capital cost according to the investors' decisions. Simulations of investment projects are commonly used by the CFOs to estimate Return on Investment (RoI). From the cognitive approach, the investment decision is largely subject to the regulatory decisions of the company and its investors, but not to the historical performance.

Analyzing the variable "LV₃. Propensity to Appraise Investment Projects", it can be observed that besides evaluation of the types of financing (cost of capital), CFOs in the construction industry tend to calculate profitability based on risk factors.

"LV₄. Propensity to Limit the Level of Leverage" analyzes the interest in limiting leverage based on different factors indicating that the decision-makers seek to form a trustworthy image of the firm. CFOs increase the operational efficiencies and tend to increase the confidence level of:

- Potential clients, in order to gain new assignments by projecting strong financial results. This is important for the construction industry because the contracting of public projects is subject to the financial health of the company.
- Current suppliers, as it is common in construction industry to operate on the basis of credit disbursements. Hence, the need to demonstrate strong payment capacity.
- Shareholders, as their level of leverage could reduce the distribution of dividends.

Finally, the latent variable "LV₅. Propensity to Assess the Environment" analyzes three elements: political, economic, and social environments that are important in the financial decision-making process. As the companies within the construction industry function based on public contracts, these environments are predominant in the evaluation of their capital structure. It is possible to analyze these variables and their implications in the valuation of capital structure only from the cognitive approach (as opposed to a behavioral or traditional approach).

The Cronbach Alpha Lambda reliability test reveals high reliability of items in each component (aforementioned latent variables), as exhibited in Table II. All results are between "acceptable and excellent".

Table 2
 Verification of reliability

Reliability	
Components	Cronbach Alpha
LV ₁ . Propensity to leverage	0.948
LV ₂ . Propensity to Value Capital Cost	0.659
LV ₃ . Propensity to Appraise Investment Projects	0.76
LV ₄ . Propensity to Limit the Level of Leverage	0.965
LV ₅ . Propensity to Assess the Environment	0.917

Source: Author's own

Structural equation modelling

As detailed in the Methodology section, we made a SEM model to confirm the structure previously found in the exploratory factor analysis, and, to guarantee that the obtained construct is representative. Based on the indices described in the methodology, the following structural model was evaluated, which groups the variables obtained in the previous section:

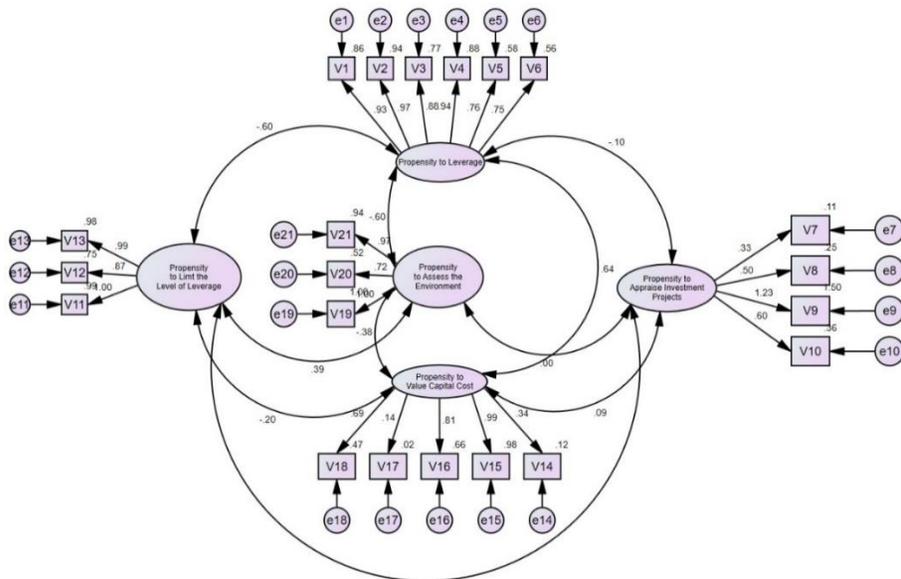


Figure 2. SEM Model.
 Source: Author's own.

The results obtained for the SEM in Figure 2 are: Chi-Square: 426 151; degrees of freedom:173; significance level: 0.000; CMIN = 2 381, RMSEA = 0.077.

