CEO EMOTIONAL BIAS AND INVESTMENT DECISION BAYESIAN NETWORK METHOD

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Abstract

This research examines the determinants of firms' investment introducing a behavioral perspective that has received little attention in corporate finance literature. The following central hypothesis emerges from a set of recently developed theories: Investment decisions are influenced not only by their fundamentals but also depend on different factors. One factor is the biasness of any CEO to their investment, biasness depends on the cognition and emotions, because some leaders use them as heuristic for the investment decision instead of fundamentals. Keeping this in view, this paper shows how CEO emotional bias (optimism, loss aversion and overconfidence) effects the investment decisions. I will use Bayesian Network Method to examine this relation. Emotional bias has been measured by means of a questionnaire comprising several items. As for the selected sample, it has been composed of some100 Tunisian executives. Our results have revealed that the behavioral analysis of investment decision impliesleader affected by behavioral biases (optimism, loss aversion, and overconfidence) adjusts its investment choices based on their ability to assess alternatives (optimism and overconfidence) and risk perception (loss aversion) to create of shareholder value and ensure its place at the head of the management team.

Keywords: Emotional Bias, Corporate Finance, Optimism, Overconfidence, Loss Aversion, Capital Investment Decision, Bayesian Network

JEL Classification: D2, G3, L2, L5, M1

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1. Introduction

The literature in behavioural economics and behavioural finance departs from thetraditional economic model to incorporate psychological evidence on non-standardpreferences and beliefs, such as loss aversion, optimism, or overconfidence.While much of the evidence on such deviations is hard to dispute, it is less clearwhether leaders need to account for them.Thebehavioral finance literature that examines the consequences of behavioral biases of managershas primarily focused on managerial optimism and overconfidence; traits that have been shownto be prevalent in managers.

The studies of the irrational act for managers in financial decision making contain distortion of corporate investment and corporate financing(Hawkins and al, 2001 ;Ho and Chang, 2009 ; Backer and al, 2004 ; Malmendierand al, 2010 ; Hackbarth, 2009 ;…). As for the investment decisions specifically, Heaton (2002) shows that the existenceof managerial optimism may result in a distorted investment policy, in forms of eitherunderinvestment or overinvestment, without

invoking the traditional theories of agencyand information asymmetry.

Consistentwith such predictions, empirical studieshave found that personal characteristics of managers, particularly the behavior of overconfidencemay lead todistortions in corporate investment decision and that optimistic managers show significantly higherinvestment sensitivity to free cash flow, particularly for equity-dependent firms (Malmendier and Tate, 2005),or for more financing constrained firms (Lin and al., 2005). Recent studies also document that overconfidentmanagers show preferences for internal finance over debt and for debt over equity (Malmendierand al, 2007).

All of the above mentioned approaches hold in common one important point, namely, the implicit assumption that financial market participants as well as company managers always act rationally. However, an extensive and growing literature on human psychology and behavior shows that most people, including investors and managers, are subject to important limits in their cognitive processes and tend to develop behavioral biases that can significantly influence their decisions.Indeed, individual reasons are cognitive shortcuts that influence the

position, making irrational and non-optimal in terms of traditional financial theories. These biases have been identified and classified and grouped as follows: The means of representation, reasoning analog bias of conservatism and confirmation, but also emotions such as loss aversion, optimism and the overconfidence.

This study examines the possible influence of three closely related emotional biases that are extensively documented in behavioral research, loss aversion, optimism and overconfidence, on a firm's investment decisions. Recent theoretical Behavioral Corporate Finance literature suggests that these biases can substantially influence the investment and financing decisions made by business managers. In fact, one strong prediction emerges from this body of theories: optimistic and/or overconfident (or, for short, "biased") managers will choose higher leverage ratios for their firms than they would if they were "rational" (or not biased). Therefore, these biases could rank among the determinants of investment decision. This study offers one of the first empirical tests of this hypothesis and, at the same time, presents new evidence about the factors that better explain observedunderinvestment or overinvestment, using a sample of Tunisian companies.

The article is structured as follows: Section 2 presents the related literature and the theories which motivate the empirical work and Section 3 discusses the empirical strategies that were adopted. Section 4 discusses the main results and Section 5 presents the concluding remarks.

2. Hypothesis Development

The implications of managerial characteristics for corporate decisions have only recently begun to be explored by Behavioral Finance researchers. Some studies address the issue from the perspective of rational managers interacting with overconfident outside investors. Only recently has a smaller number of analyses emerged focusing the cognitive biases (optimism, overconfidence and loss aversion) of the managers themselves and trying to understand how they can affect their investment and financing decisions.Recently, Felton and al (2003), Gibson and Sanbonmatsu (2004) justify risky investment decisions by the leaders optimism level likely to seek information and their desire to solve a given problem without considering the success of previous projects.Schrand and Zechman (2009) show thatoverconfident managers make optimistic forecasts and in order to meet these forecasts, exhibithigher levels of fraud and earnings management. Ben-David and al (2007) useshow that personal overconfidence causes managers tomiscalibrate their expectations of future returns.In an influential series of studiesMalmendier and Tate (2005, 2008) and Malmendier and al (2007, 2010) formalizethe notion of overconfidence and provide empirical evidence of

the effects of CEOoverconfidence on capital investment and capital structure preferences.

We investigate the influence of managerial bias (loss aversion, optimism and overconfidence) about corporate investment choice.

2.1. Optimism and investment decision

The role of managerial optimism in a firm's investment and financing decisions has been a subject of an ongoing debate in the corporate finance literature. Following Roll (1986) pioneering study on the role of managerial overoptimism in corporate acquisitions, the merits of managers' possible departure from full rationality, and behavioral corporate finance in general, have been examined in a number of theoretical and empirical studies.

Heaton (2002) focuses on optimism in a corporate setting. In particular, he discusses lucidly why the arbitrage andthe learning objection areweaker in corporate settings. Biased managers in his two-date model perceive risky corporate securitiesto be undervalued by the market, may reject positive net present value project if (seemingly costly) external funds are needed tofinance them, and may invest in negative net present value projects because of biased cash flow forecasts.Indeed, this optimistic leader tend to overestimate the value of their project, they are reluctant to increase their capital by considering that the market systematically evaluates the value of securities.Baker and al (2007) show that optimistic CEOs over invest and tend to choose higher leverage. Optimist CEO overestimates this firm growth opportunities and seeks to achieve even with the use of external financing methods.Ben-David and al (2006) calculate optimism and overconfidence measures. They find that firms with optimistic leaders invest more.Strengthening a leader involvement sense encourages optimism on the investment.

