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Mission Climate Measurement: a new validated scale

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ABSTRACT

Despite the level of interest surrounding mission statements and their internalization in organizations, there is a lack of a valid construct to measure the sense of mission in organizational climate surveys. The aim of this exploratory study is to define and validate an instrument to assess the perception of the implementation of the mission in everyday routines. A sample of 132 employees from two companies completed the questionnaire to probe the scale's reliability and validity. A principal components analyses (PCAs) were conducted, taking the three dimensions separately. Later, a confirmatory analysis of the entire scale, which was a factor analysis using structural equation modelling (SEM) techniques, taking into accounts the three aforementioned dimensions. The scale is composed of ten items arranged in three dimensions: sensemaking of the mission, employee mission engagement, and organizational alignment. These scales provide clues to human resources managers about how to define and implement the mission to ensure that it will be interiorized by all members of the company. This new scale provides scholars with a comprehensive way to measure and assess the presence of the mission in the organizational climate and provides human resources managers with a useful kit to apply within their organizations.

KEYWORDS

Climate, mission statement, sensemaking of the mission, employee mission engagement, organizational alignment.

1. Introduction

While managers pay ample attention to determining the correct strategy for the company, they often lack a basic understanding of the perceptions, feelings and attitudes of their employees (measured by the organizational climate). This ignorance frequently provokes organizations to lose effectiveness and motivation in their employees, who are their most valuable resource. Therefore, it is relevant for organizations to measure and understand the organizational climate to effectively apply human resource development policies and practices.

Actually, some pioneering studies introduced and developed the organizational climate concept in the 1960s (Likert, 1967 & Kaczka & Kirk, 1968). According to Hellriegel & Slocum (1974), the organizational climate refers to "a set of attributes which can be perceived about a particular organization and/or its subsystems, and that may be induced from the way that organization and its subsystems deal with their members and environment". The more recent definition of Patterson et al. (2005) considered the climate to be "employees' perceptions of their organizations". The psychological climate is referred to as an individual level of analysis, but most recent research focuses on the aggregate level (departmental or organizational climate constructs).

In sum, the organizational climate refers to a set of characteristics that can be perceived about a specific company. It shows the employees' shared perceptions of their work environment. Many previous studies have worked to conceptualize, measure, and use organizational climate constructs. There have been several different data-based studies published in important journals to identify the appropriate construct for climate surveys (Litwin & Stringer, 1968; Payney et al., 1976; O'Sullivan, 2007; Thumin & Thumin, 2011, among others) and its relationship with other constructs, such as that of McMurray et al. (2004), who studied the relationship between organizational commitment and organizational climate. Additionally, other studies have focused on some aspects of the climate instrument, such as the 'Transfer Climate Instrument' of Holton et al. (1997) and the 'Open Innovation Climate Measure' of Remneland-Wikhamn & Wikhamn (2011). However, after a literature review, there are few well-validated measures that consider mission statement aspects (Payne et al. 1992 or Patterson et al., 2005, among others). For instance, Patterson et al. (2005) measure the "clarity of organizational goals", a topic

related to the mission statement; however, no previous studies have focused on the employees' perceptions of the mission deployment in their regular activities.

Indeed, one cannot forget that the mission becomes visible to employees in different ways. The mission statement is just a declaration of the organization's reason for being, revealing what it wants to be and who it wants to serve (David, 1989; Bart, 2001), but the sense of mission is something different. The sense of mission is commonly understood as the employees' commitment to the company's mission (Campbell & Yeung, 1991; Davies & Glaister, 1997; Baetz & Kenneth, 1998; Bart et al., 2001). This commitment is necessary to fuel a real effect on employee behavior (Bart et al., 2001); on the other hand, without this commitment, defining a mission can even be counterproductive (Ireland & Hitt, 1992).

Currently, there is a need to measure the organizational climate while keeping in mind the employees' sense of mission. Therefore, the objective of this paper is to present and validate a scale composed of three dimensions (sensemaking of the mission, employee mission engagement, and organizational alignment) to propose an integral approach to measuring the organizational climate. This measurement is theoretically grounded and empirically validated in a new mission-based managing framework. Our paper demonstrates the usefulness and adequacy of our climate measures in terms of reliability and discriminant and external validity. This new scale offers researchers and practitioners an original approach to evaluate the organizational climate from the point of view of the mission statement. We hope that human resource managers will improve their policies and practices toward the better development of their employees.

To achieve this objective, the second section offers a literature review of organizational climate measures. In section three, three dimensions are proposed to compose the entire scale. Next, in section four, the methodology and results are shown. Finally, the last section offers a discussion and some managerial implications.

2. Organizational climate measures

The first publication about the concept of climate and the relevance of measuring the climate construct was published in the early 1960s (e.g., McGregor, 1960; Litwin & Stringer, 1968). One of the best known definitions of organizational climate comes from Reichers & Schneider (1990), who defined it as the shared perceptions of employees concerning the practices, procedures, and behaviors that are rewarded and supported in a work setting. More recently, Hong & Kaur (2008) defined organizational climate as the global impression of one's organization and the personal impact of the work environment, which influence the individual's work behaviors and job-related attitudes.

According to Neal et al. (2000), the psychological climate refers to individual perceptions of organizational attributes, practices, and procedures. When these evaluations are shared by numerous people within a firm, they are referred to as the organizational climate. As Patterson et al. (2005) state, most empirical studies have applied an aggregate unit of analysis, and now general research focuses on aggregate rather than physiological climates. Therefore, this research proposes a scale measurement of organizational climate that takes into account the employees' perceptions about the mission's implementation in the management of the company. We are particularly interested in the way that the mission inspires the employees' behaviors.

At this point, describing the relationship between climate and culture is required because they are close concepts and might lead to some misunderstandings. James et al. (2008) suggest that climate is behaviorally oriented and represents the patterns of behavior of something specific (e.g., safety or services). Meanwhile, organizational culture refers to when employees are asked why this pattern exists. According to Svyantek & Bott (2004), organizational culture is a set of shared values and norms held by employees that guide their interactions with peers, management, and customers. In contrast, the organizational climate is more behaviorally oriented; in other words, the climate for innovation, safety, or service is the surface manifestation of culture.

The most important and widely used organizational climate measures and their dimensions are summarized in table 1. A wide range of dimensions can be found: from a one-dimension construct to a scale composed of fifteen dimensions. There is also a great

variety in terms of the type of dimensions. Moreover, no mission-related dimension is found.

Author(s) and Year	*Climate denomination* Climate dimensions
Litwin and Stringer (1968)	*Organizational Climate Questionnaire*
Campbell et al. (1974)	1. Individual autonomy; 2. Degree of structure imposed on the situation; 3. Reward orientation; 4. Consideration, warmth and support.
James et al. (1981)	1. Role stress and lack of harmony; 2. Job challenges and autonomy; 3. Leadership facilitation and support; 4. Work groups, cooperation, friendliness and warmth.
Glick (1985)	1. Leader's psychological distance; 2. Managerial trust and consideration; 3. Communication flow; 4. Open-mindedness, 5. Risk orientation; 6. Service quality; 7. Equity; 8. Centrality.
Koys & deCotiis (1991)	1. Autonomy; 2. Cohesion; 3. Trust; 4. Pressure; 5. Support; 6. Recognition; 7. Impartiality; 8. Innovation.
Payne et al. (1992)	*Business Organization Climate Index:* 1. Customer service; 2. Impact of information quality; 3. Ability to manage culture.
Patterson et al. (2005)	*Organizational Climate Measure (OCM):* 1. Autonomy; 2. Integration; 3. Involvement; 4. Supervisory Support; 5. Training; 6. Welfare; 7. Formalization; 8. Tradition; 9. Innovation and Flexibility; 10. Clarity of Organizational Goals; 11. Efficiency; 12. Effort; 13 Performance Feedback; 14. Pressure to Produce; 15. Quality.
Thrush et al. (2007)	*Organizational Climate for Research Integrity (OCRI) Survey*: (64 survey items): 1. Organizational inputs; 2. Structures; 3. Processes; 4. Outcomes.
Thumin & Thumin (2011)	*Survey of Organizational Climate.*
Suarez et al. (2013)	*Organizational Climate Scale (CLIOR):* One-dimension construct (50 items)

Table 1. Some organizational climate measures and their dimensions.

There is a pressing need for well-grounded measures of the level of the mission's implementation in companies. Therefore, this study seeks to partially bridge this gap by suggesting a measure of the sense of mission climate. Measuring certain aspects of the organizational climate can reveal some improvements to help successfully internalize the mission and hence improve the alignment of the people's behaviors regarding the mission's values. The internalization of the mission refers to the way in which employees assume the mission as their own and allow it to become a part of their personal beliefs and values.

3. Measurement of the Mission Organizational Climate

According to previous studies in this field (Bart et al, 2001; Suh et al., 2011; Wang, 2011; among others), we propose three dimensions related to different aspects of the sense of mission in companies: (1) sensemaking of the mission, (2) employee mission engagement, and (3) organizational alignment.

Sensemaking of the mission

In recent decades, many companies have conducted the exercise of defining institutional principles or mission statements. These principles, commonly defined under headings such as mission, vision, values, credo, and philosophy (Abrahams, 1999; Leuthesser & Kohli, 1997, Blair Loy et al., 2011) capture an organization's 'reason for being' and identity (Wang, 2011). The mission considers the organizational purpose and enables the sensemaking of the business and its processes and practices. These statements are of great relevance to the company, as they facilitate consistency in the definition and implementation of its strategy (Drucker, 1974; Ireland & Hitt, 1992; George, 2001; Vasconcellos e Sá et al., 2011). They are also a source of motivation and emotional security for employees (Kanter, 2009; Rey & Mas, 2013) and sometimes have an impact on the performance of the company (Bart et al., 2001; Desmidt et al., 2011).

However, publishing the mission and values on a website or hanging up posters around the office is one thing; getting employees to truly internalize these principles is quite another (Campbell & Nash, 1992). To increase the mission sensemaking (hereafter, SM), many companies put great effort into carrying out communication actions. However, quite often, these initiatives do no produce the expected results (Bart, 1997; Bart and Baetz, 1998; Bartkus & Glassman, 2008). To stimulate employees to truly understand the mission, we need a combination of various types of communication actions, which integrate the mission into everyday practices and into the reality of company employees. Following the sensemaking theory of communication, sensemaking is crucial because it is the principal site where meanings emerge that inform and limit identity and action to human behavior (Weick et al., 2005). According to Wang (2011), the SM of the management philosophy is 'the process through which individuals develop cognitive maps of the management philosophy'. Therefore, SM is related to the process through which individuals understand the company's mission. SM is especially relevant because normally the philosophy and mission are abstract concepts, and employees do not know

how to act to incorporate these concepts. Therefore, SM is the first step in really knowing how to put the mission into practice and to achieve the company mission (Wang, 2011).

To expand their knowledge of the mission and to encourage its internalization throughout an organization, employees must have explicit knowledge of the mission's content (Nonaka, 1994) to the extent that they are able to explain the mission in their own words (Wang, 2011). In fact, although implicit or tacit knowledge of the mission is an option (Nonaka & Tokoyama, 2003), several studies advise that the mission be formally communicated by members of the organization (Hirota et al., 2010), with special attention paid to the denotative and connotative aspects of the message (Cochran et al., 2008). The denotative aspect refers to the correct interpretation of the meaning of the message, and the connotative aspect refers to the feelings and emotions that emerge in the process of its transmission.

If there is no explicit knowledge of the mission or if it is poorly communicated, the general result will be a lack of awareness or ambiguous or contradictory messages. For this reason, the informative communication of the mission should be an initial step to ensure that employees know the content of the mission and are able to explain it in their own words. To sum up, to know and understand the company's mission statement is a basic state for a mission-driven organization.

Employee Mission Engagement

In the past two decades, there has been a great deal of interest in employee engagement in organizations. However, there has been little academic and empirical research on this popular topic (Robinson et al., 2004). Employee engagement refers to the individual's involvement and satisfaction with the company as well as his or her enthusiasm for work (Harter et al., 2002). According to Maslach et al. (2008), engagement is related to involvement, energy, and efficacy—the direct opposite of burnout. In the academic literature, engagement is said to be related to but distinct from other constructs in organizational behavior, such as organizational commitment or job involvement. According to Saks (2006), we can consider employee engagement as "a unique construct that consist of cognitive, emotional, and behavioral components that are associated with individual role performance". Macey & Schneider (2008) state that employee engagement refers to psychological states, traits and behaviors, as well as their antecedents and outcomes.

Following to Suh et al. (2011), employee engagement can be adopted in mission statement literature. They define employee mission engagement (hereafter, EME) as 'a psychological state in which an employee desires to exert effort and devote careful attention to ensure the fulfillment of a mission that he or she perceives as significant or meaningful'.

Previous studies have highlighted the motivational nature of the EME concept (Saks, 2006). Employee motivation is one of the main reasons that an organization should define its mission statement (Bart et al., 2001; Ireland & Hitt, 1992; Campbell & Yeung, 1991; Klemm et al., 1991). Previous studies have proposed a relationship between employees' motivations and mission statements, for instance, in the public sector (Wright 2007) or in non-profit organizations (Kirk, 2010). However, other researchers have suggested that a mission that is truly interiorized and fulfilled within a company instills a strong capacity to contribute to something or to someone, constituting a source of prosocial motivations (Wang, 2011, Mas & Rey, 2013). The potential of this type of motivation (prosocial motivation based on mission statements) is reflected in the concept of EME. Moreover, central to the motivational nature of EME is the notion of an employee's willingness to invest personal effort and attention to fulfill the mission (Salanova et al., 2005). Therefore, employees with high EME tend to commit to and continue to work toward firm goals. This is an important concept to measure within a climate survey.

Mission-organizational alignment

In recent decades, several authors have submitted proposals on how to define a mission (Lundberg, 1984; Cochran et al., 2008 Jones & Kahaner, 1995; Collins & Porras, 1996; Abrahams, 1999; Levin, 2000) and to ensure the alignment of the mission and the company's processes and systems (Bart et al., 2001; Crotts, 2005; Cardona & Rey, 2008). In practice, the mission is implemented from a communicative perspective (Williams, 2008), but it frequently is not integrated into the strategy and management systems that govern day-to-day organization (Bart, 1997). Therefore, companies that already work with the mission must have and use a number of tools to help effectively manage the company's mission.

The company's mission should be present in the knowledge and information possessed by all members of the organization. To assure the proper implementation of the company's mission, its managers should systematize and apply the sense of mission to

all aspects of the company. It is therefore important to align the company's management systems with its mission (Drucker, 1974; Pearce, 1982; Campbell & Nash, 1992; Hirota et al. 2010.).

According to Bart et al. (2001), management systems and processes must be aligned with strategy to achieve a successful mission. When managers design and plan their management systems, they have to align them with their mission statements. Therefore, it is important to consider this variable to measure the influence of the mission in the company's daily decisions and management processes. A real and active mission must be present in the company's management systems and decisions, such as budgets, recruitment, planning and employee assessments or rewards (Williams et al., 2014).

On the other hand, to enhance their commitment to the mission, employees need to believe that the organization's decisions and practices are aligned with its mission (Bart, 2001; Cardona & Rey, 2008; Suh et al., 2010). This aspect is especially relevant when a mission is tested, which may occur, for example, if a company faces the need for layoffs or a client's costly claim (Jones & Kahaner, 1995). The way that the company acts in these situations, and, more importantly, how this performance is perceived by its employees, is essential for the development of true mission internalization (Campbell & Yeung, 1991; Jones & Kahaner, 1995; Collins & Porras, 1994). If employees do not perceive coherence between a company's policies and its practices, the mission will gradually lose its credibility. Such a credibility loss may occur due to a lack of coherence or due to ignorance or poor communication, especially among employees who have limited visibility and access to information about the company's general operations. Therefore, the company must frequently carry out actions to present how the organization manifests its commitment to the mission through evidence, tools, events and company decisions. Such actions promote the employees' awareness of how the company's everyday practices are coherent manifestations of the practical applications of the company's institutional principles.