With these results, we conclude that the SEM model firmly represents the causal relationships that predicts the behavior of a system, i.e. the population of CFOs. This confirmation permitted the conformation of the analysis shown below and appreciated the effect of the construct obtained on the debt-to-equity ratio. Hence, the obtained results confirm the construct.

Analysis of covariation with the debt-to-equity ratio

Based on the premises detailed in the methodology, covariations between the variables obtained from the construct and the debt-to-equity ratio of the same sample of companies were analyzed. The results by hypotheses are shown in Table III.

Table 3
 Results of Hypotheses testing

Hypotheses	Variable	Tau_B Kendall		Spearman	
		Coefficient	P value	Coefficient	P value
H1. The cognitive propensity to leverage has a direct effect on the implementation of debt-to-equity ratio.	H1: LATENT	0.862	0.000	0.964	0.000
	We issue short-term debt when short-term interest rates are lower than long-term	0.842	0.000	0.921	0.000
	We issue short-term debt with the intention of minimizing the financial risk	0.871	0.000	0.920	0.000
	We issue debt according to the feasibility for the tax deduction	0.685	0.000	0.869	0.000
	We issue debt in order to have a better credit rating	0.754	0.000	0.905	0.000
	We issue debt in lieu of the political risk	0.549	0.000	0.707	0.000
	We issue debt based on the company's transaction cost	0.483	0.000	0.637	0.000
H2. The cognitive propensity to value investment projects has a direct effect on the debt to capital ratio	H2: LATENT	0.019	0.862	0.053	0.739
	Valuation of Financial Assets	0.133	0.231	0.216	0.169
	Valuation of financial assets with calibration per risk factors	0.126	0.253	0.186	0.237
	Frequency of Internal Rate of Return (IRR) usage	-0.037	0.742	-0.047	0.767
	Frequency of Net Present Value (NPV) usage	-0.054	0.633	-0.070	0.657

	H3: LATENT	-0.379	0.000	-0.525	0.000
H3. The cognitive propensity to limit the level of leverage has an inverse effect on the debt-to-capital ratio	We limit the leverage ratio to increase the trust of our clients	-0.446	0.000	-0.593	0.000
	We limit the leverage ratio to increase the trust of the suppliers	-0.315	0.004	-0.449	0.003
	We limit the leverage ratio so that the profits from future-projects can be captured by the shareholders in an efficient manner.	-0.380	0.001	-0.516	0.000
		H4: LATENT	0.443	0.000	0.642
H4. The cognitive propensity to use techniques for capital cost valuation has a direct effect on the debt to capital ratio	Average historical returns	0.072	0.513	0.136	0.390
	Capital cost according to the investors' decisions	0.473	0.000	0.680	0.000
	Capital cost according to the regulatory decisions	0.275	0.130	0.414	0.006
	Implementation of financial simulations	0.314	0.004	0.427	0.005
	Frequency of Profitability Index usage	0.288	0.008	0.439	0.004
	H5: LATENT	-0.339	0.002	-0.480	0.001
H5. The cognitive propensity to value the environment has an inverse effect on the debt to capital ratio	The political ambience intervenes in the financial decision-making	-0.411	0.000	-0.560	0.000
	The social environment intervenes in the financial decision-making within the company	-0.237	0.030	-0.375	0.014
	The national economic situation intervenes in the financial decision-making of the company	-0.387	0.000	-0.554	0.000

Source: Author's own

The results shown in the Table III highlight the covariation and p-values coefficients obtained by analyzing every latent variables of the construct. The same analysis is shown for each of the observable variables that make up the said latent variable, with the intention of verifying the statistical significance and the level of covariance in each case.

In case of “H1: The cognitive propensity to leverage has a direct effect on the implementation of debt-to-equity ratio”, the results of the latent variable support H₁, and it can be assumed that the propensity to leverage has a very good effect on the debt-to-capital ratio. Financial theory is confirmed, the greater the propensity to leverage, the greater the direct effect on the debt-to-equity ratio. The results also show the covariance level of the observable variables. In this case, the higher covariation is for the variable “We issue short-term debt with the intention of minimizing the financial risk” and the lowest is for the observable variable “We issue debt based on the company's transaction cost”. However, the item

related to debt issuance based on political risk is located at moderate correlation levels. The cognitive approach is showing the preferences in the debt decision process.