Wang (2006) finds that misreporting firms are more likely to over-invest in specific investment and stock-financed mergers and acquisitions.Hackbarth (2009) argue that optimistic managers have ahigher probability to excel in tournaments and thus may get promoted to top executive positionsmore often, though all managers choose riskier investments (specific investment and long term) when faced by internal competition forleadership.This optimistic leader opts for specific investments such as investment in research and development in order to increase the competitiveness of its business and ensure the firm value creation. Gervais and Odean (2001), Baisand al (2005), Chuang and al (2009), show the existence of a positive relationship between overconfidence (and / or optimism) and uncertainty. This uncertainty regarding the adequacy of available information affects decision making. This reflects the negative relationship between managerial optimism and riskier investment level.

H1: *Optimistic leader over-invested in specific investment projects.*

2.2. Loss aversion and investment decision

A nascent literature recognizes that the bias of loss aversion is a significant determinant of manager financing decisions. Psychological studies document that loss aversion causes people to overestimate risk, be more uncertain about forecasts and opt for making it safer to limit the likelihood of his removal.

Baker and al (2007) in their excellent review of the growing literature on behavioral corporate finance, several managerial behavioral biases have been shown to affect corporate decisions. Bertrand and Mullainathan (2003), argue that leaders can be encouraged not to invest so as not to be challenged in their "quiet life". This kind ofconservatism is a way to counteract the risk of loss of control (Barberis and Thaler, 2002). Thus, the loss aversion of the manager due to a hostile takeover bid (hostile takeover) forces him to not invest in projects with positive returns if financed by issuing shares.

Mairesse and Mohnem (2005)show that investment in research and development plays a key strategic role for any innovative company. Due to the high costs and risks inherent in specific investment, the leader is forced to consider the capacity to effectively implement.This reflects the negative relationship between managerial loss aversion level andfirms investment specific level. One explanation is that the individual, by nature, seeks to maximize and improve well-being constantly (Helliar et al, 2005; Albouy et Schatt, 2010 ;Nosic et Weber, 2008). It is particularly annoying to see its financial assets to deteriorate in each period. Individuals working in the financial world have already met most of its needs and tend to self-esteem that wishes to satisfy (Maslow, 1989). So any leader could be threatened by the loss of social status seeks to enhance its work at the head of his company through low firm investment specific level to reduce frim risk (or his loss aversion).

H2: *Loss aversion leader under-invested in specific investment projects.*

2.3. Overconfidence and investment decision

Recent studies have documented the presence of managerial overconfidence and the effects it has on corporate policies.Baker and al (2004) survey the extant research and point out that over-confidence affects many aspects of corporate financing including both investment and financing policies. Ben-David and al (2007) ;Sautner and Weber (2009) use survey evidence to show that the overconfidence of top executives affects various corporate decisions, including the investment policy of the firm. An overconfident CEO persistently feels undervalued by the capital market and is thus reluctant to issue risky securities to finance his projects (Heaton,2002). The perceived undervaluation induces CEOs to abstain from projects (and underinvested) when they cannot be financed without tapping the resources of (unbiased) outsiders (Malmendier and Tate ,2005,2008).Gervais and al (2010), stressed that the executive overconfidence overestimate its powers to reduce the risk of his business. It tends therefore to invest more than a rational manager. Ho and Chang (2009) postulate the presence of a positive relationship between the company financial distress and CEO overconfidence level. Thus, overconfidence leads the manager to underestimate the company bankruptcy probability and, therefore, a higher debt.It seeks to exploit the growth opportunuités of its firm.This reflects the positive relationship between managerial over confidence and firmover- investment level.

Goel and Thakor (2000) argue that overconfident managers have a higher probability to excel in tournaments and thus may get promoted to top executive positions more often, though all managers choose riskier investments when faced by internal competition for leadership. Schrand and Zechman (2010) emphasize that overconfidence is positively associated with the overestimation of the probability of success and the presence of biased financial decisions. The leader overconfidence that overestimates his personal skills tends to choose financial decisions inconsistent with the firm characteristics. It underestimates the risk of bankruptcy of his company and believes the control. These beliefs led him to increase the specific investment level of the business. Simon and Houghton (2003) suggest that overconfident managers are more likely to pursue risky behavior.This reflects the negative relationship between managerial overconfidence and riskier investment level (specific investment).Graham and al (2009) suggest that overconfident managers are better innovators.

H1: *overconfidence leader over-invested in specific investment projects.*

3. Research method

3.1. Data

Our empirical study is based on quantitative research. we use a questionnaire as a method of data collection. Our questionnaire consists of four main parts, based ontreated areas in theory:

- The first part aims to identify the company (size, industry, ownership structure, debt levels, level of dividend distribution, ...).
- The second part focuses on presenting the level of loss aversion leaders.
- Party three deals with the level of optimism of the leader.
- Finally, party four seeks to show the level of overconfidence of managers.

The questionnaire is addressed to CEO of Tunisian companies. The selected sample consists of 100 managers of industrial and commercial companies listed on the tunisian stock exchange in 2010 (28 companies) and rnon-listed companies (82 companies).

Our choice of listed companies is justified by the fact that they are supposed to the most efficient and meet several conditions necessary for the reliability of our studywere limited companies which are usually diffuse shareholders, increasing the importance of role of the board and ownership structure and consequently increase the validity of the assumptions.

We decided to exclude financial firms: banks, insurance companies and investment companies for development and portfolio management ... in fact these companieshave different characteristics of non-financial businesses and to avoid correlation effects specific to a specific sector.

To get a representative sample of our Tunisian market we have added other unlisted companies.

Table 1. Visited Companies

Initial BVMT sample for 2007	50
financialfirms	(22)
Other non financial firms	120
Insufficient data to emotionnel intelligence	(40)
Insufficient data to board of directors compositions	(8)
Final sample	100

3.2. Variables' measurement

The objective of this section is to determine the variables' measurement.