In this study, the label used for mission-organizational alignment is OA.

4. Method and results

As discussed earlier, empirical and theoretical research on mission statements emphasizes the need for a mission climate measure. There is no measurement of organizational climate that is specifically designed to measure the level of the sense of mission in the company.

A series of meetings with the managers of two companies was conducted to explain the aims of this study. Established in Spain, the first company is a market leader in spare auto parts distribution that now operates in Europe. This company has worked intensively on mission-based management for more than seven years. The second company operates internationally in engineering construction activities, and its headquarters is located in South America. This company has defined its mission statement and has tried to be a mission-driven organization. Before the questionnaire was launched, some pilot managers completed it and suggested some changes to enhance its understanding. Five managers from different companies agreed to participate in the definition and assessment of the questionnaire.

The questionnaire included a section to collect 10 items to assess the constructs explained before. These items were based on previous quantitative studies of the mission statement literature. All of them were measured on a five-point Likert scale. In the last section, the respondents' socio-demographic information was collected.

The survey was launched in January 2015, and 156 questionnaires were collected, from which only 132 were retained for our analysis (61 from the first company and 71 from the second company).

The data were analyzed in a two-step process. First, any array of three principal components analyses (PCAs) were conducted, taking the three dimensions separately. The unidimensionality construct was proved. The second step was the confirmatory analysis of the entire scale, which was a factor analysis using structural equation modelling (SEM) techniques, taking into account the three aforementioned dimensions. The 6.2 EQS software was used.

Assessing the three dimensions

Table 2 shows the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity for the three dimensions. These statistics only gave rise to a slight concern with the results from the second PCA, but no special problems were detected. The results confirmed a linear dependence between the variables for each dimension and supported our view that the results were sound.

Dimension	KMO	Bartlett's test of sphericity		
		χ^2	Degrees of freedom	Significance
SM	0.710	14.297	3	0.000
EME	0.679	98.722	3	0.000
OA	0.790	169.492	6	0.000

Table 2. KMO indices and Bartlett's test of sphericity for the three dimensions.

Consequently, the three EFAs (through CFA) were conducted. Table 3 shows the loading factors for each item, proving the individual consistency of the items (0.767 – 0.885). The reliability (internal consistency) of the dimensions is confirmed by the Cronbach's alphas and the composite reliability (CR), all above 0.7 or near this threshold (Hair et al., 2006). When the state of art is still not consolidated, as is the case when an exploratory analysis is performed, these thresholds can be relaxed to 0.6 (Malhotra, 2004). In addition, the variance extracted for each scale was greater than 0.5.

Scale adapted from	Items		Loads
Sensemaking of the mission (Wang, 2011) Cronbach's α: 0.820 CR: 0.894 AVE: 0.738	SM1	I could make sense of my company's mission very well.	0.840
	SM2	I am able to interpret my company's mission in my own words.	0.885
	SM3	I can explain the mission to people outside the company if required.	0.852
Employee mission engagement (Suh et al. 2010) Cronbach's alpha: 0.746 CR: 0.862 AVE: 0.676	EME1	I am motivated by the mission to do my work.	0.789
	EME2	I work hard to ensure X is successful in carrying out our mission.	0.818
	EME3	I carry out the mission when I do my work well.	0.859
Organizational Alignment (Bart el al. 2001) Cronbach's alpha: 0.808 CR: 0.877 AVE: 0.642	OA1	To what extent is your current mission statement taken into account when setting up and managing your firm's operating planning system?	0.811
	AO2	To what extent is your current mission statement taken into account when setting up and managing your firm's budgeting system?	0.767
	OA3	To what extent is your current mission statement taken into account when setting up and managing your firm's performance evaluation criteria?	0.832

	OA4	To what extent is your current mission statement taken into account when setting up and managing your firm's system of rewards?	0.796

Table 3. Reliability analysis for the three constructs.

Discriminant validity was analyzed using the linear correlations or standardized covariances between latent factors by examining whether inter-factor correlations were less than the square root of the average variance extracted (AVE). Table 4 shows that the square roots of each AVE were greater than the off-diagonal elements. Discriminant validity was guaranteed.

	SM	EME	OA
SM	0.859		
EME	0.425	0.812	
OA	0.375	0.525	0.801

Diagonal elements are the square roots of average extracted (AVE).
Table 4. Correlation matrices of the three dimensions.

Confirmatory factor analysis for the entire scale

Once the unidimensionality for each dimension was assessed, the second step of the analysis was lunched. It consisted of a confirmatory factor analysis with the 10 items from the three dimensions.

The model was estimated using the robust maximum likelihood method from the asymptotic variance–covariance matrix. The fit indices obtained in the measurement model estimation showed that the variables converged towards the factors established in the CFA (see Table 5). χ^2 Satorra–Bentler was 57.84, with 32 degrees of freedom and a p-value of 0.00341. χ^2/df was 1.81, which was below the acceptable limit of 5. RMSEA was 0.079, and the comparative fit index (CFI) was 0.915. Bollen's (IFI) fit index was 0.919, and McDonald's (MFI) fit index was 0.907. Being cautious about the significance of the robust χ^2 statistic and noting the global indicators, the global fit was acceptable. Table 4 shows the standardized solution.

Dimension	Items	Load	t-value	r^2
SM	SM1	0.787	-	0.619
	SM2	0.805	9.250	0.648
	SM3	0.745	7.477	0.554
EME	EME1	0.640	-	0.409
	EME2	0.746	5.795	0.557
	EME3	0.770	7.044	0.593
OA	OA1	0.766	-	0.587
	AO2	0.666	6.731	0.443
	OA3	0.760	7.602	0.578
	OA4	0.701	6.949	0.491

Table 5. Confirmatory factor analysis for the climate scale.

To proceed to a benchmarking exercise between the two companies, the aggregated responses on a scale from 1 to 5 were calculated for each dimension (figure 2). The first company scored higher in the three dimensions. It was expected that the company that scored better in one dimension would also score better in the other two dimensions because of the correlations among them. The findings show better results for the first company because it is a company that has been working since 2008 to implement mission-based management via the policies and practices within the company.

In addition, a multiple group analysis among the two companies has been performed to test the invariance of the correlations of the dimensions across the two companies. The data fit reasonably: the scaled χ^2 Satorra–Bentler was 88.31, with 67 degrees of freedom and an associated p-value of 0.042, a CFI of 0.926 and a RMSEA of 0.070. The only correlation that does not operate equivalently in the two companies is the correlation between SM and EME. It shows the differences in the relationship between employees' understanding of mission and their engagement with it.

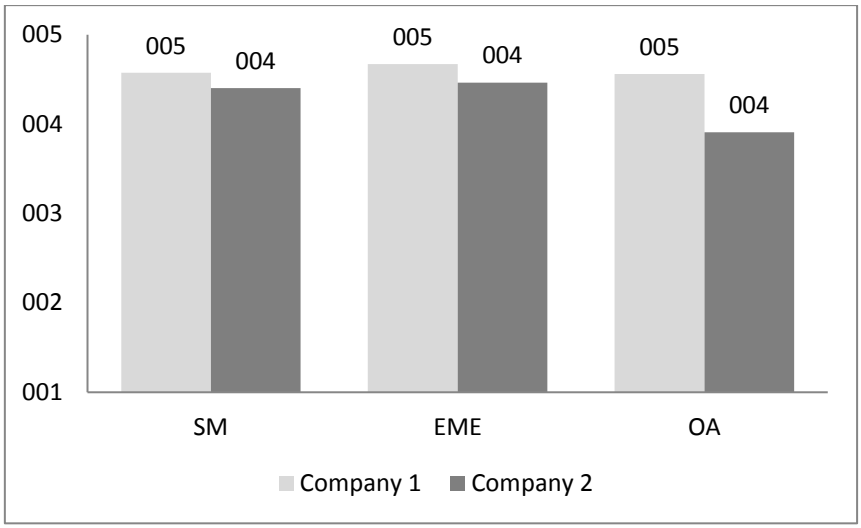

Figure 1. A comparison of the mission climate indices of the two companies.

5. Discussion and managerial implications

Successful organizations understand the needs and attitudes of their employees and seek to develop their capabilities. Human resource managers try to create a positive environment where people can work happily and feel that what they do contributes to some personal aims through their engagement with the mission values. Consequently, the company's performance indicators improve alongside the empowerment of their employees. To assess the fit between personal values and the mission, organizational climate surveys are a powerful tool. The results of these surveys also provide a basis for effective action planning for employee development and organizational change. The climate survey is an important tool to help organizations understand their employees' perceptions of their working environment. The proposed scale can assess the different dimensions that affect people's behaviors. Although the working environment in organizations is a topic studied by different authors, it has not been addressed from the perspective of the company's mission. Organizations' mission statements are basic starting points that will enable the development and implementation of corporate strategies. In this sense, having indicators that measure the degree of the mission's internalization, the level of mission-based motivation and the effectiveness of mission-derived management tools is important and useful for making management decisions.

The proposed scale includes three dimensions. The first one (consisting of three items) captures the knowledge of the mission and the sense of this particular mission, which is

employees' first step in internalizing the mission; hence, it is a starting point for assessing the climate. This first dimension provides an answer to "what" the mission in this company is and to what extent the employee knows it. It is not enough to have only superficial knowledge of the mission; it must be fully understood to the point that every employee is able to explain it (Nonaka & Tokoyama, 2003, Cochran et al., 2008, Hirota et al., 2010).

The second dimension (employee mission engagement) relates to the employees' motivation to feel that they are contributing while they stick to the mission. It provides an answer for "why" an employee should work at this company, which has this explicit statement mission. This dimension is assessed using three items. What are the values that make the employee adhere to the mission and hence feel that it is worth working at this company? This is the conceptualization of the second dimension.

It is not enough to simply know the mission statement (the first dimension); the mission has to motivate employees (the second dimension), and it should be aligned with the company's management (the third dimension). This third dimension ensures that the management system and processes enable the accomplishment of the mission statement. This last dimension is assessed using four items. To strengthen commitment within the company, employees must believe that the day-to-day decisions are aligned with the mission. Consequently, employees know the reward deserved according to their behaviors. Employees thus have to assess the alignment between actual personal work and the mission statement. Such assessments provide feedback to the employees, which helps them know how their work is valued; hence, they can make any necessary adjustments.

Overall, the scale provides clues to human resources managers about how to define and implement the mission to ensure that it will be interiorized and shared by all members of the company, thus yielding profits in terms of overall performance (financial and non-financial). Nevertheless, this extreme has still not been probed in empirical studies. Future research is needed in this line. These results need to be confirmed using a larger and more representative sample, which would make them more generalizable.

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Value Creation and Women on Boards

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ABSTRACT

Value creation is a major claim of most companies. Mahajan (2017) argues that "value and value creation are natural to and basic in human behaviour and endeavour", nevertheless women are often marginalized and impeded in their advancement towards leadership positions, where they could shape and influence the process of value creation. The present article looks at the companies of EURO STOXX 50 index in the year 2015 and offers an overview of women representation on the boards of these 50 companies. The paper tries to establish whether the success of these companies can be related to the percentage of female members in supervisory positions. The findings reveal the existence of a weak correlation between Earning before Taxes (EBT) and the proportion of women on the boards of the EURO STOXX 50 companies.

KEYWORDS

Value creation, women on supervisory boards, key performance indicators, gender quota, earnings before taxes.

1. Introduction

Value creation is a major claim of most companies and when leafing through the annual reports of companies one encounters expressions such as "value to our shareholders", "we provide value for our customers", "we create value for our employees, shareholders, business partners, neighbours and the public", etc. While it seems to be clear for whom value is created, the concept of "value" itself is subjected to various interpretations and is regarded in the literature as ambiguous (Lepak, Smith and Taylor, 2007; Marinova, Larimo and Nummela, 2017). Mahajan (2017) argues that "value and value creation are natural to and basic in human behaviour and endeavour", nevertheless women are often marginalized and impeded in their advancement towards leadership positions, where they could shape and influence the process of value creation. The urge to better use the talent pool represented by women was voiced by many actors: OECD (2016) for example emphasized that women "can provide society with different perspectives and approaches to management, organisation and business issues". In order to change the organizational culture of all-male boards, positive actions such as gender quotas were introduced in many European countries.

The present paper looks at the companies of EURO STOXX 50 index in the year 2015 and offers an overview of women representation on the boards of these 50 companies, the index being described as a "Blue-chip representation of supersector leaders in the Eurozone" (stoxx.com). The paper tries to establish whether the success of these companies can be related to the percentage of female members in supervisory positions. The findings reveal the existence of a weak correlation between Earning before Taxes (EBT) and the proportion of women on the boards of the EURO STOXX 50 companies.

This paper replicates the study of Binder, Alonso-Almeida and Bremser (2016) which analysed the relationship between female's representation in the management board (executive board) and firm performance (measured by EBT) of the EURO STOXX 50 companies in 2014.

The author of this paper deems the presence of women on corporate boards as valuable in itself and argues that images such as the "white, heterosexual, western, middle/upper class, able man" (Zanoni et al., 2010, p. 13) ought to be challenged in international business.

2. Value creation in annual reports

The centrality of value creation is uncontestable for companies and management and organizational scholars alike. While agreeing that "there is little consensus on what value creation is or on how it can be achieved" (Lepak, Smith, Taylor, 2007, p. 180) this paper does not seek to coin a new definition of value creation. It examines companies' understanding of the world "value" and "value creation", it presents shortly the management approach which places value creation at the core of a company's strategy, namely value-based management (VBM), and it focuses on the presence of women in supervisory board by trying to establish whether there is a relationship between the percentage of women on board and companies' performance as measured by earnings before taxes (EBT). Before embarking on the quest of finding the meanings of "value" and "value creation" as understood by the companies of EURO STOXX 50 index, it is, however, important to adopt a definition of value creation from the existing body of literature.

Value is seen to positivly impact the stakeholders, employees, cusomers, partners and CEOs, society, companies and shareholders (Mahajan, 2016). The author acknowledges the significance of the monetary component of value creation, as it becomes apparent also from the definition offered by Lepak, Smith and Taylor: "value creation depends on the relative amount of value that is subjectively realized by a target user (or buyer) who is the focus of value creation – whether individual, organization, or society – and that this subjective value realization must at least translate into the user's willingness to exchange a monetary amount for the value received" (2007, p. 182). Value destruction should be avoided by the CEO by focussing on the customer and using financial and non-financial assets and measures (Mahajan, 2016, p. 69).

The paper draws on existing literature in the field of key performance indicators (KPIs), diversity management, women quota and supervisory boards and it is structured as follows: in a first step, value and value creation is described on the basis of the annual reports of the 50 EURO STOXX companies. By reading the annual reports it also became evident, that some of the companies employ the value-based management approach, and therefore, one section is dedicated to this aspect. In a second step the presence of women on the supervisory board as a relevant resource is examined and here evidence from literature is brought into light. Finally, a correlation analysis is conducted in order to see, whether there is a relationship between the number of women on supervisory boards and

financial performance of the companies under scrutiny. The last sections is dedicated to the findings and it also shows the limitations of this study and offers suggestions for future research.

Most of the companies of the EURO STOXX 50 index use in their annual reports the word "value", be it in the sense of monetary worth, importance in the eyes of someone, or principle or belief. The Belgian company Anheuser-Busch InBev for instance employs the word "value" in the following contexts: "The total transaction is valued at 12 billion US dollar and is conditional on completion of the Combination" (Anheuser-Busch InBev, 2015, p. 2).

The French company Essilor states strongly to have five values, which are "expressed every day in the way teams around the world work together" (Essilor, 2015, p. 59). These values are respect and trust, diversity, entrepreneurial spirit, working together and innovation (Essilor, 2015, p. 61).