For “H₂: The cognitive propensity to value investment projects has a direct effect on the debt to capital ratio”, no coefficient reaches an adequate level of significance (<0.05). Therefore, the hypothesis H₂ can be rejected. Since in the valuation of investment projects, an outlay of resources such as liquid assets, is contemplated to obtain future benefits or return, the hypothesis initially assumed that there could be covariation with the debt-to-equity ratio at a cognitive level. However, in classical financial theory, the decisions of investment and capital structure are independent, and therefore the result is consistent with the previously discussed theory. The results observed in the covariance level of the observable variables are also shown, they did not reach desirable levels of significance.

For “H₃: The cognitive propensity to limit the level of leverage has an inverse effect on the debt-to-capital ratio”, these variables are notoriously foreign to traditional financial valuation. From the data, the hypothesis H₃ is accepted, and it is assumed that the propensity to limit the level of leverage does have an inverse effect on the debt-to-equity ratio. From a cognitive perspective, the CFOs limit leverage with the intention of granting greater confidence and a better image to clients, suppliers and shareholders. However, for CFOs, it is more important to limit leverage to offer confidence to their clients, than to capture profits from their shareholders and finally to promote a good image with their suppliers, in that order. From the point of view of financial theory, which assumes that the CFO and the shareholder have a principal-agent relationship, this shows the existence of the agency problem. From the point of view of the construction industry, the operation of the sector is strongly linked to the contracting of public works, and it is important to maintain a good image before the client -government. The company needs to justify its financial health as required by the law for contracting one of these works. In turn, the main creditors in the sector are suppliers, and supplies are typically purchased on credit.

For hypothesis “H₄: The cognitive propensity to use techniques for capital cost valuation has a direct effect on the debt to capital ratio”, the hypothesis is accepted. From the cognitive approach, the values obtained are consistent with classical financial theory, where different types of financing like issuance of shares or debt are assumed during the valuation of the required return on the cost of capital. Therefore, a direct effect of adjusting to the debt levels assuming a higher profitability for the company and a lower financial risk was considered. In the case of observable variables, one can observe that the CFOs are mainly concerned with the decisions of the investors and the variable that had the lowest correlation was the one corresponding to the review criterion of average historical returns. This means that the decisions of the investors are more important than the historical return, for the sample of CFOs studied.

Finally, for “H₅: The cognitive propensity to value the environment has an inverse effect on the debt to capital ratio”, the latent variable "propensity to value the environment" had an inverse effect on the debt-to-equity ratio. In view of the analysis of results, the hypothesis H₅ has been accepted. It is assumed that the propensity to value the environment has an inverse effect on the debt-to-equity ratio. From a cognitive perspective, it is observed that CFOs in the construction industry limit leverage based on the perception of the environment. These types of variables are also foreign to the traditional financial calculation and, therefore, provide greater indicators for the valuation of the level of debt due to factors not previously considered in the estimate. The variables of the study indicate that the social environment could have the least correlation with the valuation of the debt, whereas the political environment has the greatest effect associated with the contracting of public works.

In view of the above analysis of the results, it can be empirically confirmed that cognitive analysis performed in this study aggregates value to the theory of capital structure (Modigliani & Miller, 1963). The study permits to incorporate seemingly unknown variables during the traditional evaluation and measures the effect of the debt-to-equity ratio. By this means, the study obtained significant information about the financial behavior of the industrial agents and their perceptions, such as biases in the decision-making process, allowing to add, evaluate, and measure the effect in the non-observable internal psychological processes in relation to the individual's personality and the environment. This contrasts the behavioral finance theory, which prioritizes the observable behavior and its effects on the financial metrics. Thus, the aforementioned latent variables in each hypothesis, highlighted deviations in terms of the decision-making process of the senior financial executives in order to determine the appropriate combined financial actions to fund the investments. In view of the previous results, it can be emphasized that the construction sector is susceptible to the external conditions, such as political ambience, which strongly affects the debt-to-equity decisions.

Finally, it's important to mention that the present research contributes to the corporate finance knowledge bank, particularly, towards the paradigm that makes use of the human behavior (Thaler, R.H., 2015), arguing mainly on the financial decisions process. Furthermore, the results obtained from the analysis of the hypotheses emphasizes on the cognitive approach (Pérez J.A., et al, 2019) and enhances the behavioral focus. Hence, the new paradigm poses significant benefits through the sophistication of the economic models, which currently allows the evaluation of strange elements that are located in the non-observable internal psychological processes of the respondents.