3.2.1. Firms' investment decision

The purpose of this article is to show the impact of emotions on the firms' investment decision (investment nature, level and horizon).The appropriate measures in the literature to evaluate investment decision are:

3.2.1.1. Assets specificity

In our study we will use the degree of assets intangibility as a proxy of the specific investments. The degree of assets intangibility can be appreciated on many levels. The France Bank and Ministry of Industry in studies devoted to the development of intangible investments in France have usedthe ratio often intangible / tangible assets. In Tunisia, as in France, the intangible asset accounting record comes from the capitalization of such expenses. However, the unavailability of information legitimizes the use of the amount of intangible assetsis presented in the balance sheet although this amount is usually surrounded by doubtas the result of discretionary choices performed by the leaders. Akin to the French context, the measurement of intangible capital in the

Tunisian context has the sameproblems, which leads us to adopt accounting.

Based on that discussion and the availability of data of Tunisian companies we offer the following indicator of the degree of activation of intangible expenses:

Asset Specificity Rate (ASR) = intangible assets / asset accounting.

This measured is used by Cazavan-Jeny (2004), Moussu and Thibierge (1997), Thibierge (2001)…

3.2.1.2. Investment level

In this study we will use the presence of free cash flow and growth opportunities astwo indicators ofover-investment (low Future investment opportunitiesand free cash flow) orunderinvestment (low free cash flow and Future investment opportunities). The literature differs on how to measure the free cash flow as conceptualized byJensen (1986). In general, however,it is defined as operating income beforedepreciationinterest expense and taxes,as well as dividends paid (Lehn andPoulsen, 1989; Gul and Tsui, 1998; Jaggi and Gul, 1999) divided by book value of total assets to account for effects related to size (Lang and al, 1991).

Free Cash Flow Rate (FCFR) = Operating profit / total assets.

Future investment opportunitiesare measured by Tobin's Q (Skinner, 1993). Tobin's Q is defined as the ratio of market value of a firm to the replacement value of its assets (Lindenberg et Ross, 1981; Griliches, 1981; Cockburn et Griliches, 1988; Megna et Klock, 1993; Skinner, 1993). A Tobin's Q greater than one then the company has signed a profitable investment opportunities and vice versa. In our study, we will retain an approximation of Tobin's Q, calculated as follows(Chung and Pruitt, 1994):

$$Q_{it} \cong \frac{MVS_{it} + D_{it}}{A_{it}}$$

MVS – market value of common and preferred shares; D – book value of debt, defined as current liabilities plus long-term debt plus inventories minus current assets; A – total assets.

3.2.1.3. Investment horizon

Referring to the theory of agency leaders has an obligation of result on short horizons. Their wealth is tied to the performance of the firm during the duration of their mission is the period during which they run the firm. These leaders prefer investment projects in the short term to quickly reveal the performance of these investments and reduce uncertainty about their own value on the labor market (Narayanan, 1985). In our study we will use the rate of investment operations (industrial and commercial assets) as an indicator of the investment horizon.

Capital Expenditure Rate (CER) = operating assets / Total assets

This measured is used byCliche (2000),Gervaisand al (2002), Malmendier and Tate (2005), Chang and al (2009), Drairef (2010)…

The investment decision takes 9 follows:
- 1 if the manager chooses investment specific: positive variation in the rate of assets specificity.
- 2 if the manager chooses overinvestment:low future investment opportunitiesand free cash flow
- 3 if the manager chooses underinvestment:low free cash flow and future investment opportunities.
- 4 if the manager chooses long-term investment: negative variation in the rate of capital expenditure
- 5 if the manager chooses short-term investments: positive variation in the rate of capital expenditure.
- 6 if the manager chooses (overinvestment+long-term investment): negative variation in the rate of capital expenditure, low future investment opportunitiesand free cash flow.
- 7 if the manager chooses (underinvestment +short-term investments): positive variation in

the rate of capital expenditure, low free cash flow and future investment opportunities.
- 8 if the manager chooses (specific investment+overinvestment +long-term investment): positive variation in the rate of assets specificity, negative variation in the rate of capital expenditure, low future investment opportunitiesand free cash flow.
- 9 if the manager chooses specific investment+underinvestment +long-term investment): positive variation in the rate of assets specificity, low free cash flow, future investment opportunities andnegative variation in the rate of capital expenditure.

3.2.2. Emotional bias

The questionnaire focuses on evaluating and scoring of the three emotional biases (risk aversion, optimism and overconfidence). The questions have been inspired from the questionnaires formulated by the Fern Hill and Industrial Alliance companies.

The emotional bias takes 2 follows:
- 1 if the individual has a high level for each bias
- 0 if not

3.2.3. Capital structure choice

The appropriate measures in the literature to evaluate three methods of financing are:

3.2.3.1. Internally generated resources (The Cash Flow)

Research within the framework of financial theory of investment, have resorted tomany measures of internal resources. Cash flow represents the flow generated by the activity of any business, is one of the most appropriate (Lehen and Poulsen, 1989;Molay, 2006; Naoui and al, 2008; ...).

CF = Net income + Depreciation – Dividend

Casch Flow rate (RCF) = CF / Total Assets

To show that the leader chosen or not internally generated ressources, we can use the change in flow rate. A negative change indicates the use of internal resources.

Cash flow rate variation = RCF_N- RCF_{N-1} / RCF_{N-1}

3.2.3.2. Debt level

We observe a variety of variables that measure the level of debt in the company.Measures such as total debt service ratio has been selected by several authors (Hovakimian and al, 2004). Others have used the debt ratio in the medium and long term (Myers, 2001). The

debt ratio in the short term was also used by Titman (1984).

As part of our analysis we propose to use the debt ratio as a measure of this variable. It should be noted that this ratio is calculated by:

Leverage ratios (LEV)=(total debt / total assets)

This measure is also used by Koh (2003),Demaria and Dufour (2007), Jarboui and Olivero (2008), Ben Kraiem (2008) and Sahut and Gharbi (2008).

To show that the manager uses debt or not, we can use the change in debt ratio. A positive change indicates the use of debt.

$$\text{Leverage ratios variation} = LEV_N - LEV_{N-1} / LEV_{N-1}$$

3.2.3.3. Equity level

This variable is measured by the value of equity in the balance sheet of the company.To show that the leader chosen or not the capital increase, we can use the variationin the percentage of investment. A positive change indicates an increase of capital.