Airbus focuses on delivering value for shareholders as in "value to our shareholders through our share buybacks, with an additional €1 billion launched in October 2015" (Airbus Group, 2015, p. 19). Airbus also claims to "recognize the value that diversity brings" and therefore "is committed to advancing women in the workplace and developing female talent" (Airbus Group, 2015, p. 26). This claim is, however, doubtful: Denis Ranque, the chairman of the board, speaks about the existence of a "more appropriate level of gender diversity", though as of 1st January 2016, there were two women on the board of directors of Airbus.

Moreover, it has to be pointed out that there is often a tendency of using words in a loose or even misleading manner. Fresenius for example had at the end of 2015 an all-male supervisory board, being actually the only company of the EURO STOXX 50 index in this situation. Yet, in its annual report it is mentioned that "Fresenius values a culture of **diversity**[1]. The interplay of a wide range of views, opinions, cultural backgrounds, experiences, and values help us to achieve our full potential and contributes to our success" (Fresenius, 2015, p. 27).

Other companies of the EURO STOXX 50 index claim in their annual reports to being committed to value creation. Nokia states for example the following: "We aim for all our

[1] Original emphasis.

business groups to be innovation leaders, drawing on our frontline R&D capabilities to deliver leading products and services for our customers, and ultimately ensure the company's long-term value creation" (Nokia, 2015, p. 40).

Social and economic value creation is the aim of the Spanish company Inditex (Industria de Diseno Textil SA): "To create value for society while creating value for the business is the fundamental target of Inditex " (Inditex, 2015, p. 98).

Philips, ING, and Eni offer in their annual reports a detailed description of the process of value creation, though none of them claim to use VBM. Philips draws on "six different forms of capital to drive value in the short, medium and long term" – human, intellectual, financial, manufacturing, natural and social capital (Philips, 2015, pp. 12-13).

Eni goes one step further than Philips, and presents the effects of the capitals employed (financial, productive, intellectual, human, social and relationship, and natural capital) on the company itself, but also on the company's stakeholders.

ING too provides the reader with a value creation model in its annual report, mentioning that "as a financial institution, our input is mainly in the areas of financial, intellectual, and human capital, whereas we impact society across all the capital outputs defined in the International Integrated Reporting Council (IIRC) value creation framework" (ING, 2015, p. 6).

It should be clear by now the words "value" and "value creation" appear in most annual reports of the companies of EURO STOXX 50 index, and as already mentioned some of these companies also employ a VBM metric. The next section of this paper gives a short overview on VBM and on the of the EURO STOXX 50 companies using this approach.

3. VBM and the EURO STOXX 50 companies

The following table shows the eight companies of the EURO STOXX 50 index, which according to their annual reports were using VBM in 2015.

No.	Company name	Country	Sector	VBM
1	Airbus Group SE	FR	Industrial Goods and Services	✔
2	BASF	DE	Chemicals	✔
3	Bayer	DE	Chemicals	✔
4	BMW	DE	Automobiles and Parts	✔
5	Daimler	DE	Automobiles and Parts	✔
6	Deutsche Telekom	DE	Telecommunications	✔
7	SAP	DE	Technology	✔
8	Unicredit	IT	Banks	✔

Figure 1. Overview of the EURO STOXX companies using VBM in 2015 (Source: own representation based on the information provided in the annual reports of all 50 EURO STOXX companies)

One can find many definitions of VBM in the literature. According to Firk, Schrapp and Wolff (2016, p. 42) "VBM is a holistic managerial approach that aims to align corporate action with value creation". The driving philosophy of companies using VBM is to "maximize shareholder value by producing returns in excess of the cost of capital" (Simms, 2001). In order to maximize shareholder value "VBM links the company's strategic objectives to a coherent set of performance measures through cause-and-effect chains ('value drivers') that include all relevant processes and all pertinent information systems across a company" (Burkert and Lueg 2013, p. 5). Among the most known metrics associated with VBM are economic value added (EVA), discounted cash flow (DCF) and cash flow return on investment (CFROI).

EVA is the most common method, and a registered trademark of Stern Stewart & Company. To calculate the EVA, capital losses are deducted from capital profit. It is considered a simple method, which can be advantageous. However, the existence of a market and book value in the calculation of the EVA can lead to a lack of transparency. Capital profit in opposition to the profit from a balance sheet, is a KPI that describes the profit with interest rates. Capital losses are calculated from the capital multiplied with the capital margin. Yet, only figures taken out from the profit and loss statement or the balance sheet are not sufficient for doing VBM, and calculating the EVA.

When using the DCF method cash flow becomes the central KPI and an equity or an entity approach can be here employed. Discounted rates and the net present value are for the calculation essential. The advantage of the DCF is its acceptance internationally; it is often employed e.g. in mergers and acquisitions valuations. Disadvantages of the DCF-method are that the expected cash flows are uncertain and can change yearly or even during the year.

Companies sometimes use the CFROI method for VBM as well. Developed by the Boston Consulting Group, KPIs like the cash value added (CVA), free cash flow, weighted average costs of capital (WACC) and the gross investments are used for calculating the CFROI. Advantages are that cash flow values can be internally or externally calculated and used by managers and investors to indicate liquidity and solvency. The disadvantages of the CFROI-method are the slightly more complex formulas for calculation.

VBM is, however, 'not just about the numbers' as Haspeslagh, Noda and Boulos (2001) noted: "A successful VBM program is really about introducing fundamental changes to a big company's culture. And therein lies the reason for most of the failures: Transforming beliefs in a large organization is arguably the most difficult of all managerial challenges". In the following paragraphs the understanding of VBM as described in the annual reports of the EURO STOXX companies using this approach is presented.

Airbus states that "among other indicators, the Group uses a Value Based Management approach in order to guide the Company towards sustainable value creation by generating financial returns above the cost of capital" (Airbus, 2015, p. 61). The KPIs employed by Airbus are Return on Capital Employed (RoCE), EBIT pre-goodwill impairment and exceptionals and free cash flow.

The German company BASF considers VBM an essential part of its strategy: the company's slogan "We add value as one company" is regarded as one of the four principles which contribute to the company's "We create chemistry" strategy (BASF, 2015, p. 30). The annual report describes VBM as a holistic approach, implemented at all levels of the company: "According to our value-based management concept, all employees can make a contribution in their business area to help ensure that we earn the targeted premium on our cost of capital. We pass this value-based management concept on to our team around the world through seminars and training events, thereby promoting entrepreneurial thinking at

all levels within BASF" (BASF, 2015, p. 30). As a steering parameter BASF uses EBIT after cost of capital (BASF, 2015, p. 30).

Bayer is another German company of EURO STOXX index which uses VBM (six out of the eight companies employing VBM are German). According to the annual report, "one of the prime objectives of the Bayer Group is to steadily increase enterprise value" (Bayer, 2015, p. 55). The steering parameters involved in reaching this objective are CVA and CFROI: "These indicators support management in its decision-making, especially in the areas of strategic portfolio optimization and the allocation of resources for acquisition and capital expenditures" (Bayer, 2015, p. 55).

BMW writes that "the business management system applied by the BMW Group follows a value-based approach, with a clear focus on achieving profitable growth, increasing the value of the business for the capital providers and safeguarding jobs" (BMW, 2015, p. 20). While declaring that the KPIs engaged in measuring value creation are defined for each controlling level, BMW employs not only financial indicators, such as RoCE, and return on equity (RoE), but also non-financial indicators, such as the size of the Group's workforce (BMW, 2015, pp. 20-21).

Daimler too uses KPIs which are oriented "toward our investors' interests and expectations and provide the foundation of our value-based management" (Daimler, 2015, p. 77). At the core of Daimler's performance measurement system is value added which is "calculated as the difference between operating profit and the cost of capital of average net assets" (Daimler, 2015, p. 77).

Deutsche Telekom states that in order to "set and achieve [its] strategic goals more effectively" (Daimler, 2015, p. 64) a value management approach is pursued. According to the information from the annual report, the Group has a code of conduct which "defines how employees and management should practice value-based and legally compliant conduct in their daily business activities" (Daimler, 2015, p. 46), and the Group's corporate governance is value-oriented (Daimler, 2015, p. 63). Among the KPIs employed by Deutsche Telekom are RoCE, EBIT, and free cash flow.

Dedicated to "creat[ing] long-term value by addressing future needs" SAP uses VBM and it concentrates on two different goals: "We use various performance measures to help manage our performance with regard to our primary financial goals, which are growth and

profitability, and our primary non-financial goals, which are customer loyalty and employee engagement" (SAP, 2015, p. 59).

The Italian company Unicredit describes in its annual report its "principles of value creation and capital allocation" (Unicredit, 2015, p. 36). The main performance indicator used by Unicredit is the EVA.

From the excerpts of the annual reports it becomes apparent that the companies implementing VBM systems do have slightly different understandings, approaches, and KPIs in use. However, as all companies of EURO STOXX 50 index do claim to create value, in the next step of the paper the author analyses the degree to which these companies concentrate not only on organizational growth, but also on organizational sustainability. Sustainability could be achieved if women too were given the chance to be in top positions. The next section contains a literature review with regard to the presence of women on boards and women quota and it introduces the hypothesis of this paper.

4. Women on boards and women quota – a literature review

A controversial issue during the past decades was women's presence in supervisory boards. Women are still the exception in German supervisory boards but their representation increased gradually (Holst and Kirsch, 2014). It can be seen that more women are integrated in supervisory boards in Northern Europe (e.g. Norway, Iceland, Latvia, Finland and Sweden to mention the top 5 countries with the highest women quota). It depends on the examined countries if a study can find a significant link between firm performance and the women quota in supervisory boards. On the one hand, it was shown e.g. for Denmark that a higher women quota in supervisory boards can determine a better company performance (Lückerath-Rovers, 2011) but on the other hand, this finding could not be verified for the same country by other studies (Rose, 2007).

Beaufort and Summers (2013) identified at European level a 1.5% change of women representation in mainly male supervisory boards between 2009 and 2013. If women were already member in a supervisory board, the women quota was likely to increase further. When one woman was a board member, the women quota stood at 3.2%; by already 3 women in the supervisory board, the women quota increased to 3.7%. According to the above study the average women quota in supervisory boards in Europe in 2013 was 7.9%. France stood out as a positive example with a women quota of 28.1% in 2013.

Another study on women in European listed companies suggests positive effects of diverse boards on corporate governance and even on firm performance (Buchwald and Hottenrott, 2014). A similar result was registered by a Catalyst study which examines the relationship between women on corporate boards and their companies' financial performance in the United States (Catalyst, 2007). The study "Women matter. Gender diversity, a corporate performance driver" shows that companies with a higher proportion of women in top management perform better (McKinsey, 2007). Other authors signal rather the lack of evidence that female representation in supervisory boards improves profitability (Ferreira, 2014). It is suggested that rather benefits for the society should be measured when women occupy supervisory board positions. In a study with 108 German large corporations which took place between 2009 and 2013, there was not enough evidence to indicate a significant relationship between gender diversity and firms' financial performance (Dick, 2015).

There are however, institutional factors driving gender quotas in supervisory boards such as e.g. welfare provision for state-owned enterprises, political coalitions and a legacy of initiatives (Terjesen, Aguilera and Lorenz, 2015). It is more likely to establish a high gender quota in supervisory board with left-leaning governments. In a survey of 201 Norwegian firms the positive effect of the women quota in supervisory boards is seen in increased board development activities and in a decreased level of conflict (Nielsen, 2010). Another exhaustive study, in which 2.360 companies from the Morgan Stanley Capital International All Country World Index (MSCI ACWI) were observed over a period of 6 years by the Credit Suisse Research Institute (2012) shows as a result a better mix of leadership skills, a wider pool of talent and a better risk aversion, the higher the women quota in supervisory boards in the companies is (Kersley and O'Sullivan, 2012).

Many studies (e.g. Bilimoria, 2006; Terjesen, Sealy and Singh, 2009) suggest also a positive relationship between female supervisory board members and the number of women officers in management.

What needs to be acknowledged is the fact that gender balance became a priority and diversifying corporate supervisory boards often represent a target to be achieved. Small improvements can be seen with a law instituted quota for women in supervisory boards (Corkery and Taylor, 2012). In Norway, Italy, France, Spain and starting with 2016 also in Germany binding gender quota exist (Sullivan, 2015). Norway was the first country to legislate board quotas in 2004 and many countries followed with law determined or

optional women quotas in supervisory boards, however, less than 10 % of the board members consist of women (Dizik, 2015).

Moreover, men in supervisory boards have often better networks and for this reason the male supervisory board managers often recruit male followers which minimizes the women quota in supervisory boards on the long run (Terjesen, Aguilera and Lorenz, 2015). Rosa, Carter and Hamilton (1996) analysed the impact of gender on small business performance in the United Kingdom (UK) and concluded that there are "some considerable differences by sex in quantitative economic and financial performance measures" (p. 476).

Kalleberg and Leicht (1991) examined organizational performance in terms of survival and success and according to the results of their study, companies that have a high women quota in supervisory boards are not more likely to go bankrupt than those with a high male quota, because both men and women are equally successful with regard to earnings growth.

Another study with reversed causality shows that in over 3,876 public companies the presence of independent female directors is necessary in supervisory boards to contribute best to the firms' performance (Terjesen, Couto and Francisco, 2015). This means that, when no women are included as supervisory board members, the companies' results are lower (measured by Tobin's Q and shown by the Return on assets ROA). Finally, another study with reversed causality about 151 of the capital market listed German firms shows that only after a critical mass of about 30% (e.g. 3 women in absolute positions) is attained, then a higher firm performance can be reached (Joecks, Pull and Vetter, 2012).

The present research focuses on the companies of the EURO STOXX 50 index, and aims at exploring whether there is a link between the EBT of these successful European companies and the number of women in supervisory boards. It has to be noted that the relationship between the EBT and the women quota in management boards was analysed thoroughly by Binder, Alonso-Almeida und Bremser (2016), however, the focus of this article lies on the supervisory board and especially on the link between firms' performance measured by EBT and the proportion of women on the supervisory boards. The following hypothesis are formulated and will be tackled in the following sections:

H1: Enterprises which have a higher gender quota in supervisory boards are more successful and achieve a higher EBT.

H2: Enterprises of technologically more innovative sectors require more women in supervisory board functions in order to achieve success.
H3: Enterprises of traditional sectors often don´t see an impact on their companies and refuse to promote more women in supervisory board positions.
H4: Country or sector specific gender quotas in supervisory boards for the EURO STOXX 50 companies loose their relevance concerning Europe as a whole.

5. Methodology

The EURO STOXX 50 Index was selected to represent the performance of the 50 largest companies among 19 supersectors in the year 2015. There are enterprises of seven Eurozone countries which are integrated in this index. This index has a fixed number of components and is part of the STOXX blue-chip index family. Moreover, EURO STOXX 50 index is one of the most liquid indices for the Eurozone and serves for benchmarking purposes. The index is a financial control index which ensures stable and up-to-date figures. It represents the performance of only the largest and most liquid companies in a sector (STOXX Limited, 2016). The EURO STOXX 50 Index was chosen in this publication as value and value creation was not analyzed before for these 50 companies.

The following table gives an overview of the 50 companies which are part of the EURO STOXX index, their sector of activity, country of origin, the percentage of women on their supervisory boards, as well as information on whether these companies use VBM.