Conclusions

In behavioral finance, variables of the non-observable internal psychological processes are relegated to a second term because their focus is to analyze observable behavior; and this does not distinguish nor measures the level of affectation of social and personal prejudices.

The main contribution of the cognitive approach is that, besides behavioral approach, it is possible to obtain a deeper understanding of the circumstances that interact in decision-making by allowing the addition and evaluation of the elements of the construct. These elements that involve underlying cognitions related to the personality of the individual from internal and external factors, and not exclusively in the observable behavior, which only prioritizes the objectivity over the subjectivity. For behavior-based finance, this is important because it is proposed that observable behavior can be predicted by affective, not just rational or contextual, reactions of decision makers.

The present work adds to the conjecture of cognitive finance and evidence that it is feasible to assess elements, which are previously unidentified in the field of corporate finance. This was achieved using item response theory, which allowed a cognitive financial assessment, and provided an additional tool for the search for the optimal capital structure, considering that the subjective views of CFOs have a relevant effect on the corporate decisions. The results allow this new approach to be compared with classical financial theory and behavioral financial theory. And it can be argued that it adds a new dimension to the field: unobservable latent variables that come from cognitive emotional biases have an impact in what we ultimately observe. Compared to the behavioral approach, the cognitive approach allows the obtention of a deeper understanding of the circumstances that interact in decision-making process.

In this stance, we apply the methodology to the construction industry in Mexico. The empirical results obtained show that there is clearly a measurable outcome between the elements of the capital structure construct and the debt-to-equity ratio. That is, the construct of the capital structure (Pérez J.A. et al 2019) does not only exist, but also helps explain the propensity towards the use of debt or equity.

Therefore, some of the variables specific to the construction industry, such as the different positions that CFOs assume according to internal and external factors, have been verified. Results of this study show that the CFO bears in mind external factors such as the political environment, the social environment, and the economic environment when deciding on the ratio of debt relative to equity. Specifically taking into account the results of this study, a riskier environment leads to less debt.

Interestingly, we find that CFOs in the sector tend to be concerned with the perception and trust by clients and suppliers when making decisions about the amount of debt the company should have. This is in contrast with the traditional finance point of view, where it assumed that management of the company

and investors have a principal-agent relationship, and the management of the company must always act on the best interest of the investor. This result might not be strange to those familiar with the construction industry, because one might think that public agencies, as the main customers and consumers in the construction sector, exert a great influence on the direction of the industry. This study hence demonstrates that this intuition is in fact correct, the customer impression of the company is indeed a concern that ends impacting the decisions that are taken within the company.

Traditional financial theory states that decisions of capital structure and investment decisions are independent. The results confirm this from the cognitive point of view, since this study does not find that the debt-to-equity ratio is impacted by the perception of propensity to appraise investment projects. Based on these results, it can be said that, for the construction industry in Mexico, it is not only feasible, but also valuable, to analyze and measure the derivations of the CFO's personality to decipher their financial behavior, which ultimately impact observed metrics.

Firms focused on behavior-based finance will be benefited as the observable behavior as a consequence of the construct can be predicted by affective, not just rational or contextual, reactions of decision makers. Investors and portfolio managers can be benefited from the new cognitive paradigm and the results of this study, since they will have more tools to analyze companies and make investment decisions. With the new set of tools proposed by cognitive finance, the investor has a way to assess the priorities of the CFOs, that precede behavior, and to take a more informed investment action.

This study can have an impact on the academic community, and the construction industry, where some variables that were long considered to affect decision making, yet were not previously analyzed empirically, have been confirmed through this research. From the findings of this work, it can be determined that the cognitive finance approach allows improvements for the valuation of the optimal capital structure. In this case, it has been possible to identify the derivations of the environment, however, other variables could be identified, that affects financial decisions of various natures. Furthermore, the present study suggests that there are other variables elusive to this study that can have important derivations in the current and other sectors. Particularly personal prejudices that are not measurable by previous financial paradigms, have an influence on financial decision-making. Moreover, other financial decisions within the framework of corporate finance can be analyzed under this scope, not only the capital structure decision.

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