Level of Capital Invested (LCI)= equity / total assets

$$\text{Level of Capital Invested Variation} = LCI_N - LCI_{N-1} / LCI_{N-1}$$

The financial decision takes 7 follows:

- 1 if the manager chooses the internally generated resources: positive variation in the cash flow rate.
- 2 if the manager chooses debt: positive variation in the leverage ratio.
- 3 if the manager chooses the capital increase: positive variation in the level of invested capital.
- 4 if the manager chooses internally generated resources + debt : positive variation in the cash flow rate and debt ratios.
- 5 if the manager choosesinternally generated resources + capital increase:positive variation in the cash flow rate and level of capita invested.
- 6 if the manager chooses debt + capital increase: positive variation in the leverage ratio and level of invested capital.
- 7 if the manager chooses internally generated resources + debt+ capital increase: positive variation in the cash flow rate, leverage ratio and level of invested capital.

3.2.4. Control variables

Static trade-off theory (STT) and pecking order theory (POT) is the body of theory of reference that addressed the issue of the financial structure of

the firm.The factors that explain the financial structure are mainly at the cost, size, level of risk,growth opportunities, the structure of assets and business (Rajin and Zingales, 1995;Booth and al, 2001; Molay and Dufour, 2010).

We include in our model three control variables that explain the effectiveness ofchoice of financial structure of the company. These variables are proxies forprofitability, firm size and growth opportunities.

We include in our study three control variables that explain company capital structure choice . These variables are proxies for profitability, firm size and growth opportunities.

3.2.4.1. Profitability

More profitable firms have, *ceteris paribus,* more internally generated resources to fund new investments. If their managers follow a pecking order, they will be less likely to seek external financing (Famaand French, 2002). Thus, on average, these firms' leverage ratios will be lower. In trade-off models, on the other hand, this relationship is inverted. More profitable firms are less subject to bankruptcy risks*, ceteris paribus*. Hence, their expected bankruptcy costs are reduced and they can make more use of the tax shields provided by debt, thus choosing a position of greater leverage.We will keep the ratio of return on assets ROA to measure this variable:

ROA=Earnings before interest, tax, depreciation divided by total assets, lagged one year period

3.2.4.2. Firm size

Studies suggest that the probability of bankruptcy is lower in larger firms and that, therefore, their debt capacity is higher than that of smaller ones, all else equal. On the other hand, fixed transaction costs can make new stock issues unattractive to small corporations, stimulating them to issue debt(RajinandZingales, 1995 ; Hovakimian and al, 2004; DufourandMolay, 2010).

Indeed, most studies have applied total assets or turnover as a measure for firm size (Bujadi and Richardson, 1997). In this paper, it is measured through the log of the firm's total assets (LNSIZE).

3.2.4.3. Future investment opportunities

It is argued that future profitable investment opportunities can influence corporate financing decisions in different ways. In the context of the pecking order theory, firms that have many investment opportunities and believe that their stocks (and risky bonds) are undervalued by the market, may choose a capital structure with less debt. If they maintained high debt ratios, they would be forced to

distribute precious cash flows generated by their business and could face the need to issue undervalued securities to fund new projects. This could, in turn, induce underinvestment. A more static version of the pecking order model, on the other hand, predicts that firms with more future opportunities will be more levered, ceteris paribus, because they need more external financing and issuing debt is preferable to issuing new stock.(Rajin and Zingales, 1995 ; Graham, 2000 ; Booth and al, 2001 ; Dufour andMolay, 2010 ; Naouiand al, 2008).

We   will keep the Tobin's Q   to measure this variable. The Tobin's Q Estimated with the approximation formula proposed by Chung and Pruitt (1994):

$$Q_{it} \cong \frac{MVS_{it} + D_{it}}{A_{it}}$$

MVS – market value of common and preferred shares; D – book value of debt, defined as current liabilities plus long-term debt plus inventories minus current assets; A – total assets.

For simplification purposes, the summary of each variable extent range in the model, its name as well as its expected impact on the capital structure choice are depicted in the following table:

Table 2. Operational definitions of variables

Class :	Phenomena :	Mesure :	Variables :	Predictions :		
Endogens variables :						
Investment decision	Assets specificity	Asset Specificity Rate (ASR) = intangible assets / asset accounting.	**AS**			
	Investment level	Free Cash Flow Rate (FCFR) = Operating profit / total assets. and $Q_{it} \cong \frac{MVS_{it} + D_{it}}{A_{it}}$	**INL**			
	Investment horizon	Capital Expenditure Rate (CER) = operating assets / Total assets	**INH**			
Exogenous variables :				CF	LEV	EQ
Optimism	Directors overestimate capacity of their firms	The questionnaire obtained score	**OP**	+	+	-
Lost aversion	Lossrumination and reputation	The questionnaire obtained score	**LA**	+	-	+
overconfidence	Directors overestimate their personal competences	The questionnaire obtained score	**OVER**	+	+	+
Capital structure choice	Internally generated resources (The Cash Flow)	CF = Net income + Depreciation – Dividend Casch Flow rate (RCF) = CF / Total Assets) Cash flow rate variation = RCF$_{N-1}$- RCF$_{N-1}$ / RCF$_{N-1}$	**CF**	+	+	-
	Debt level	Leverage ratios (LEV)= (total debt / total assets) Leverage ratios variation = LEV$_{N}$- LEV$_{N-1}$ / LEV$_{N-1}$	**LEV**	-	+	+
	Equity level	Level of Capital Invested (LCI) = equity / total assets Level of Capital Invested Variation = LCI$_{N}$- LCI$_{N-1}$ / LCI$_{N-1}$	**EQ**	+	-	+
Controls variables:						
Profitability	Reports on the company's ability to meet its commitments	ROA= Earnings before interest, tax, depreciation divided by total assets, lagged one year period	**PF**	+	+	-

Firm size	Firms signaled performance	Ln (total assets)	LNSIZE	+	+	+
Future investment opportunities	Indicates the productive capacity of the company	$Q_{it} \cong \dfrac{MVS_{it} + D_{it}}{A_{it}}$ MVS – market value of common and preferred shares; D – book value of debt, defined as current liabilities plus long-term debt plus inventories minus current assets; A – total assets.	FIO	-	+	+

3.3. Bayesian Network Method

The definition of a Bayesian network can be found inmany versions, but the basic form (Pearl, 1986) is statedas follows: a Bayesian network is a directed probabilitygraph, connecting the relative variables with arcs, andthis kind of connection expresses the conditional dependence between the variables. The formal definitionfollows.

A Bayesian network is defined as the set of {D, S,P},where.