No.	Company name	Sector	Country	Representation of women on board	Value based
1	Air Liquide	Chemicals	FR	41,7%	✗
2	AIRBUS GROUP SE	Industrial Goods & Services	FR	16,7%	✓
3	ALLIANZ	Insurance	DE	30,8%	✗
4	ANHEUSER-BUSCH INBEV	Food & Beverage	BE	14,3%	✗
5	ASML HLDG	Technology	NL	33,3%	✗
6	ASSICURAZIONI GENERALI	Insurance	IT	40,0%	✗
7	AXA	Insurance	FR	35,7%	✗
8	BASF	Chemicals	DE	25,0%	✓
9	BAYER	Chemicals	DE	20,0%	✓
10	BCO BILBAO VIZCAYA ARGENTARIA	Banks	ES	25,0%	✗
11	BCO SANTANDER	Banks	ES	36,4%	✗
12	BMW	Automobiles & Parts	DE	30,0%	✓
13	BNP PARIBAS	Banks	FR	50,0%	✗
14	CARREFOUR	Retail	FR	25,0%	✗
15	DAIMLER	Automobiles & Parts	DE	25,0%	✓
16	DANONE	Food & Beverage	FR	38,5%	✗
17	DEUTSCHE BANK	Banks	DE	31,8%	✗
18	DEUTSCHE POST	Industrial Goods & Services	DE	35,0%	✗
19	DEUTSCHE TELEKOM	Telecommunications	DE	40,0%	✓
20	E.ON	Utilities	DE	16,7%	✗
21	ENEL	Utilities	IT	33,3%	✗
22	ENGIE	Utilities	FR	57,9%	✗
23	ENI	Oil & Gas	IT	20,0%	✗
24	ESSILOR INTERNATIONAL	Health Care	FR	18,8%	✗
25	FRESENIUS	Health Care	DE	0,0%	✗
26	GRP SOCIETE GENERALE	Banks	FR	50,0%	✗
27	IBERDROLA	Utilities	ES	38,5%	✗
28	Industria de Diseno Textil SA	Retail	ES	25,0%	✗
29	ING GRP	Banks	NL	25,0%	✗
30	INTESA SANPAOLO	Banks	IT	26,3%	✗
31	L'OREAL	Personal & Household Goods	FR	40,0%	✗
32	LVMH MOET HENNESSY	Personal & Household Goods	FR	23,5%	✗
33	MUENCHENER RUECK	Insurance	DE	40,0%	✗
34	NOKIA	Technology	FI	25,0%	✗
35	ORANGE	Telecommunications	FR	40,0%	✗
36	PHILIPS	Industrial Goods & Services	NL	33,3%	✗
37	SAFRAN	Industrial Goods & Services	FR	23,5%	✗
38	SAINT GOBAIN	Construction & Materials	FR	40,0%	✗
39	SANOFI	Health Care	FR	35,7%	✗
40	SAP	Technology	DE	22,0%	✓
41	SCHNEIDER ELECTRIC	Industrial Goods & Services	FR	38,5%	✗
42	SIEMENS	Industrial Goods & Services	DE	30,0%	✗
43	TELEFONICA	Telecommunications	ES	11,0%	✗
44	TOTAL	Oil & Gas	FR	33,3%	✗
45	UNIBAIL-RODAMCO	Real Estate	FR	36,4%	✗
46	UNICREDIT	Banks	IT	20,0%	✓
47	UNILEVER NV	Personal & Household Goods	NL	54,6%	✗
48	VINCI	Construction & Materials	FR	40,0%	✗
49	VIVENDI	Media	FR	42,9%	✗
50	VOLKSWAGEN PREF	Automobiles & Parts	DE	15,0%	✗

Figure 2. Overview of the 50 EURO STOXX companies from 2015 *(Source: own representation based on the information from: https://www.stoxx.com/index-details?symbol=SX5E and the annual reports of the res, retrival date: 03/03/2017)*

The research was conducted for the first time at the beginning of the year 2016 and it was carried on in the year 2017. The original study published in 2016 tackled the relationship between EBT and the women quota of executive boards, relying on data extracted from the 2014 annual reports of the fifty EURO STOXX companies and financial websites.

The current study looks at the number of women in supervisory boards as presented in the 2015 annual reports of the fifty EURO STOXX companies, and data regarding the EBT of each of the fifty companies was collected similarly to the research from 2016, via financial websites.

The composition of EURO STOXX index in 2015 changed slightly in comparison to the year before. Two new companies were included in the EURO STOXX index: Fresenius (Germany) and Safran (France) replaced Repsol (Spain) and REWE (Germany), a change which became effective on September 2015 (STOXX Limited, 2015). The composition change of the index takes place once a year, in September, when only the biggest companies are maintained on the basis of their market capitalization and their price index. Out of the 50 EURO STOXX companies four have e.g. the highest index weights: Total (France) with 4.78%, Sanofi-Aventis (France) with 4.39 %, Bayer (Germany) with 4.29 %, and Anheuser-Busch InBev (Belgium) with 4.11 %.

In order to examine how successful these companies are, the EBT was chosen as being a relevant KPI, taking thus into consideration the fact that companies may face different tax rates in different states. In other words, the lack of a harmonized taxation system across the Eurozone will not affect the results of this study, the EBT making possible a comparison of the 50 EURO STOXX companies at European level.

6. Findings

Figure 2 has already offered an overview of the 50 EURO STOXX companies, the sector in which they are active, and their country of origin. In the next figure it can be seen that the 50 EURO STOXX companies in Europe are located only in 7 countries. The allocation to different sectors can be seen for each country of EURO STOXX 50 index in figure 3.

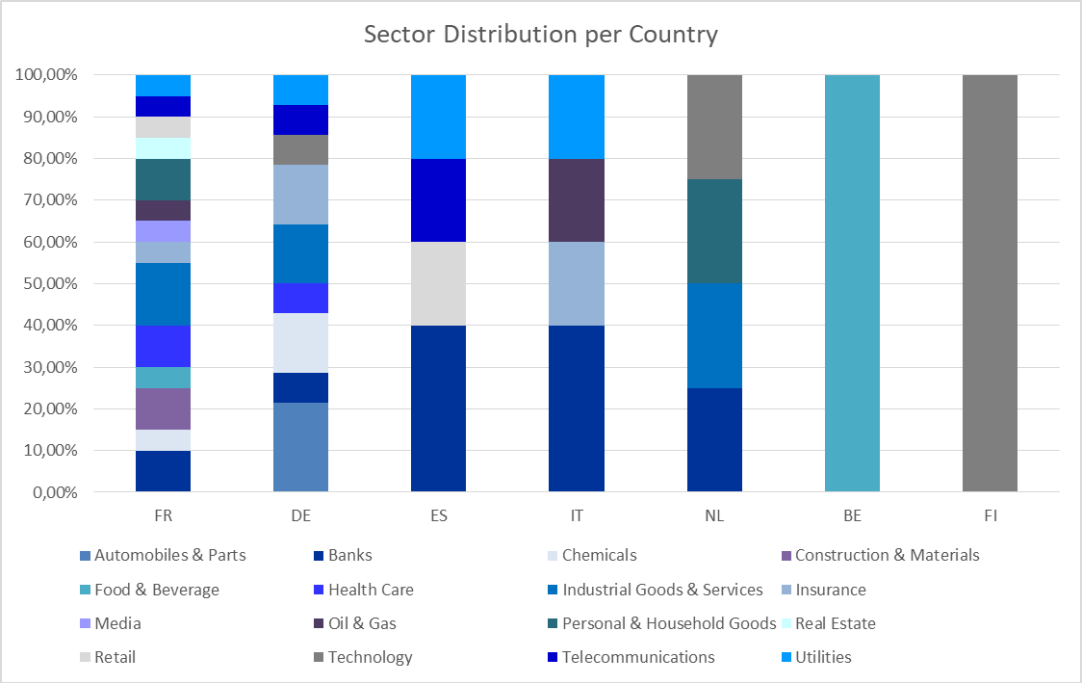

Figure 3. The 50 EURO STOXX countries in Europe and their sectors *(Source: own representation based on the information from: https://www.stoxx.com/index-details?symbol=SX5E, retrival date: 03/03/2017)*

Hypothesis H2 (Enterprises of technologically more innovative sectors require more women in supervisory board functions in order to achieve success) and hypothesis H3 (Enterprises of traditional sectors often don´t see an impact on their companies and refuse to promote more women in supervisory board positions) could not be verified in the sector specific analysis. It could be seen that the women quota is not much higher in technologically more innovative sectors like e.g. Media (42,86%) compared to traditional sectors like e.g. Construction & Materials (40,0%) and e.g. Personal & Household Goods (39.36%). Therefore, these two hypotheses could not be confirmed.

Figure 4 shows the number of companies that each country has in EURO STOXX 50 index. Most EURO STOXX companies are located in France (20) followed by Germany (14), Spain (5) and Italy (5). The Netherlands has four companies in the EURO STOXX index, while Belgium and Finland have only one big company.

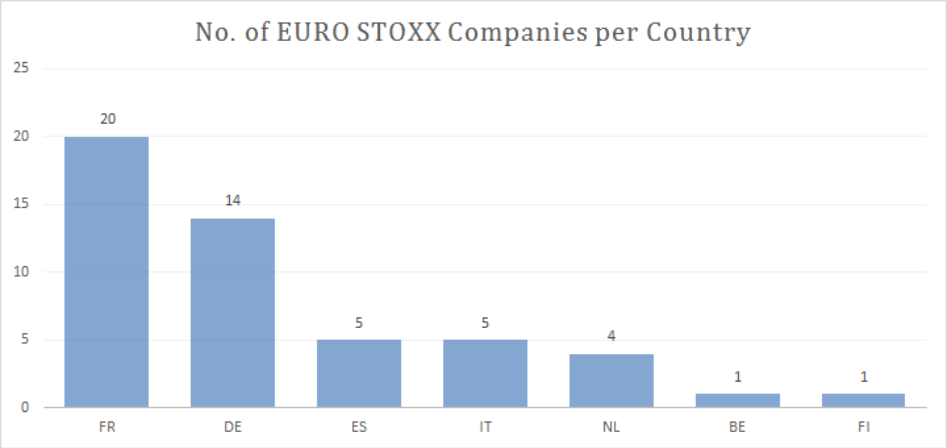

Figure 4. Number of EURO STOXX 50 companies per country *(Source: own representation based on the information from: https://www.stoxx.com/index-details?symbol=SX5E, retrival date: 03/03/2017)*

In order to test the raised hypothesis (H1: Enterprises which have a higher gender quota in supervisory boards are more successful and achieve higher EBT), two steps are necessary. In a first step, the EBT of the EURO STOXX index should be examined. In a second step, the gender quota per sector and in total should be analyzed for supervisory boards and the findings should be brought together.

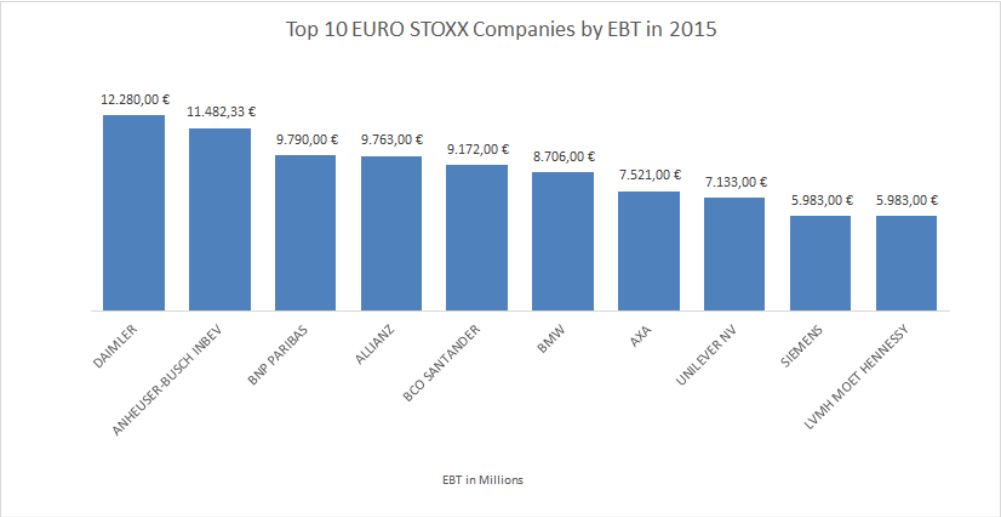

Figure 5. Top 10 EURO STOXX companies by EBT with figures of 2015 in million EUR *(Source: own representation – the EBTs of all the 50 companies were taken from http://www.finanzen.net/ - retrival date: 03/03/2017)*

Figure 5 shows a top 10 ranking of the EURO STOXX companies according to their achieved EBT in 2015. On the first place in 2015 was Daimler (Germany) with an EBT of €12.3 million. Daimler has overtaken Volkswagen (Germany), which was on the first place in 2014 with €10.8 million, but it suffered a serious draw back in 2015 due to the emissions scandal. Daimler is followed in the 2015 EBT-ranking by Anheuser-Busch InBev (Belgium) with €11.5 million and BNP Paribas (France) with € 9.8 million.

While in the 2014 EBT-ranking one could find Deutsche Bank (Germany), E-On (Germany), Enel (Italy) or Eni (Italy), in 2015 these four companies are no longer among the most powerful companies by EBT. Deutsche Bank e.g. suffered in 2015 claims for compensation and the energy sector went through a critical situation which caused in all cases lower EBTs for these companies.

When considering hypothesis 1 (Enterprises which have a higher gender quota in supervisory boards are more successful and achieve a higher EBT) it could be observed that a higher gender quota is not explicitly necessary for achieving a higher EBT. Daimler achieves the highest EBT but has a relatively small women quota (25,0%). The same can be said e.g. for Anheuser Busch Inbev which has the second highest EBT but has a women quota of only 14,3%. For this reason the first hypothesis could not be supported.

If by now the focus was on offering a broad insight on the EURO STOXX companies and the KPI EBT, in the following section the emphasis will be on completing this insight by introducing also the information on gender quotas in supervisory boards as found in the annual reports of the EURO STOXX companies. Figure 6 shows the percentage of women in supervisory boards in each of the 7 countries, as given by the EURO STOXX companies.

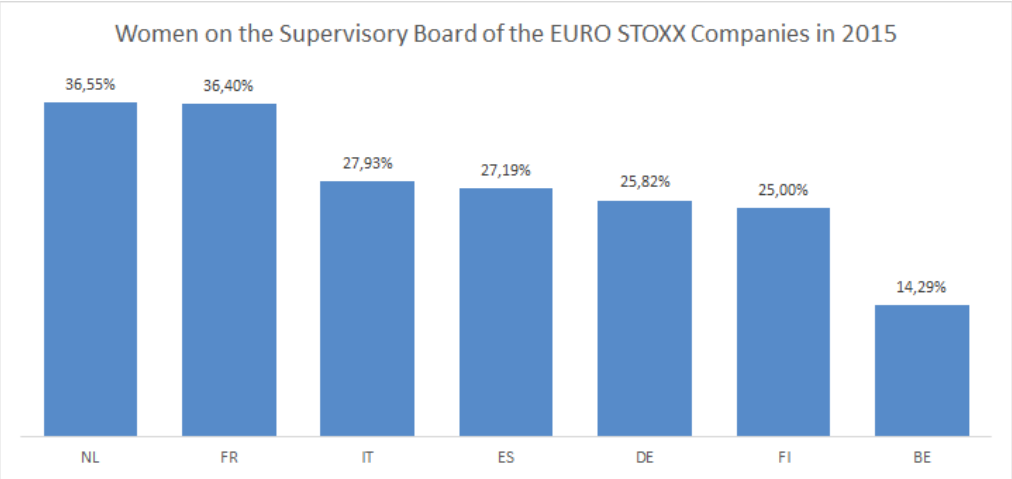

Figure 6. Number of women on the supervisory board of EURO STOXX companies in 2015 in different countries. *(Source: own representation – the information with regard to the number of women on the supervisory board was extracted from the 2015 annual reports of the respective companies)*

In six out of the seven countries the women quota in supervisory boards in 2015 is higher than 25% in average. In contrast only in two countries the women quota in management boards in the year 2014 was higher than 25%: This shows that there are more women in supervisory boards than in management boards. The highest women quota in supervisory boards has Netherland with 36.6% followed by France with 36.4%. Figure 6 shows that the expected women quota of 30 – 40% is not yet achieved by EURO STOXX companies.

Due to the fact that the countries Germany and France have the highest number of companies in EURO STOXX 50 index and the highest EBT per company and per employee these two countries are examined more closely.

By constructing a frequency distribution (figure 7), one can see that in France, most of its EURO STOXX companies have in the supervisory board a 40% women representation. Only one French company (Engie with 57%) has a women quota of up to 60% in the supervisory boards and four French enterprises have a women quota up to and including 50%: BNP Paribas, GRP Société Générale, Vivendi and Air Liquide.

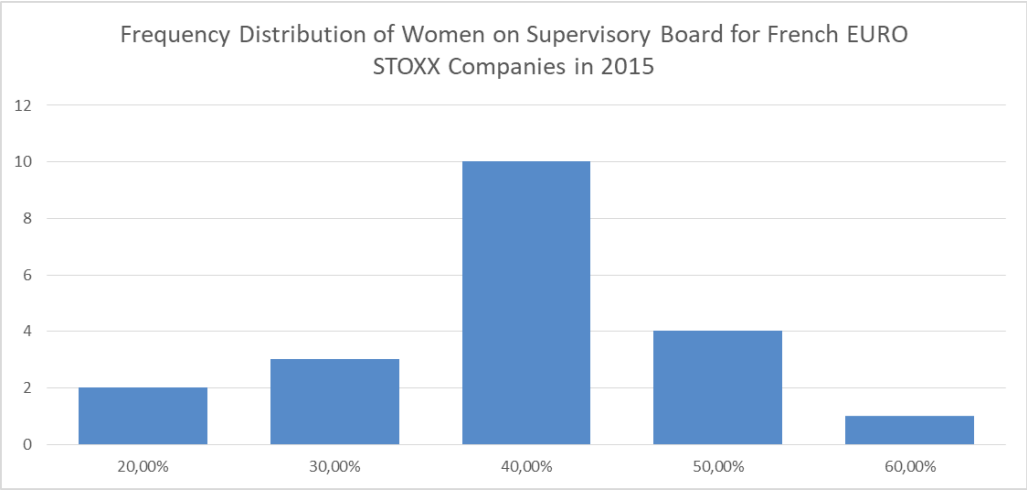

Figure 7. Frequency distribution of women on the supervisory board of French EURO STOXX companies in 2015 *(Source: own representation – the information with regard to the number of women on the supervisory board was extracted from the 2015 annual reports of the respective companies)*

The classes into which women from the supervisory boards of German companies could be divided are different in comparison with those of the French companies. There is no German company which reached a women quota in supervisory boards of 50% or up to 60%. The highest women quota in supervisory boards for German enterprises is that of maximum 40%. Enterprises that have such a high women quota are Deutsche Telekom and Münchener Rück (each with 40%), Deutsche Post (35%) and Deutsche Bank (32%) (see figure 7).

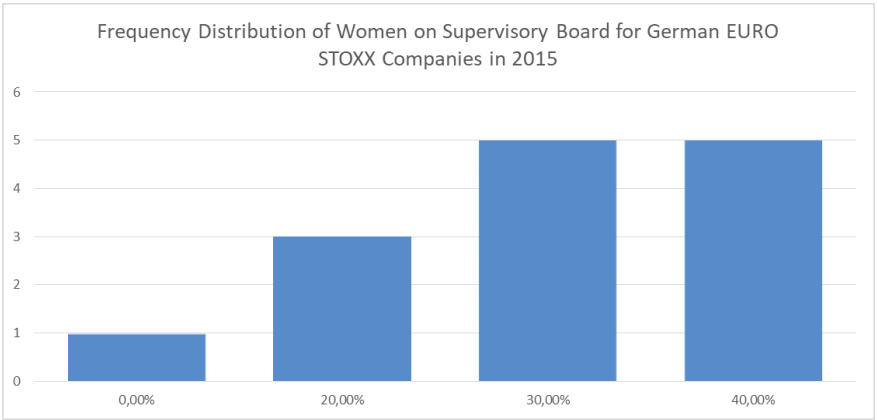

Figure 8. Frequency distribution of women on the supervisory board of German EURO STOXX companies in 2015. *(Source: own representation – the information with regard to the number of women on the supervisory board was extracted from the 2015 annual reports of the respective companies)*

As it can be observed, the companies having the highest women quota are not part of the top 10 ranked companies by EBT (BNP Paribas is the only exception here). When all French companies are considered and a corelation analysis is drawn between the percentage of women and the EBT of these companies, only a weak relationship between these two variables can be seen (r=0.01).

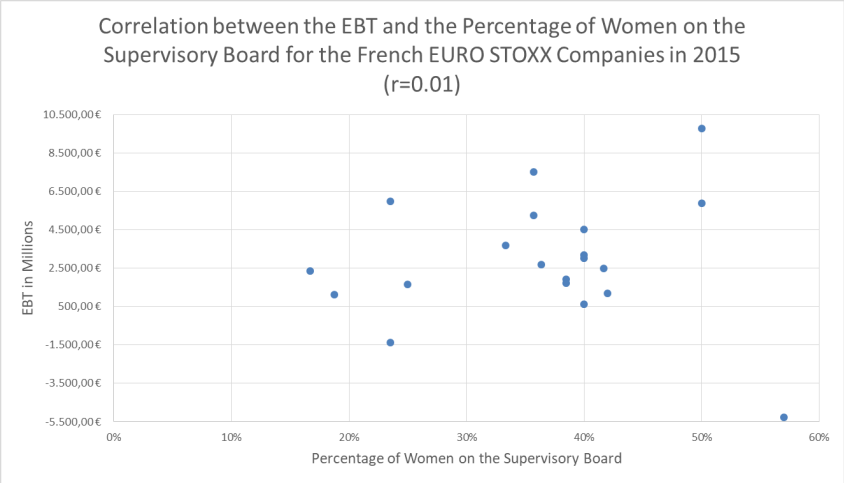

Figure 9. Correlation between EBT and women quota in supervisory boards of the French EURO STOXX companies in 2015 *(Source: own representation – the information with regard to the number of women on the supervisory board was extracted from the 2015 annual reports of the respective companies)*

A similar result was found also in the case of German companies after running a correlation for the EBT and the percentage of women on the supervisory board (see figure 10). An increasing women quota in the German companies seems to cause an increasing EBT.

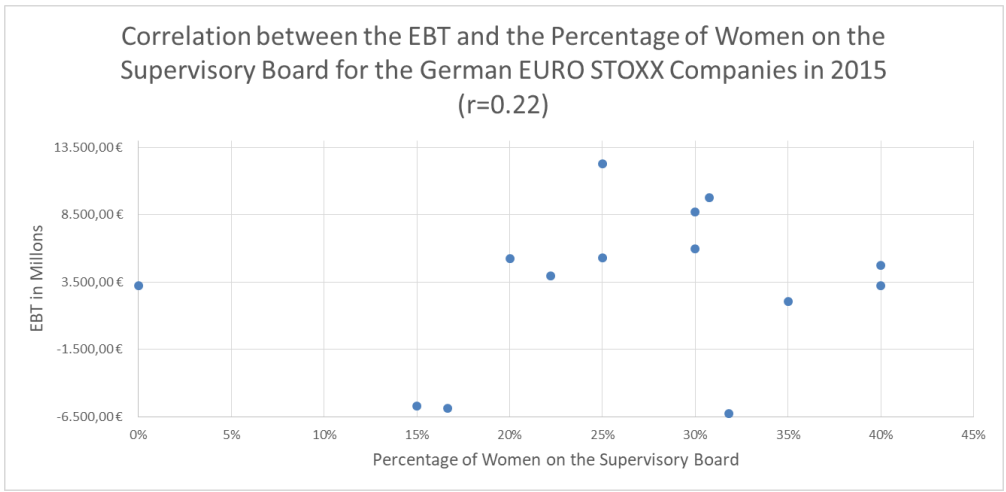

Figure 10. Correlation between the EBT and women quota in supervisory boards of the German EURO STOXX companies in 2015 *(Source: own representation – the information with regard to the number of women on the supervisory board was extracted from the 2015 annual reports of the respective companies)*

7. Discussion of results and conclusion

As the statistical analysis of the previous section has shown, hypothesis 1 (H1: Enterprises which have a higher gender quota in supervisory teams are more successful and achieve a higher EBT) cannot be supported. A recommendation for future research would be to repeat the analysis using another sample, not to choose the EURO STOXX 50 Index but another index.

Neither Hypothesis 2 (H2: Enterprises of technologically more innovative sectors require more women in supervisory board functions in order to achieve success), nor hypothesis 3 (H3: Enterprises of traditional sectors often don´t see an impact on their companies and refuse to promote more women in supervisory board positions) could be verified. Finally hypothesis 4 (H4: Country or sector specific gender quotas in supervisory boards for the EURO STOXX 50 companies loose their relevance concerning Europe as a whole) can be seen as realistic because country-specific laws regulate the women quota in a unique way. Due to the fact that there are no laws at European level to regulate consistently the women quota on supervisory boards, country-specific laws are still relevant, determining different women quotas for different countries. This is the reason why the findings concerning EURO STOXX 50 index companies are not generalizable.

Nevertheless, these findings should be treated cautiously. They do not imply that women in supervisory positions are less effective than men. The success of a company is influenced by the entire supervisory board, male and female alike.

Moreover, a successful result in the form of EBT is generated mainly by the management board and not by the supervisory board only.

Furthermore, another type of information should be included in future research, such as women qualification, experience, educational background, etc. All these aspects could provide a more realistic image regarding the role of women in supervisory boards and company performance.

The quota of women in the supervisory boards is shown in this article on basis of the year 2015. However, the development of the women quota in supervisory boards remains to a certain degree constant over a period of time. The reason is that the term of office of supervisory board members is fixed via contracts for a certain time span – e.g. five years. For this reason no massive change of the women quota in supervisory boards can be expected. Additional research is needed to shed more light on this issue.

Moreover, as presented in the literature review, female participation in supervisory boards shows mixed results with regard to company performance. Therefore, a more holistic approach is needed, researching not only the number of women on board but also considering women participation in total workforce, industry' sectors, management, subsidiaries, etc.

In the same time EBT as a performance indicator provides only a rough approximation of company success, a combination of indicators could provide better results. Even the consequent measurement of the KPI EBT per employee in all cases as relative figure brings additional insights.

Moreover, depending upon the country of residence of the company, the board structure differs (Anglo-Saxon one-tier board versus German two-tier board system). Thus, a comprehensive indicator should be found, one which identifies only those women, which are actually able to influence company decisions. A long term research could bring more results and appropriate solutions to improve the situation of women on the boards of companies.

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The European Perspective of the Labour Market for Graduates in Business Administration: The Spanish case.

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ABSTRACT

In view of the economic situation of the European Union, a growing concern of graduates in business and social sciences is the phenomenon of finding a job and therefore, professional skills required by modern companies, short-, medium- and long-term causes and consequences of it.

This research can be a useful tool for students and professionals who are in the process of seeking their first opportunity or who have lost their job. Even for those executives who will decide to change their career path by facing day to day the challenge of selection processes. An objective that, in addition to the traditional interest that encloses in itself, has become one of the key current topics.

Among the immediate objectives of this study, there is an in-depth analysis of the students' true professional objectives, in order to find out if they really meet the business world expectations. Collaboration and suitability between higher education and business requirements. Professional and university education should be more focused on today's reality.

KEYWORDS

Job, vacancy, Administration and Business Management Degree, European Union, Public Relations, Communication.

1. Theoretical Framework

As soon as the students finish their university studies after three or four years devoted to college, the new graduates face the first major challenge of their life. Until then, they have been guided and tutored by their families in the first years of their life or by school teachers, and later, by university professors. Now they are alone facing a fact that will significantly affect positively or negatively on their life. They have to decide where they intend to direct their professional future, since nowadays few young people follow their parents' profession and take benefit from their experience or family business.

The main purpose of this study is to offer young people, who have recently finished their university studies, some meaningful guidelines that can help them effectively when seeking their first job, or when they are changing to another one. At the same time, it is also intended to help them tracing the course of their professional career so that the private interest of the student (to find a job) can match with the public interest of business and society (to find good professionals), according to what modern company demands.

The European Union Treaties designed the EU identity, setting the constitution of it. The identity crisis that the EU is experiencing consists of this contradiction between what it should be and what it really is.

From the very beginning, the raison d'être of the European Union or its ultimate goal has always been something very clear: "an ever closer union between the people of Europe", as stated in the first article of the Treaty on European Union, which was founded in 1993. But until few years ago, this goal seemed very far away. We were in the first babbling. Over the years, small steps have been taken towards this goal: freedom of movement throughout the Union, single market, single currency. With the Euro, the European Union takes a giant step. The goal is glimpsed and it is at this moment that the politicians are afraid of taking the leap. They are afraid of losing their personal prerogatives, their power, or what they believe it is "their sovereignty". It was since then that European Union gets in "no man's land". It is neither a federal state nor a group of isolated states that can make their own decisions freely.

In the European Union, there are four characteristic freedoms of movement already defined in the agreements of the Treaty on the functioning of the European Union, Articles 45 et seq.: Free movement of capital, services, goods and people. The last one, free movement of people – understanding freedom of workers and freedom of establishment – is the less real and the most difficult one, according to the results of our research, which are described in this essay.

Beyond the scope of management positions, this freedom is very limited for the majority of citizens of the European Union, since cultural, social and language difficulties have raised an invisible wall where geographical borders once stood. It is a wall that only in case of serious labour crises, the average citizen dares to cross. The young university student, for his education and language skills is called to adapt himself to this reality and the requirements of a European Union without borders, which is his new and young country; the new professional framework he has to be aware of.

There is another issue of the current labour market that affects, above all, the young graduate who intends to enter the world of business management: The phenomenon of the globalization of production in general and the market labour in particular. This phenomenon includes, among others, the offshoring of companies and the outsourcing of production. The young university student is facing a new labour world affected by the crisis, especially the university student who wants to work in business management. It is also an international market, open therefore to the competition of any university in the world, not only from Europe. Added to this concern, is that not only languages but also other competences and skills are going to play an important role not only in Europe but in the entire world.

Not only the skills to find employment are part of the path to achieve the professional goal that each student of Business Administration or related careers in Economics, Business and Social Sciences has set, since "first we must know how to transmit these competencies to the student through teaching practice", as quoted in *Twenty professional skills for teaching practice* by Medina, M, from the University of Coahuila, Mexico and Barquero, J.D. (2012). According to the present situation of the Spanish and European university education, and also taking into account the role of business companies in study

programs, it is not a matter of "previous information" but an approach of cooperation and collaboration between the university and the company. University should teach in accordance with company needs and expectations.

1.1 Professional insertion and the Business Administration Degree

Labour insertion in general, and that of university students in particular, has been the object of study and research in recent decades. We are going to limit our study to Business Administration students, though most of the problems affect the university students in general.

One of the most extensive studies on this subject is the one published by Javier Vidal on the occasion of a seminar held in Leon, Spain. This study collects some lectures of different specialists in this area, such as: Professor Ulrich Teichler, talking about experiences developed in Europe with CHEERS project; Jim Allen, Ger Ramaekers and Rolf Van der Velden dealing with competencies in relation to the method known as the Bologna Declaration, a method that intends to homogenize the competencies of different European academic degrees.