(1) D is a set of variables (or nodes): in our case it consists of capital structure choice, optimism, loss aversion, overconfidence, profitability, firm size and future investment opportunities.

(2) S is a set of conditional probability distributions(CPD).S = {p (D /Parents(D) / D ∈D}, Parents(D) ⊂ D stands : for all the parent nodes for D, p(D/Parents(D) is theconditional distribution of variable D.

(3) P is a set of marginal probability distributions.P = {p(D) / D ∈D } stands for the probability distribution of variable D.

In the Bayesian network, variables are used to express the events or objects. The problem could be modeled with the behavior of these variables. In general, wefirst calculate (or determine from expert experience) theprobability distribution of each variable and the conditional probability distribution between them. Then fromthese distributions we can obtain the joint distributionsof these variables. Finally, some deductions can bedeveloped for some variables of interest using someother known variables.

In our study we try to show the evolution of CEO financing choices according to the evolution of his emotions and his company characteristics. Thus, theoretically, have to show that the company capital structure choice (Internally generated resources, debt and Equity) depends on: CEO emotional biases (CEO optimism level, loss aversion and overconfidence), firm profitability, firm size and firm future investment opportunities.

3.3.1.Define the network variables and their values

The first step in building a Bayesian network expert is to list the variables recursively, starting from the target variable to the causes. In this order we present the variables in the table below:

Table 3. The network variables and their values

Variables	Type
Investment decision	Discret [1 ; 2 ;3 ;4 ;5 ;6 ;7 ;8 ;9]
Capital structure choise	Discret [1 ; 2 ;3 ;4 ;5 ;6 ;7]
Optimism	Discret : YES/NO
Loss aversion	Discret : YES/NO
overconfidence	Discret : YES/NO
Profitability	Discret : YES/NO
Firm size	Discret [1 ; 2 ; 3]
Future investment opportunities	Discret : YES/NO

3.3.2. Graphical model

The second step of Bayesian network the construction is to express the relationships between variables. The BayesiaLab learning of Bayesian network by taking the database as a discrete entry process without sampling data.

The Bayesian network constructed is the result for the total database.According to the data that we have received through the questionnaire, we have established relationships following graph (Figure 1):

Figure 1. Investment decision: Bayesian Network
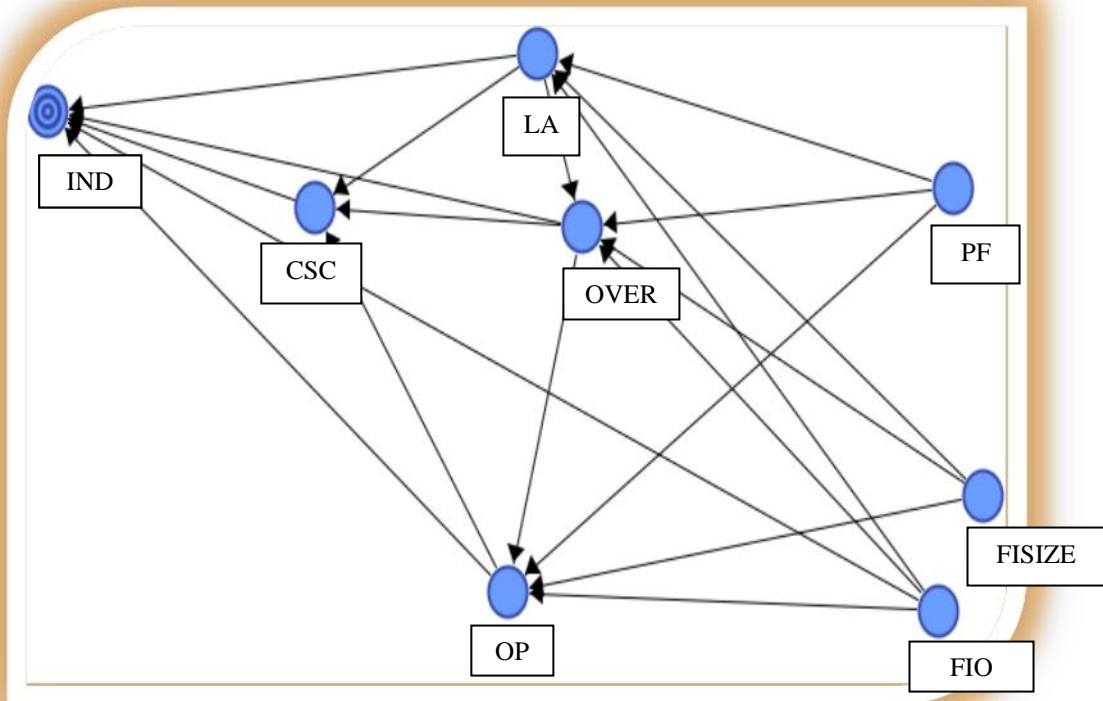
4. Empirical results

4.1. The relationships discovered analysis

The relationships between the variables in the database are directed at the parent node child node. Each relationship is composed of three different measures: the Kullback-Leibler, the relative weight and the Pearson correlation (direction of relation). Indeed, the Kullback-Leibler and the relative weight are two measures indicating the strength of relationships and the level correlation between variables, in that while the correlation measure of personal meaning and relationship significance.

The relative weight scale of 0 to 1. Thus, the table (Table 4) below shows the relationships analysis results between variables across the network Pearson correlation.

Table 4. The relationships analysis

Parents nodes	Childs nodes	Kullback-Leiblerdivergence	Poids relatif	relative weight
CSC	IND	0,976628	1,0000	0,1848*
FIO	IND	0,720238	0,7375	0,2702
OP	CSC	0,631802	0,6469	-0,0985*
OVER	IND	0,470045	0,4813	0,1531*
LA	IND	0,371970	0,3809	-0,0912*
LA	CSC	0,322634	0,3304	-0,1251*
OP	IND	0,226392	0,2318	-0,1186*
OVER	CSC	0,225408	0,2308	0,3086
FSIZE	LA	0,193522	0,1982	-0,3519
FSIZE	OP	0,191295	0,1959	0,2133
FIO	OVER	0,135048	0,1383	0,0346**
PF	OVER	0,134062	0,1373	0,1251*
FSIZE	OVER	0,108402	0,1110	0,0429**
FIO	OP	0,097059	0,0994	-0,0688*
PF	OP	0,096918	0,0992	0,1714*
PF	LA	0,077256	0,0791	-0,1662*
LA	OVER	0,053792	0,0551	-0,1555*
FIO	LA	0,044916	0,0460	-0,0308**
OVER	OP	0,042004	0,0430	-0,0159***
Kullback-Leibler **close to 1:** important **correlation between the variables**				
Relative weight close to 1: important **correlation between the variables.**				
Pearson correlation:*,,***,respectively at 10%,5%,1%.**				

Table 4 examines the relationship (strength and correlationtype) between networks variables.