Regarding the graduates survey of CHEERS, Spain is the country where graduates in general take a longer time to find a job:

Country	**Job search length (in months)**	**Employees %**	**Dissatisfaction with current job %**
Norway	3,3	87	4
Sweden	4,9	83	11
Finland	501	93	9
United Kingdom	4,4	87	18
Netherlands	4,7	93	7
Germany	5,5	87	12
Austria	6	87	10
France	7,1	69	14
Spain	11,6	73	13
Italy	8,9	79	18
Total	**6,1**	**84**	**11**

Table 1. Time to find a job. *(Source: CHEERS survey of graduates 2016)*

In view of this fact, it is urgent to try to reduce this period of transition, which implies the difficulty of finding a job. This phenomenon is crossed by the industrial sector reduction, the increase on services, the technological revolution and the increase in life expectancy of the population, as well as the offshoring and the skills of developing and emerging countries in almost all fields, especially in the primary sector (facts that are bringing about what we could term as revolution in the labour market).

Many times the services that companies need to cover do not match the professional capacities that jobseekers provide due to some changes occurred in society, such as:

- The increase in active population with the incorporation of women and young people into the labour market;
- Technological developments that produce new professions and new ways of working;
- The market globalization, which seeks more favourable environments by means of a more open economy without borders and free movement of people and flow of capital.
- The integration in the European Union and the Single Market, which leads to competition within companies, due to the free movement of people, goods and services.

The key to entering this market is to have a flexible and multifunctional curriculum vitae. A professional career is no longer valued as unique and constant throughout one's professional life. What is really important is to develop the so-called human capital, that is, a series of skills like responsibility, initiative, organization, adaptive capacity, flexibility and personal self-assessment. Likewise, it is necessary to promote certain skills regarding work, such as ability to learn, to communicate and to work in teams.

Technological changes are also affecting work organization, as a consequence of new ways of employment relationship, employment models – working at home, teleworking…etc. –, social cohesion and integration, since technology could develop a new system of social stratification arising from an unequal opportunity among those who have information and know how to use it and those who cannot have access to it or do not know how to do it.

On the other hand, the traditional long labour paths that were very common in the past and still now, are already declining. After ten to fifteen years of professional practice, there is a moment of disruption and refocusing of the professional activity. It may consist of a simple change of job or it could mean a more radical change due to boredom, fatigue or stagnation, without improvement prospects, promotion possibilities or exciting challenges capable of encouraging hope, creativity or personal independence.

The main features of this model of professional path are as follow: The change of professional activity stops being an exception. The tendency to retreat into oneself when the retirement age arrives disappears and new opportunities are emerging to stay active, useful and productive for longer. The idea of permanent change is assimilated as a new way of life, even healthier and more desirable than the one-activity-for-all-life style.

As a result, the traditional vision of the career is left behind and a new point of view is adopted in which there is room for frequent and important changes of orientation, sensitivity and activity.

1.2. European labour supply

The global economy has also made a global market from the labour market. This is a huge opportunity for a young BA student, but also a competition with some people who are usually better trained in languages and have a better basic education, according to all the specialized articles published about this issue.

This competition is even greater within the internal market of the European Union because companies are free to hire the most suitable candidate without prevailing his/her nationality. Even in public administration there are very few positions that can be reserved to own nationals for public order, security or public health purposes, as required by Article 45(3) of the Treaty on the Functioning of the European Union. On the other hand, companies from other countries of the European Union chose people from their country of origin for some key management positions due to the connection they have with their parent companies. Therefore, there are two requirements that are increasingly necessary: languages and mobility.

As for the university labour market, the European Higher Education Area has been created with the purpose of providing each degree with a specific professional value. The European Higher Education Area (EHEA) is a process involving governments, universities, students and organizations from 46 European countries and the European Commission. It was pushed up by the Declaration of Bologna, which was signed on June 19, 1999 by Ministers with responsibility for High Education from 29 European countries.

The objective of the EHEA is to make European Higher Education systems compatible within their diversity. It is an open space that supports the mobility of students, graduates, teachers and administration staff. It is structured around the European cooperation to guarantee quality and a system of university degrees organized in three cycles. These degrees will be comparable and therefore recognized in the 46 countries involved in the process. Therefore, the EHEA facilitates the graduates' employability by eliminating the obstacles to the compatibility of higher education.

The international economic situation in which we are immersed, combined with the fact that sometimes labour markets are not able to absorb the large number of existing university graduates, make it difficult for a scenario in which there is no single graduate without employment. The European Employment Services, however, can make it easier for graduates with academic programs designed with business companies' support, more opportunities for professional internships and skills acquisition, to increase their chances of finding a job related to their studies.

Although the global labour market is not regulated as the European Union one, it is a reality too. The globalization of trade, technology, capital and regulation is generating an increase in the professional movement between countries: The percentage of milennials – young people born between 1980 and 2000 – working abroad, will increase more than 50% from 2020. The number of international destinations is also growing - the 13 average countries in 1988 increased to 22 in 2009 and will exceed 33 in 2020 - according to the 4th report, 'Personnel Management in year 2020', by PricewaterhouseCoopers'.

This report focuses on the mobility of talent and takes into account the opinion of top management and professionals of 900 companies. Geographical mobility has become,

according to this report, an essential tool for young professionals, together with education. Among young Spanish managers, the 80% want to work abroad, 82% and 72% expect to use a non-native language at work.

The mobility of talent manifests itself in different ways: From the circulation led by global companies to new models of teleworking, the increase of international opportunities for academic reasons and the unavoidable migratory flow of social groups in search of better living conditions. The shortage of talent, on the other hand, will offer greater possibilities of finding employment in other parts of the world.

1.3. Job profile required by the labour market

Employability refers to the set of skills and attitudes that offer any person the opportunity to obtain a job and to remain in it. The word “empleabilidad” does not exist as such in Spanish, it comes from the English word "Employability". This word, in turn, was constructed from "employ", which is translated as ‘empleo’ and "ability", whose translation is “habilidad”. Together they formed: "Employability", which has been adapted without major changes to Spanish as “empleabilidad ".

According to Guillermo Campos, in Implicaciones del concepto de empleabilidad en la reforma educativa, Revista Iberoamericana de Educación (ISSN-1681-5653), http://www.rieoei.org/deloslectores/573Campos, the meaning given to this word is: "ability to obtain or keep a job". A secondary implication of this same word is: Proven ability in the market to avoid unemployment.

At this moment and in this limited space of the labour market, some academics have called it the “entry port”. Piore (1985) and the segmentalists recognize it as the point of access to internal markets. A similar image is handled by Lester Thurow (1972) and Keneth Arrow (1972), who, from the economy and the administration sectors, have explored the type of relationships that arise between the job seeker and the employer (or representative of the employer institution) when they are physically "facing each other”.

At that time, employability skills will be evident, they will be confronted with the materialization of the new terms of demand and with the requirements of the job itself. The result will be success or failure in obtaining employment.

Similarly, Arrow Kenneth, Op. Cit., 1972, suggested that education can be a mechanism to distinguish desirable from undesirable workers. This hypothesis is also called the "filter" theory, which, like the row effect, implies that education does not directly contribute to the growth of the productivity of individuals, but serves as a means to classify people according to the academic qualifications they have obtained.

Based on these research, the idea that employability is the evidence that markets are changing has been deduced focusing on the lowering of the productive risk through the construction of "ultimate stability" environments. However, the cost of new work environments is borne by job seekers, who must arrive with the new skills already developed and convinced of the need to share interests with the company. These skills must be developed individually, although recently their social importance has been recognized to the point that it is also considered as a responsibility of schools and government.

Where does the market move? What technical training requirements, what skills, what experience is the market demanding? What economic sectors are emerging? What profiles are the most demanded in these sectors? And what requirements do these profiles demand? The answers to these questions will allow us to identify those aspects to which we must pay special attention when developing our employability.

The skills required to consider a person to be "employable" usually vary according to the context in which this person is placed. However, there are some abilities developed thanks to the university studies. These kind of skills have been analysed in this research.

Those include: Solving problems, communication skills, decision taking; to be positive and innovative; ability to be self-confident, self-disciplined, and responsible. To have a positive attitude towards work, analysing, and understanding. Ability to follow instructions, identifying internal and external obstacles, anticipating threats and

opportunities, problems and possible solutions. Organizing, planning and managing. It is also important to be able to strengthen one's identity and personal security.

Furthermore, according to a study from PricewaterhouseCoopers (consulting and human resources company), employability can also be explained through six basic features:

Adequacy-vocation: The individual should be satisfied with the work he has and not simply accepting it for economic needs.
Professional competence: The person shows concern in constantly updating his knowledge.
Suitability: He/she is qualified for the position he/she occupies.
Physical and mental health: This is essential to obtain and keep a job. A lack of health is a disadvantage in a labour market as competitive as it is nowadays.
Alternative resources: It means that the person is able to find solutions to any problem, even when traditional ways have been exhausted.
Personal relationships: The individual is able to achieve a social harmonious environment at work.

As can be noted, these "employability classifications" are not based on technical competences. On the contrary, most are "soft" ones. These skills can be summarized and grouped into three types:

- *Basic skills*: Covering basic reading, writing, arithmetic, etc.
- *Thinking skills:* Including creative thinking skills, innovation, learning, problem solving, etc.
- Personality features and affective skills: Including responsibility, honesty, enthusiasm, positive attitude, etc.

Generally speaking, employers have no problem with people's technical skills development, but they have serious reservations about the non-technical skills. Regarding the employability skills of the three categories mentioned, it is observed that although companies look for people who possess a skill set of the three categories described above, they tend to give much more value to affective skills, such as: positive attitude towards

work, ability to communicate well, and ability to learn. Highly specialized technical skills are little considered by companies to measure the employability of an individual.

2. Methodology

«Social reality is complex, multivariate and difficult to understand. It is perceived by researchers and students as a set of multiple realities. Therefore, the analysis cannot, be simple or carried out only through a single methodology or scientific perspective» (García Ferrando et al., 1992:15).

There is no single scientific method, universally accepted. There are some features composing the scientific method that should be followed with rigor – hence the name "scientific rigor": clear objectives, operational design, validity and reliability in data collection; rigorous analysis and realistic conclusions.

In the first place, we use the qualitative method, not only as a quantitative-qualitative symbolic antinomy, but considered as the empirical method that tries to understand reality -multiculturalism- and it tries to establish identities and differences. Under no circumstances the quantitative analysis of data collected in the investigation is excluded. We will try to take account of the issues, components and specific levels of the object of knowledge by this method.

In the second place, we have used the historical method, not as the historian works by reconstructing and interpreting the past, but as the sociologist does when questioning the social reality, about the cursus suffered by what he is studying, how it has arrived to be as it is, and even why it has become so. The aim is to deepen the awareness of the contingency of social reality perceiving the historicity of the social phenomena studied that is multiculturalism and the PPRR evolution.

In the third place, we have used the comparative method, a consequence of the awareness of diversity: the variety of forms and processes, structures and social behaviours, both in space and time, which leads to the curiosity of the researcher.

Interest inventories are perhaps the most popular instruments in the evaluation of vocational behaviour, as shown by surveys conducted in the United States, where

instruments such as the Strong Campbell Interest Inventory are used by almost 90% of the counsellors (Watkins, 1994). The questionnaires or inventories of interests are a series of items in which individuals are asked to indicate their vocational preferences and have a numerical value that allows obtaining a final score that represents a profile or pattern of interests (Super, 1967; Cronbach, 1998; Roe, 1972).

The interests of a student at a specific time may vary, since the answer given to the questionnaire may be influenced by different factors, both internal and external- Even if it is a true answer, it does not respond to a true stable conviction. However, the answer has a real value.

The questionnaire method is the most common to collect information. There are two main types of questionnaires: Those for measuring and diagnosing personality and those used to collect information. The latter is the one we have used. We have passed the questionnaire to 296 students from the International University of Barcelona, 245 students from the University of Barcelona and 375 ESERP students, so that the sample was large enough to be considered significant.

In order to get information about the companies' requirements regarding the most requested positions, we have selected ten job offers for the ten most requested positions. We have taken them from Infojobs and Michael Page websites among others. A total amount of 100 job offers. Obviously, it is not a questionnaire, because we have the answer without having asked any questions. It is a research work, which is also another system of collecting information and we have used it as a complement to the data collection made by the questionnaire. The vacancy advertisements of selection firms or employing companies are an answer to the implicit question of what is required for a specific position; what is expected of the candidate who applies for a commercial manager position or for any of the other positions mostly desired according to the survey. This information found in the specialized media has much more value than we could have obtained directly through a form, because it is not influenced by the question and reflects reality much better.

When designing the questionnaire, we have always had in mind the objective pursued, which is to inform and guide BA graduates to enter the labour market in the fastest and easiest way. At the same time, the process of joining the company selected should be a satisfaction source and a personal development process for the candidate.

By means of the questionnaire, we tried to find out the most desirable post in the selected sector. Consisting of two questions regarding future project, considered partially closed questions, since one of the answers given had to be chosen, and partially open, because it could be chosen another answer different to the given ones. The questionnaire also had another two questions: about the current position of the applicant and another one about language knowledge.

So then, taking the questionnaire as research process, following the rules of validity, reliability and impartiality referred afterwards, the applicability criterion is also met in order to guarantee that the procedure followed could be also applied in other areas.

We have followed Rafael Muñiz' scheme to develop our questionnaire. Although this author refers to market study, his ideas fit perfectly in the subject frame we are analysing.

3. Analysis and Results

First of all, it was necessary to know which sectors are the most requested and within these sectors, the most desired positions by BA students. On the other hand, we also needed to know the companies' requirements for these jobs. I had to start by designing a questionnaire that would allow us to get as close as possible to the current BA students' wishes. To do this, we have created a model that serves three university centres in order to cover different groups of students and thus avoid possible deviations from reality, as could have happened if we were limited to a single centre. The UB for being a public University, the UIC as a private University and ESERP as well.

The questionnaire technique is the most used to gather information. When designing the questionnaire, we have taken into account Mc Millan and Schumacher outlines (2005) *Investigación educativa. Una introducción conceptual*; Madrid: Pearson-Addison Wesley.

There are two main types of questionnaires: those for measuring and diagnosing personality and those used to collect information. The latter is the one we have used. We have passed the questionnaire to 296 students of the International University of Barcelona, 245 students of the University of Barcelona and 375 students of ESERP, so that the sample was high enough to be considered significant analysing a total of 916 people.

	COMMUNICATION AGENCIES, PUBLICITY, EDITION AND REPRODUCTION	CONSULTING,CONSULTANCY, AUDIT AND BUSINESS ACTIVITIES	BANKING AND INSURANCE	REAL ESTATE ACTIVITIES	INDUSTRIAL	TOURISM, HOTELS AND TRAVEL AGENCIES	BIG CONSUMPTION	TELECOMMUNICATIONS S. I+ D	EDUCATION	HEALTHCARE AND HOSPITAL SECTOR	OTHER	TOTAL	TOTAL%
INTERNATIONAL RELATIONS MANAGEMENT		5	3	3	1	2	3		4			23	7,77
MANAGEMENT/ GENERAL DIRECTION	4	30	14	3	9	18	7	2	2	3	1	93	31,42
HUMAN RESOURCES MANAGEMENT	2	3	1	2		3	1		1			13	4,39
PUBLIC RELATIONS, BUSINESS AND INSTITUTIONAL MANAGEMENT	3	4	4	1	2	4	1			0		19	6,42
BUSINESS MANAGEMENT	2	8	4	4	4	4	3	1	0	1		32	10,81
GENERAL MARKETING MANAGEMENT	9	10	2	2	2	8	3	1	2			39	13,18
PURCHASING MANAGEMENT	1	1	1	1	2	2	1	0			1	9	3,04
LOGISTICS AND OPERATIONS MANAGEMENT	0	3	2	0	3	2	1	1				13	4,39
CONSULTANT-AUDITOR PARTNER	1	5	2	1	0	2	0					11	3,72
CREATIVE ADVERTISING DIRECTOR	3	1	0	0	0	2	0					6	2,03
ADMINISTRATIVE, FINANCIAL AND CONTROL MANAGEMENT	1	8	7	2	2	3	0	0	0	1	2	26	8,78
OTHER		2	1	1	2		2	1			3	12	4,05
TOTAL	28	80	41	20	27	50	22	6	9	5	8	296	
TOTAL %	9,46	27,03	13,85	6,76	9,12	16,89	7,43	2,03	3,04	1,69	2,7		

Table 2. Jobs most requested by private university students in general.