The analysis of the relations shows the presence of a strong relationship (Kullback-Leibler = 0976 / weight rate = 1) and positive (β = 0.1848) between investment decision and financing decision. Thisconfirms the predictions of financial theory fororganizational independence between the two decisions. The optimism of the leader affects (Kullback-Leibler = 0.7202 / 0.2318 = weight rate) negatively (β = -0.1186) the investment decision of his business. This result confirms our hypothesis (H1, H2 and H3) and shows that the optimism of the leader is correlatedpositively with the presence of an investment decision sub-optimal (high specificity, over-investment and long-horizon).

Loss aversion is correlated (Kullback-Leibler = 0.3719 / 0.3809 =weight rate) negatively (β = -0.0912) with his investment choices. This finding validates our theoretical predictions (H5, H6). It shows that emotions or emotional biases affect the rationality of managerial decisions which the investment decision.

Overconfidence leader's influence (Kullback-Leibler = 0.47 / weight rate = 0.4813) positively (β = 0.1531) the investment decision of his business. This result confirms our theoretical development (H7, H8 and H9) and shows that emotional biasesaffect managerial decisions including investment decisions.

The results show a strong relationship (Kullback-Leibler = 0.2263 / 0.7375 = weight rate) and not significant (β = 0.2702) between growth opportunities andinvestment decisions.

Network investment decision analysis confirms financing decision results. Thus, the financing decision is negatively correlated with the optimism level (β = -0.0985) and loss aversion (β = -0.1251).

Analysis shows that firm size affects their emotional state.Thus, the size negatively affects CEO loss version level (β =-0.3519), positively correlated with leader optimism rate (β = 0.2133) and CEO overconfidence level (β = 0.0429).

Growth opportunities are positively correlated with the level of overconfidence (β =0.0346) and negatively with the leader's loss aversion level(β =- 0.0688) and optimism (β =- 0.0308).

Firm profitability is negatively correlated with CEO loss aversion level (β =- 0.1662), positively correlated with his optimism level (β = 0.1714) and overconfidence level (β = 0.1251).

Relationships analysis shows a negative correlation between CEO loss aversion rate of and his overconfidence level (β =-0.1555).

Finally, the results also show a negative correlation betweenmanagerial overconfidence and optimism level (β =- 0.0159).

4.2. Target variable analysis: Capital structure choices (CSC)

To analyze the capital structure choice, we must choose the variable capital structure choice (CSC) as a target variable in the Bayesian network. Then we can use the function that generates the analysis report of the target capital structure choice. In this report, the relationship between capital structure choice and the other variables are measured by binary

mutual information and the binary relative importance.The mutual information of two random variables is a score measuring the statistical dependence of these variables. It is measured in bits.

Table 5. Traget variable analysis

Nodes	Binary mutual information	Binary relative importance	Modal value	
IND= AS+LTIN+UNINV (14,21%)				
OC	0,0555	1,0000	YES	87,74%
CSC	0,0259	0,4663	EQ	32,95%
LA	0,0085	0,1525	NO	50,97%
OP	0,0016	0,0290	YES	53,37%
FSIZE	0,0007	0,0127	BIG	58,72%
PF	0,0001	0,0023	NO	54,36%
OVER	0,0001	0,0022	YES	60,91%
IND = OVERINV (12,20%)				
FIO	0,0937	1,0000	YES	90,01%
CSC	0,0730	0,7788	CF	36,84%
OP	0,0324	0,3457	YES	85,43%
OVER	0,0196	0,2090	NO	62,58%
PF	0,0037	0,0396	YES	53,58%
FSIZE	0,0025	0,0272	BIG	62,22%
LA	0,0008	0,0082	YES	57,85%
IND = AS (12,11%)				
CSC	0,0151	1,0000	EQ	28,71%
FIO	0,0082	0,5449	NO	58,33%
LA	0,0044	0,2891	YES	72,08%
FSIZE	0,0029	0,1948	BIG	51,54%
OVER	0,0013	0,0894	YES	53,59%
PF	0,0001	0,0091	NO	54,15%
OP	0,0000	0,0004	YES	58,73%
IND = LT+OVERINV (11,24%)				
OVER	0,0381	1,0000	YES	88,73%
CSC	0,0232	0,6099	CF+LEV	26,33%
LA	0,0214	0,5610	NO	61,75%
FIO	0,0186	0,4876	NO	66,39%
OP	0,0121	0,3175	NO	58,95%
FSIZE	0,0082	0,2141	BIG	72,50%
PF	0,0004	0,0103	NO	52,74%
IND = ST(11,14%)				
CSC	0,0445	1,0000	EQ	36,16%
OP	0,0194	0,4361	NO	63,86%
PF	0,0050	0,1128	NO	67,54%
LA	0,0021	0,0478	YES	69,45%
OVER	0,0016	0,0357	YES	52,79%
FSIZE	0,0015	0,0343	BIG	55,05%
FIO	0,0002	0,0035	YES	53,93%

Nodes	Binary mutual information	Binary relative importance	Modal value	
IND = UNDINV(11,14%)				
OVER	0,0511	1,0000	YES	90,46%
CSC	0,0222	0,4342	CF	27,93%
LA	0,0074	0,1449	YES	75,61%
OP	0,0058	0,1138	YES	71,34%
FSIZE	0,0011	0,0216	BIG	64,73%
PF	0,0010	0,0200	NO	61,25%
OVER	0,0007	0,0139	YES	54,96%
IND = AS+LT+OVERINV (11,08%)				
Nodes	Binary mutual information	Binary relative importance	Modal value	
CSC	0,0263	1,0000	LEV+EQ	24,96%
LA	0,0063	0,2391	YES	74,62%
FIO	0,0015	0,0557	NO	50,35%
OVER	0,0014	0,0528	YES	65,39%
FSIZE	0,0011	0,0405	BIG	57,15%
PF	0,0009	0,0347	NO	60,98%
OP	0,0000	0,0005	YES	59,71%
IND = ST+UNDINV(9,40%)				
Nodes	Binary mutual information	Binary relative importance	Modal value	
FIO	0,0375	1,0000	YES	88,69%
CSC	0,0149	0,3973	EQ	29,15%
OVER	0,0030	0,0803	YES	69,05%
OP	0,0021	0,0564	YES	67,28%
PF	0,0007	0,0190	NO	51,15%
LA	0,0001	0,0020	YES	63,63%
FSIZE	0,0000	0,0006	BIG	59,47%
IND = LT (7,48%)				
Nodes	Binary mutual information	Binary relative importance	Modal value	
CSC	0,0144	1,0000	EQ	33,81%
FIO	0,0016	0,1123	NO	52,30%
OVER	0,0012	0,0807	YES	52,36%
FSIZE	0,0001	0,0056	BIG	58,93%
OP	0,0000	0,0005	YES	59,68%
PF	0,0000	0,0002	NO	56,34%
LA	0,0000	0,0000	YES	62,18%

Mutual information: This is the amount of information given by a variable on the target value.
Relative importance: The importance of this variable with respect to the target value.
Modal value: The average value of the explanatory variable for each the target value.

Investment decision analysis shows that 14.21% of Tunisian companies opt for the combination (specific investment + long term + under-investment), 12.2% use their financial capabilities to overinvest, 12.11% prefer specific investments, 11.24% overinvested in long-term projects, 11.4% choose the short-term investments, 11.08% overinvest in specific projects and long-term, 9.4% prefer short-term investments and limit the presence of a long-term investment by the under-investment, 7.48% choosing long-term investment.

The results show that 87.74% of growth opportunities, 32.95% of preferred equity, 50.97% of CEO risk appetite, 53.37% of CEO optimism and a firm great size to 58.72% involve the use of specific investments in the long term and the presence of under-investment situations with a probability of 14.21%.

Table 5 shows that 90.01% of firm growth opportunities, 36.84% preference for internally generated resource, 85.43% of CEO optimism, 62.58% of CEO overconfidence non suggestibility . 53.58% of firm profitability and his size great to 62.22% implies that this company chooses to over-investment with a probability of 12.2%.

Target analysis suggested that 28.71% of CEO preference for the equity, 58.33% of firm of growth opportunity, 72.08% of CEO loss aversion, 53.59% of his overconfidence and a firm size large with 51.54% involve the presence of 12.11 % of asset specificity.

88.73% of CEO over-confidence, 26.33%, preferably for the couple (internally generated resource+ debt), 61.75% of his risk appetite, 66.39% of firm growth opportunities, 58.95% of CEO optimism bias non suggestibility and high firm size with 72.50% implies a CEO preference for over-investment in long-term projects.

36.16% CEO equity preference, 63.86% CEO optimism bias non suggestibility, firm low profitability to 67.54%, 69.45% of CEO loss aversion, 52.79% of overconfidenceand a large firm size with probability of 55.05% implies a preference for investment projects in the short term with a probability of 11.14%.

90.46% to firm growth opportunity, 27.93% preference for internally generated resource, 75.61% of CEO loss aversion, 71.34% of his optimism, a great firm size to 64.73%, low profitability to 61.25% and54.96% excess trust involves a preference for the under-investment with a probability of 54.96%.

24.96% of the CEO preference (debt and equity), 74.62% of his loss aversion, 50.35% of lack firm future opportunities investment, 65.39% of leader over-confidence, a great firm size with a probability of57.15% and low firm profitability of 60.98% kick

start CEO to over-invest inspecific investment and long term with a probability of 11.08%.

The presence of 88.69% firm growth opportunities, the 29.15% firm equity preference , 69.05% CEO over-confidence, 67.28% of his optimism and 51.15% of a low firm probability push the manager to choose the under-investment and the short term with a probability of 9.40%.

Finally, the choice of 33.81%equity firm financing decision, the52.30% lack of firm growth opportunities and 52.36% of CEO overconfidence push this leader to choose projects long-term investment with a probability of52.36%.

4.3. Average target maximizing analysis

After presenting all the explanatory variables for each category of the target variable, it is necessary to introduce the variables maximizing each modality of the target variable. Thus, the target dynamic profile capability software (Bayesialab) to query about an a posteriori maximization of the target average. This test shows the case to maximize the target variable value.Table 6 presents the dynamic profile of the capital structure choice (CSC).

Table 6. The Traget dynamic profile analysis

IND = AS			
Nodes	**Optimal modality**	**Probability**	**Joint probability**
A priori		12,11%	100,00%
CSC	LEV	18,05%	9,50%
TAI	SMALL	100,00%	0,09%
IND = OVERINV			
Nodes	**Optimal modality**	**Probability**	**Joint probability**
Apriori		12,20%	100,00%
CSC	CF	37,76%	11,90%
FIO	NO	61,76%	6,89%
OVER	NO	75,00%	5,67%

IND = UNDINV			
Nodes	**Optimal modality**	**Probability**	**Joint probability**
A priori		**11,14%**	**100,00%**
CSC	**CF**	**26,15%**	**11,90%**
FIO	**YES**	**62,12%**	**5,01%**
OVER	**NO**	**100,00%**	**2,87%**

IND = LT			
Nodes	**Optimal modality**	**Probability**	**Joint probability**
A priori		**7,48%**	**100,00%**
CSC	**LEV+EQ**	**13,25%**	**11,04%**
FIO	**NO**	**29,14%**	**4,64%**
OVER	**NO**	**56,25%**	**2,13%**
FSIZE	**MEDIUM**	**79,61%**	**0,85%**
PF	**YES**	**100,00%**	**0,56%**

IND= ST			
Nodes	**Optimal modality**	**Probability**	**Joint probability**
A priori		**11,14%**	**100,00%**
CSC	**CF+LEV+EQ**	**22,53%**	**17,36%**
OVER	**NO**	**73,23%**	**2,19%**
FIO	**YES**	**100,00%**	**1,53%**

IND = LT+OVERINV			
Nodes	**Optimal modality**	**Probability**	**Joint probability**
A priori		**11,24%**	**100,00%**
CSC	**CF+EQ**	**23,85%**	**8,87%**
OVER	**YES**	**36,39%**	**5,47%**
OP	**NO**	**52,16%**	**3,57%**
OVER	**YES**	**68,66%**	**1,95%**
LA	**YES**	**100,00%**	**1,27%**