Although someone can argue that the longer a questionnaire is, the more reliable will be, the pursued objective of this questionnaire was only and exclusively to find out the position and area most desired by BA students, and for that purpose, two questions were enough.

The reliability of a questionnaire lies on the precision with which it measures what is analysing. That is to say, the measurements have no mistakes and they are consistent and precise, without any doubt based on precise questions that do not lead to the least confusion.

Over the years, the results may vary, but this does not mean that data corresponding to a specific period of time would not be reliable. Given the specific features of this

questionnaire, we have not believed it necessary or possible to apply methods to verify the questionnaire reliability.

The synthesizing of frequencies is a useful and necessary method to sum up large amounts of data, as it is our case - we have interviewed 916 people -. In this way, we have intended to provide a detailed picture of the data taken from the questionnaire.

The number of times a job is chosen is checked by frequency. The higher the frequency is, the more required the job is and therefore, its position in the ranking is also higher.

Once the data collection process is complete, the analyst begins to explore the data by measuring the central tendency and especially, the dispersion of data around this central tendency.

Frequency analysis is especially useful for describing discreet data categories with multiple options. This analysis implies the construction of a frequency distribution. The frequency distribution is a record of the number of scores that fall within each reply category. Therefore, the frequency distribution has two elements: the reply category and the frequency with which respondents fall into each category.

The only technical requirement of the frequency analysis is that the answer categories should be mutually exclusive and exhaustive. This means that only one reply is possible. The frequency analysis should be exhaustive in the sense that all respondents should fall into a single category. This is our case, since they have only given an answer and they all have chosen a job position.

Regarding the measurement of the central tendency, each data set has a tendency to group around a central value. For most statistical analyses, the average is the measure most often used in central tendency. The average is used more frequently, due to the relation it has with variance statistics. The average is also important in sampling distribution, which consists of all possible media taken from the individual samples and it has the average of the total population as its centre. The average is affected by extreme scores (outliers) which are not common to the standard (or population) as a whole. The average is preferred

when a distribution is symmetric and the interest is focused on a score that represents all the results. In our case, there are no extreme scores that could be considered as outliers, since the most desired position is that of general manager, but it has been chosen by less than 25% of respondents.

With regard to the average of the most desired areas, from 916 students surveyed, 896 have chosen one of the ten areas proposed. The average area would be the one chosen by 89.6 respondents, equivalent to 10%. Therefore, the following areas are above the average: Assessment, consultancy, auditing, communication agencies, tourism, banking and insurance. Below: Industry sector, technology research and development, consumer sector, real estate business, education and healthcare sector.

Regarding the average of the eleven most desired positions, the method is the same. If we have 916 students surveyed and eleven positions selected, the average would be the area selected by 83.2 respondents, corresponding to a 9%. The commercial manager position is at the mid-point. Above the average, there would be the following positions: General manager (top management), marketing manager, finance manager and Public Relations manager. Below average there would be: Head of international relations, art director, human resources manager, consulting partner, purchasing manager and logistics manager. The median selected areas would be the industrial and the consumer goods industry.

It is also worth highlighting from the analysis of the table that 100% of the respondents have answered the questionnaire, thereby indicating that the questions were right and of their interest.

As for the answers given by the students of the three universities chosen, they are quite similar. ESERP students stand out for their preference for the area of communication, advertising, publishing, editing and reproduction; tourism sector and travel agencies. The students of the UIC University are keen on assessment, consultancy, auditing business activities; tourism sector and hotel business. Finally, students from the University of Barcelona prefer banking, assessment and consultancy sectors.

4. Conclusions

The method used to find out the job preferences of students and graduates can be applied to any other group or university degree or even to any other professional training. It is very likely that each sector and position will demand special requirements, but it will also have many aspects in common with the results we have arrived at in this study.

On the other hand, it will be convenient to repeat this research from time to time, since over the years some requirements could become unnecessary and others could be more relevant than before.

Given the existing job mobility in the European Union and taking into account that we are dealing with the European Union's internal market, a market that will be more accessible as extensive the candidate training will be, this study could be applied to the European Union's job market .

After fully examining the answers given by all the respondents and comparing these results with the requirements demanded by modern European Union companies, in terms of training, experience, languages and skills, we have arrived at the following general conclusions. They are the result of both the market research and our own line of research, and parallel to practical results, theoretical results have also been achieved.

As regards to *university training*, as in 40% of the research cases, a master or postgraduate course is required. In another 17.28% of cases, the postgraduate education is a plus. At first conclusion, it is fair to say that in most of the cases, an additional specialty in the specific area chosen to work is a must. Yet, this would not imply that this specialty should be acquired immediately after completing University studies, since it can be combined later with working life.

In terms of *work experience*, if 88.18% of cases require specific work experience of at least 3 years and in 60% of cases, more than 5 years' experience may become appropriate to look for a job in the selected area as soon as possible. Ideally, there should be greater coordination between university and business companies to facilitate that Administration and Business Management students could begin their internships while they are studying,

or at least during vacation periods. This would partially offset this time, which is really necessary.

Regarding the *English language skills*, there is a significant gap between the level of Administration and Business Management graduates and the level required by the companies. 76, 37% of cases, the companies require a high level of English.
However, the percentage of BA students that have a high level of English varies between 18% and 37%, based on colleges and male or female students. How this distance could be reduced? Obviously, this should be a task made during primary and secondary studies, and the fault lies there.

Unfortunately, according to reports issued by all international entities, our primary and secondary school not only fails in this field. However, the student should be aware that he has to overcome this deficiency of English language skills, finding a solution from the first year of his university studies. The importance of languages must be emphasized, starting from the basis that Management and Business Administration University centres cannot become language schools either. They may insist on the need of mastering languages, especially English, but they cannot take responsibility for the previous stages. This is why some schools and universities begin to incorporate English in their curricula and, some pioneers as ESERP provide official degrees in English. 70% of the contents are in English and the student obtains an official double degree, the English and the Spanish, as well as a fluent English level. Other universities, such as Universidad Rey Juan Carlos in Madrid or Universitat Pompeu Fabra in Barcelona also offer some degrees in English language.

As for the *management skills* required by the companies, it is something that should concern to the BA student in the first place, but to all the Spanish education system as well, because these attributes and habits cannot be taken up overnight, as they are the result of parents, teachers and universities working together.

Employability is a general social issue. It not only concerns students. Companies should be interested in having good professionals at management level. Their competitiveness will depend on these good managers in many cases. Education for these future managers

should not depend only on the students and their parents, because they are losing a great amount of potential good managers that cannot afford their education. Furthermore, they are holding ad eternum a division of the social classes.

Neither *society* nor the *Government* are released from any liability for BA students' education – and this is also valid for any University student - , since they are called to lead the companies of our country. The most productive investment is the educational and training one. The optimal education of University students is a government responsibility and to give them the chance to work in our country. If they have to immigrate to other countries because there are no jobs for qualified people, the talent does not come back and the investment done is lost. However, it is also a responsibility of the schools, both primary and professional schools. They should encourage some basic skills of the young people that are being trained, such as good work habits, honesty, punctuality, regular attendance, productivity, strictness, fellowship and team spirit among others.

We have said that *educational investment* is the most productive one. We should add also that it is the largest one. Thus we cannot admit that while the new graduate is looking for his first job, this investment keeps unproductive. This has been the main object of this work: Making students, companies and Government aware of the importance of getting the most out of this investment.

It is necessary to introduce in all University degrees a *subject on job market training and information*. It would consist of the following sections, among others: career professional opportunities, business sectors, job titles, type of contract, CVs writing; how to be successful in a job interview; how to seek employment promptly and quickly; what the Companies are expecting from their employees according to the position held. It is important to get across to students that there is no shortcut without work.

Whether we have contributed, even minimally, to this awareness, the effort required to carry out this research work will be well rewarded, looking forward to other researchers following this line to support science and the new European Union that we are creating with our decisions day by day.

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A Binomial Model with Edgeworth Expansion on Particular Circumstances

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ABSTRACT

Contexts with high volatility and extreme events condition the value of the firm, its tax savings and continuity. These conditions must be contemplated for the employed valuation model. In that sense, the present paper' basis is the classic binomial model incorporating: a) firm contingent states of continuity or dissolution; b) tax saving valuation like a basket of real options, and c) extreme events by Edgeworth transformation. The paper structures in the following manner: first it develops the binomial function changed with the Edgeworth extension and the construction of implicit binomial lattice. Then it develops a valuation adapted to the binomial model with Edgeworth expansion that incorporates contingent tax savings, continuity or liquidation scenarios and cost of bankruptcy. With a hypothetical case it is illustrated its functioning, and comparing the results obtained between situations with kurtosis and skewness or normally. Finally the main conclusions are exposed.

KEYWORDS

Contingent States, Real options, Tax Savings, Edgeworth Expansion.

1. Introduction

Nowadays, firms are living in high volatility contexts and exposed to small probability events but with high impact on decisions and company's worth value. As a consequence, projecting variables such as results, worth value, or financial costs assuming normal distribution might be a false estimation of what will occur in reality in businesses resulting on a poor valuation process. Thus, we must develop models where random variable estimations include high-order moments. In other words, we must introduce asymmetry and kurtosis in order to capture biases and fat-tailed distribution related to extreme events.

A well-known method used in firm valuation is the discounted cash flow. Depending on how they treat cost of capital and tax savings, we could classify them into: a) Weighted Average Cost of Capital (WACC), Capital Cash Flow (CCF), and Adjusted Present Value (APV) (Ruback, 2002; Booth, 2002; Damodaran, 2006; Booth 2007; Fernandez, 2014). On its traditional version, discounted cash flow methods present controversial issues related to valuing tax savings as a result of using financial debt and its impact on firm and equity worth value because of futures scenarios conditioned to liquidation as a result of financial difficulties. These models assume firm's value as a lineal relationship generated by positive tax savings and projecting expected average cash flows that sum up potential scenarios. This simplifying assumption has nothing to do with real business because of the following reasons: a) Tax savings: their existence is conditioned by positive results, the operative earnings tax being equal or higher than the tax savings; b) firm and equity worth value: these models must include contingent scenarios of continuity and liquidation with free cash flows higher than debt flows (firm's continuity) or insufficient free cash flows (automatic firm's liquidation); c) Including extreme events and biases: this could be achieved modifying the probability distribution function of random variables (results, firm worth value, and cost of debt) with the Edgeworth expansion that introduces asymmetry and kurtosis.

The objective of this paper is to develop a valuation model that considers: a) contingent value of tax savings; b) continuity scenarios and firm liquidity; c) extreme events that transforms probability distribution. In order to achieve our first objective, we propose to value tax savings as they were the cash flow of a financial option (Velez Pareja, 2016). Regarding our second objective, binomials models will be adapted from previous works (Broadie & Kaya, 2007; Milanesi, 2014). These papers as based on the classical concept of considering shareholders' equity as a call option, but in contrast to these publications

and to presenting an original work consistent with the tax savings treatment, we assume that firm value follows a geometric Brownian motion (Brandao, Dyer & Hahn, 2005; Smith, 2005). In addition, operative earnings before taxes are described by an arithmetic Brownian motion. Finally, our third objective is achieved incorporating the Edgeworth expansion into the binomial valuation model (Rubinstein 1998; Milanesi, 2013).

This paper will be structured in the following manner: in the next section, we will develop a series of equations in order to explain the Edgeworth transformation on the binomial model, implicit probabilities, tax savings value as in an option portfolio, and the binomial valuation model conditioned to liquidation results. Subsequently, we will present a practical example assuming normal behavior from random variables (symmetry and mesokurtic) and a negative and extreme biased (asymmetric and platykurtic). We will contrast the obtained results between the proposed model and the traditional discounted cash flow model. Finally, we will present our main conclusions.

2. Edgeworth Expansion

2.1. Edgeworth Expansion in Binomial Distribution and Implicit Probabilities

This model uses a binomial probability distribution $[b(x)]$ in order to project the behavior of: earnings(E), firm value(V), financial debt yield(i). In general, random variable (x) is present in its path $n+1$, final nodes, and $j=0, 1, 2,...n$ positions. The number of potential different paths is determined by,

$$r_j = \frac{n!}{j!(n-j)!} \quad (1)$$

The value for every position is,

$$[(2j) - n]/\sqrt{n} \quad (2)$$

Binomial probability function $b(x)$ for every node is,

$$\left[\frac{n!}{j!(n-j)!}\ q^j \times (1-q)^j\right] \quad (3)$$

In order to incorporate asymmetry and kurtosis to the stochastic process in the binomial method, it is necessary to transform function $b(x)$ (equation 3). On the binomial function $b(x)$, values related to four moments (mean, variance, asymmetry, and kurtosis) are $E(x) = 0$; $E(x^2) = 1$; $E(x^3) = 0$, $E(x^4) = 3$. Assuming a value different from 0 and 3 to higher moments, means getting away from normality and requires to apply the transformation

on the original function. Jarrow and Rudd (1982) apply the Edgeworth expansion to the binomial model from a technique developed by Schleher (1977) where the real probability distribution *f(x)* is now approached by a different one named *w(x)*. Through statistic distribution, this technique is known as the Edgeworth expansion (Cramer, 1946, Kendall & Stuart, 1977). This expansion approached a probability distribution that is more complex as could be the normal or lognormal distribution. This technique enables coefficients to be moments not only for the original distribution, but also for the approached one. The result is a new function *g(x,)* where the following moments are captured: $E(x) = 0$; $E(x^2) = 1$; $E(x^3) = E$, $E(x^4) = K$ (Rubinstein, 1998) from the following five steps:

a) We must calculate the transformation function with the following expression[1];

$$w(x) = [1 + 1/6\,E(x^3 - 3x) + 1/24(K - 3)(x^4 - 6x^2 + 3) + 1/72E^2(x^6 - 15x^4 + 45x^2 - 15)] \quad (4)$$

The transformed function is the product between equations 3 and 4 on every node, so *g(x) = b(x)w(x)*. The expansion is only an approximation being $\sum_j g(x_j) \neq 1$. Probabilities must be weighted so they add 1, replacing $g(x_j)$ with $f(x_j)/\sum_j g(x_j)$.

b) Once we have got the adjusted density function, we proceed to estimate mean m and its variance (v^2);

$$\mu \equiv \sum_j g(x_j)x_j \quad (5)$$

$$v^2 \equiv \sum_j g(x_j)(x_j - m)^2 \quad (6)$$

Having equations 5 and 6, the necessary parameters come up in order to standardize random variables (projected results, interest yield, or firm value).

c) Higher moments are incorporated on mean and variance. Transformation function *w(x)* is applied on the binomial function *b(x)*, originating the transformed function *g(x).* At the same time, random variables x_j are replaced by the now standardize with the following expression,

$$x^{g(x)} = (x_j - m)/v \quad (7)$$

Having the new function *g(x)* and the inclusion of higher moments on mean and variance, we proceed to project the underlying asset value.

d) The random variable value on every node is denoted as V_j . It is calculated using the corrected function *g(x)*. Inputs are: growth rate (μ); obtained probabilities from the

1 Having asymmetry E=0 and kurtosis K=3, the transformation gets canceled, and the function gets back to the binomial normal estate.

corrected function *g(x)* are denoted as $p_j = g(x_j)$, associated to the underlying value on the option strike date, and standard deviation σ,

$$V^E_j = V_0 e^{\mu \times t + \sigma\sqrt{t} \times x_j} \quad (8)$$

Before its estimation, we must operate on equation 9 to get the growth rate expression (μ);

$$(r/d)^t = \sum_j p_j (V_j/V) \quad (9)$$

Variables involved in the equation are *V*= project intrinsic value at the initial moment; *r*= risk free rate; *d*= asset return yield; *t*= time until the decision must be made; μ=expected risk free increment from the logarithm of V_j/V and σ= volatility of the logarithm of V_j/V. Once we replace equation 8 on equation 9, applying logarithms and clearing from the risk free increment (μ) (equations 10 and 11),

$$(r/d)^t = \sum_j p_j e^{\mu \times t + \sigma\sqrt{t} \times x_j} = (\sum_j p_j e^{\sigma\sqrt{t} \times x_j}) e^{\mu \times t} \quad (10)$$

$$\log[(r/d)^t] = \log\left(\sum_j p_j e^{\sigma\sqrt{t} \times x_j})\right) + \mu \times t \quad (11)$$

We find the following equation to project the growth rate incorporating higher moments, necessary input of equation 8,

$$\mu = \log[(r/d)] - \frac{\left[\log\left(\sum_j p_j e^{\sigma\sqrt{t} \times x_j)}\right)\right]}{t} \quad (12)$$

Growth rate μ is similar, theoretically, to the one we use to estimate risk neutral values assuming a lognormal distribution, $\mu=[log(r/d)-1/2\sigma^2]$ (Rubinstein, 1998). Once we incorporate higher moments, we abandon the lognormal distribution assumption. Having these elements, we are ready to project value for different nodes. The following equation, summarize present value according to the successive projected values,

$$V^E_0 = \sum_j p_j (V^E_j) \times \rho^{-t} \quad (13)$$

On this case, V_j^E is estimated with equation 8, *pj=g(xj)* with equations 4 and 7, and ρ is the risk free discounted rate.

e) We must estimate implicit probabilities for every node through backward induction (Rubinstein, 1998).