IND = ST+UNDINV			
Nodes	**Optimal modality**	**Probability**	**Joint probability**
A priori		**9,40%**	**100,00%**
FIO	**YES**	**14,88%**	**56,00%**
CSC	**CF+LEV**	**21,44%**	**9,71%**
OVER	**NO**	**28,61%**	**2,69%**

LA	NO	50,00%	1,54%
IND= AS+LT+OVERINV			
Nodes	**Optimal modality**	**Probability**	**Joint probability**
A priori		11,08%	100,00%
CSC	LEV+EQ	25,05%	11,04%
LA	YES	41,12%	6,33%
FIO	YES	69,82%	3,58%
OVER	YES	100,00%	1,87%
IND= AS+LT+UNDINV			
Nodes	**Optimal modality**	**Probability**	**Joint probability**
A priori		14,21%	100,00%
CSC	LEV	22,42%	9,50%
OVER	YES	50,05%	4,13%
FIO	YES	100,00%	2,06%

Optimal modality: modality is maximizing the target value .

Probability: the prior probability of each variable.

Joint probability: the probability that the target variable takes the value n given that the explanatory variable takes the value p. for example, the probability of choosing AS+LT+UNDINV by an executive overconfidence is 4.13%.

The investment decision dynamic profile analysis (Table 6) presents the following findings:

The100% decrease in the firm size and 18.5% increasedthe CEOpreference of debt are correlatedpositively with the increase of the 12.11%.specific investments. This result confirms the principle of independence between investment decision and financialreporting by corporate financial theory.

The 37.76%increased use of internally generated resource, the 61.76% reduced levelof growth opportunities and 75% decreased CEO overconfidence level cause an increase of over-investment with 12.20%. This confirms our theoretical development and affirms the presence of a negative correlation between CEO overconfidence and investment level.
This executive overconfidence overestimates his skills toreduce firm risk. It tends therefore to invest more than a rationalmanager.

The26.15%increased preference of internally generated resource, 62.12% increasing the firmgrowth opportunities level and100% decrease CEO overconfidence level are positively correlated with the increase under-investment of 11.14%. Leader'soverconfidence tends to overestimate the value of their project. They are reluctant toincrease their capital by considering that the market systematically evaluates the value of

securities. They give up the implementation of certain projects requiring recourse to external financing methods. This implies the presence of the under-investment situation.

The13.25%increased use of torque (debt and equity), 29.14%lower growth opportunities , the 56.25% reduced CEO overconfidence level, 79.61% reduced to an average firm size and 100%increasingthe firm profitability represents an increase in choice of long-term investment projects of around 7.48%. This result contradicts our theoretical development. The leader overconfidence growth opportunity for his company seeks to ensure its status as the leader. It uses its leverage decision to minimizeagency conflicts and ensure value creation. He chose short-term investmentsenhancing the value of his business.

The 22.53%increase in the use of all financial resources (internally generated resource, debt and equity) , the 73.23% decrease in the CEO overconfidence level and 100% higher firm growth opportunities pushing Tunisian leader to increase its preference for investment projects in the short term of around 11.14%. This finding contradicts our theoretical prediction. This is explained by the fact that overconfidence leaders who hold a large proportion of shares in the company they work for, have an expected utility of wealth is significantly

affected by the variance of the anticipated firm benefits. So they tend to choose long-term investments valuing risky business.

The 23.85% increased preference for the couple (internally generates resource and equity), 36.39% increasing CEO overconfidence, the 52.16% decrease CEO optimism level, 68.66% increased opportunities growth and 100% increased the CEO loss aversion level lead to increased preferences for over-investment manager and investment horizon length of about 11.24.

The 14.88% increase firm growth opportunities, 21.44% higher preferences for the couple (debt and internally generated resource), the 28.61% decrease in the CEO overconfidence level and its loss aversion level of 50 % implies an increase in preference for under-investment and short-term projects.

The 25.05% increased preference for directing the couple enjoyed debt and equity, 41.12% increasing CEO loss aversion level , 69.82% firm growth opportunities and 100% increased managerial overconfidence level generate a increase in choice of specific investments and long-term over-investment of 11.08%.

Finally, 22.42% the increase in firm debt rate, 50.05% increasing CEO overconfidence level and 100% increased firm growth opportunities to reflect 14.21% increase in the specific investments level and long-term underinvestment.

Conclusion

This research examines the determinants of firms' investment decision introducing a behavioral perspective.

Theoretical analysis presented CEO emotional biases highlights role (optimism, loss aversion, overconfidence) to explaining his investment decision. Thus, the optimism of the leader over the problem of managerial opportunism described by the agency theory in specific projects. The leader optimistic about its firm growth opportunities level uses specific investments risky to reduce the risk of takeover and preserve its place at the head of his company. Behavioral investment level analysis has enriched the predictions of theories based on asymmetric information (signals theory and rooting theory) and agency theory in choice of underinvestment or overinvestment.

Empirical analysis presenting survey CEO large private companies in Tunisia. Data analyses revealed CEO emotional biases importance in explaining his investment decision. Indeed, empirical relationship analysis between optimism and investment decision shows behavioral dimension role in the explanation. CEO optimism level is positively correlated with a preference for specific investment and overinvestment level. An optimistic leader who seeks the benefit for him and his firm has an incentive to overinvest in specific investment.

We also note that CEO loss aversion level is positively correlated with firm investment specific level and negatively correlated with overinvestment level. CEO loss aversion causes overestimate firm risk level, are more uncertain about forecasts and opt for making it safer to limit the likelihood of his removal. It uses specific investment and prefers under-investment in the case of firm low financing capacity.

CEO overconfidence positively affects firm specific investment level and his overinvestment rate. Leader's overconfidence of their personal and professional capacities tends to make investments in research and development.

Thus, the existence of overconfidence leaders can destroy investment decisions either underinvestment or overinvestment.

Finally, CEO investment decisions analysis by integrating the behavioral dimension is consistent with the corporate financial theory (agency theory, transaction cost and consolidation), the leader affected by behavioral biases (optimism, loss aversion, and overconfidence) adjusts its investment choices based on their ability to assess alternatives (optimism and overconfidence) and risk perception (loss aversion) to create of shareholder value and ensure its place at the head of the management team.

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