Process starts at terminal nodes, estimating probabilities with the following expression.

$$q = q'_j / \frac{n!}{j!(n-j)!} \quad (14)$$

Once we define V^E as the underlying asset value, the two subsequent nodes are ($q_t^+ V_t^{+e}$; $q_t^- V_t^{-e}$). These are probabilities conditioned by the precedent node (q_{t-1}; V_{t-1}). The probability associated to node (q_{t-1}) is equal to the sum of the following subsequent nodes

$q_{t-1} = q_t^+ + q_t^-$. The precedent node summarizes the underlying's movements and probabilities (q_t^+ V_t^{+e}; q_t^- V_t^{-e}).On every node, certain equivalents are obtained by applying conditional probability. Equations are,

$$p_{jE(t)} = {q_t^+}/{q_{t-1}} \quad (15)$$

$$1 - p_{jE(t)} = {q_t^-}/{q_{t-1}} \quad (16)$$

V_{t-1} comes up from the product between subsequent brunches (V_t^{+E} ; V_t^{-E}) and certain equivalents coefficients (p_{jEt}; $1-p_{jEt}$), discounting at a risk free rate related to time interval. Consequently, we apply backward induction to value the underlying asset and the option within itself (equation 17).

$$V_{(j-1,t-1)}^{E} = \left[p_{jE(t)} \times V_{(j-1,t-1)}^{E,+} + (1 - p_{jE(t)}) \times V_{(j-1,t-1)}^{E,-}\right] \quad (17)$$

2.2. Tax Savings Present Value as an Option Portfolio and the Edgeworth Expansion

Traditionally, tax savings value for a period is estimated by,

$$V_T^{AF} = IF \times \tau \quad (18)$$

where IF represents computable financial interest magnitude and τ is the tax marginal rate. Successive tax savings present value is equal to

$$VA(V_T^{AF}) = \frac{IF \times \tau}{r} \quad (19)$$

This previous equation presents a debate between academics and practitioners. On this particular case, r is the discounted rate which is used on tax savings cash flows. There exists a discussion which discounted rate should be used. There are two extreme positions: a) Modigliani and Miller (1963) propose discounting tax savings at the risk free rate; b) Miles and Ezzell (1980, 1985) propose discounting tax savings at the debt yield during the first year, and discounting at the cost of capital of an unleveraged firm k_u for the following years. There are also some middle ground positions (Taggart, 1991; Inselbag & Kaufold, 1997; Tham & Wonder, 2001; Tham & Velez Pareja, 2001; Tham & Wonder, 2002; Booth, 2002; Farber, Gillet & Szafarz, 2006; Cooper & Nyborg, 2006; Oded & Michel, 2007; Velez Pareja, 2016). It is held that tax savings are conditioned by the capital structure objective whether by maintaining a fixed debt present value (Modigliani & Miller, 1963) or by keeping a fixed debt/equity market ratio (Miles &

Ezzell, 1980, 1985). Fernandez (2014) discards these positions [2]and, supported by papers where he proves that debt to equity ratio stays constant, proposes to estimate a debt to equity ratio based on book values. This occurs, partially, because administrators strongly consider book value since rating agencies keep an eye on them constantly (Flannery & Rangan, 2006). Accordingly, there is a debate about it. Copeland, Koller and Murrin (2000), declare that financial literature does not provide a clear answer related to what discount rate for tax savings in the correct one.

Applying option theory, this debate is solved. Tax savings contingent value is conditioned to the existence of positive results. This occurs since in options, risk is treated on cash flows, and risk free rate is simply used to reflect the time value of money.

When we do not expect changes on tax legislation, the only source of risk is determined by the variability of firm results. Thus, tax savings are subject to: a) the existence of positive results, b) results are equal or higher to the tax savings. If not, its deduction operates until the imputable operative earning value.

$$\text{AF} = \begin{cases} \text{EBIT} < 0; (0) \\ 0 < \text{EBIT} + \text{OI} < IF; (\text{EBIT}) \times \tau \\ \text{EBIT} \geq \text{IF}; (\text{IF}) \times \tau \end{cases} (20)$$

We must apply equations 18 and 19 if we could verify conditions a) and b). However, if we want to incorporate this third situation, we must apply real option theory. Tax savings is similar to a portfolio where we have a long position and a short position on an American call options. In other words, caps strategy being the underlying asset, the tax imputable base, composed by the operative results $S_t = EBIT_t$. Tax savings is equal to the algebraic sum between a long positiong on an American call $C(0)_t$, with a strike price $X = 0$, and a short position on an American call $C(IF)_t$, with a strike price equal to the imputable tax saving $X = IF \times \tau$.

There are three flows generated by the option portfolio similar to the tax savings. Flow 1: No exercise, inexistence of tax savings: $EBIT < 0; (0)$. Flow 2: Exercising the option. Option value will depend on the operative earnings: $C(0)_T = \max(EBIT \times \tau\,; 0)$. Exercising the long position will go from $0 < EBIT < IF; (EBIT) \times \tau$ to infinity. Flow 3: Selling the call option (tax savings) $C(IF)_T = \min\big((EBIT) \times \tau; (IF) \times \tau\big)$. Exercising the short position will go from $EBIT + OI \geq IF; (IF) \times \tau$ with its cap.

2 Modigliani and Miller consider that debt present value stay constant, and Miles and Ezzell assume debt value as a multiple of equity market value.

Cash flows from the resulting portfolio come from adding the premium earned by the short position as a result of the tax saving (flow 3) and the cash flow that we lose by not exercising the long position (flow 2). In other words, portfolio value comes from the difference between the projected operative earnings tax and the projected earnings tax, conditioned to cash flows and precedent exercises $C(AF)_T = C(0)_T - C(IF)_T$. The synthetic expression relays to the terminal value related to the option portfolio,

$$\mathrm{C(AF)^E_T} = \min\{[\max(\mathrm{EBIT^E}) \times \tau\,;\ 0];\ (\mathrm{IF^E}) \times \tau\} \quad (21)$$

On this case, all the expressions have with the *e* index that indicates a transformed variable incorporating higher moments through the Edgeworth expansion. Therefore, the underlying (EBIT) is assumed to incorporate asymmetry and kurtosis as the debt interest rate (i), so $IF^E = i^E \times P$ being P firm debt adapting equation 8. Once we project stochastic variables $\mathrm{EBIT^E}$ and $\mathrm{IF^E}$ on every node $t = 1 \ldots T$ and node (i, j) on the binomial tree, we must estimate the tax savings present value,

$$\mathrm{V^{AF\ E}_{T-t}} = \mathrm{C(0)_{T-t}} - \mathrm{C(IF^E)_{T-t}} + \mathrm{V^{AF\ E}_{T-t+1}}\mathrm{e^{-rf}} \quad (22)$$

Term $V^{AF\ E}_{T-t+1} e^{-rf}$ represents tax savings for period $T - t + 1$ discounted at the risk free rate. For every node on moment *T*, we assume continuity of tax savings estimated on equation 21. From node *T-t*, tax savings is integrated between call option $C(AF)_T^E$ and expected tax savings present value on *T-t+1* for *(i,j)* $V^{AF\ E}_{T-t+1(i,j)} e^{-rf}$.

Applying obtained probabilities for the transformed variable according to equations 15 and 16 on nodes (*i,j*), we determine tax savings thinks as an American cap and floor equal to $IF^E \times \tau$,

$$\mathrm{V^{AF\ E}_{T-t(i,j)}} = \mathrm{p_{jE(t)}} \times (\mathrm{V^{AF\ E}_{T-t+1(i)}} \times \mathrm{e^{-rf}}) + (1 - \mathrm{p_{jE(t)}}) \times (\mathrm{V^{AF\ E}_{T-t+1(j)}} \times \mathrm{e^{-rf}}) + \mathrm{C(0)_{T-t(i,j)}} - \mathrm{C(IF^E)_{T-t(i,j)}} \quad (23)$$

In order to simplify this expression, we proceed to denote the option portfolio as $C(AF)^E_{T-t(i,j)} = C(0)_{T-t(i)} - C(IF^E)_{T-t(i,j)}$, the expression stays as,

$$\mathrm{V^{AF\ E}_{T-t(i,j)}} = \mathrm{C(AF)^E_{T-t(i,j)}} + \mathrm{p_{jE(t)}} \times (\mathrm{V^{AF\ E}_{T-t+1(i)}} \times \mathrm{e^{-rf}}) + (1 - \mathrm{p_{jE(t)}}) \times (\mathrm{V^{AF\ E}_{T-t+1(j)}} \times \mathrm{e^{-rf}}) \quad (24)$$

2.3. Binomial Model, Liquidation Possibilities and Tax Savings Value

This section proposes the whole model: the binomial valuation model with liquidation possibilities (Broadie & Kaya, 2007; Milanesi, 2014) and tax savings determination through an option portfolio. Nevertheless, the highlight of this section is to consider results $EBIT^E$ and debt interest rate i^E are projected incorporating the Edgeworth transformation. Consequently, firm value, tax savings, debt and equity follow this process. The model's logic is the following: projected terminal results must be enough to cover debt payments. If not, we proceed to cancel debt interests and firm is liquidated. Firm value is $EBIT^E$ present value conditioned to liquidations scenarios and future tax savings present value. Shareholders' equity is equal to the addition between these two. On liquidations scenarios, we do not expect tax savings, and we assume that we cannot transfer tax losses to other individuals or firms. Then, we will present every step of the model:

a) *Projected unleveraged firm value*: we must project $EBIT^E$ using equation 8 being, on this case, the underlying asset result,

$$\mathrm{EBIT}^{\mathrm{E}}{}_{\mathrm{i,j,t}} = \mathrm{EBIT}_0 e^{\mu \times t + \sigma\sqrt{t} \times x_j} \quad (25)$$

Next, we will project unleveraged firm value (V^E), after the deterministic result. As we want to add the project results (equation 25), we must deduct ratio $EBIT_0/V_o$, to firm value on *t=0* (Brandao, Dyer & Hahn, 2005; Smith, 2005)[3], in order to use a present value adjusted by results $V_0{}^A$. As we want to simplify, we assume that this ratio stays constant through the whole projected period,

$$\mathrm{V}_{\mathrm{i,j,t-1}}{}^{\mathrm{E}} = \mathrm{V_0}{}^{\mathrm{A}} e^{\mu \times t - 1 + \sigma\sqrt{t-1} \times x_j} \quad (26)$$

Finally, projected unleveraged firm value comes from adding obtained values on nodes (equations 25 and 26),

$$\mathrm{V}^{\mathrm{E}*}{}_{\mathrm{i,j,t}} = \mathrm{V}_{\mathrm{i,j,t}}{}^{\mathrm{E}} + \mathrm{EBIT}^{\mathrm{E}}{}_{\mathrm{i,j,t}} \quad (27)$$

b) *Binomial tree to estimate debt value*: we must start assuming that firm writes a bond with periodical payments (IF^E), composed by interest and principal cancelation at the end of its lifetime (P),

$$\mathrm{IF}^{\mathrm{E}} = \mathrm{i}^{\mathrm{E}} \times \mathrm{P} \quad (28)$$

3 Results or projected cash flow are calculated through the traditional manner and are discounted from the start value in order to add results or obtained flows through the selected stochastic process.

Interest rate follows a transformed geometrical Brownian motion (equation 8) expressed in the following manner,

$$i^{E}_{i,j,t} = i_0 e^{\mu \times t + \sigma\sqrt{t} \times x_j} (29)$$

On this stage, interest is not adjusted by tax savings. Since it is contingent variable, we apply model contained on equations 22 and 23.

c) *Equity, debt, and asset value not conditioned to insolvency or continuity scenarios*: We must calculate equity value (E^E), debt (D^E), and unleveraged firm (V^{E*}) value without conditioning it to insolvency scenarios through a backward induction. This transformed binomial tree is the middle step for the final tree, but both start from terminal values (T), related to equity, debt, and total assets. They will be analytically presented on d). If results are higher than interests, then equity, debt and firm value come from equations 33, 34, 35 respectively. If not, we must apply equations 36, 37, and 38. From these terminal values, we must calculate the unconditioned value for moment $t=0$ through backward induction. We must use implicit probabilities coefficient (equations 15 and 16),

$$\widetilde{E}_{(j,t)}{}^{E} = e^{-rf}(p_{jE(t)}\widetilde{E}_{(i,t+1)}{}^{E} + 1 - p_{jE(t)}\widetilde{E}_{(j,t+1)}{}^{E}) (30)$$

$$\widetilde{P}_{(j,t)}{}^{E} = e^{-rf}(p_{jE(t)}\widetilde{P}_{(i,t+1)}{}^{E} + 1 - p_{jE(t)}\widetilde{P}_{(j,t+1)}{}^{E}) (31)$$

$$\widetilde{V}_{(j,t)}{}^{E*} = e^{-rf}(p_{jE(t)}\widetilde{V}_{(i,t+1)}{}^{E} + 1 - p_{jE(t)}\widetilde{V}_{(j,t+1)}{}^{E}) (32)$$

Intermediate values are used on point d) which will be developed next.

d) *Firm value, equity, and tax savings conditioned to insolvency and continuity scenarios*: Once we have completed steps a, b, and c, we are ready to implement the final step of the model. There are three different situations depending on the time horizon: 1) Final horizon on tree projection (T), 2) intermediate nodes ($0<t<T$) and 3) initial moment ($t=1 \rightarrow 0$). They are subject to the following condition I) $EBIT^E$ higher than interest debt, then we assume continuity ($EBIT^E \geq IF^E$); II) potential firm liquidation state as a financial default ($EBIT^E < IF^E$). These are the expressions for every step:

1) *Equations to estimate conditioned values at final time (T)*: These are equations that calculate terminal value explained on c) that enable us to apply equations 30, 31, and 32. They are the starting point and input to determine intermediate nodes:

I) Firm continuity (T): Firm value plus free cash flow is higher or equal to debt payment (interest plus capital) $V_{(i,j)T}{}^{E} + EBIT_{(i,j)T}{}^{E} \geq IF_{(i,j)T}{}^{E} + P$,

$$E_{(i,j)T}{}^{E} = \left[V_{(i,j)T}{}^{E} + EBIT_{(i,j)T}{}^{E} - IF_{(i,j)T}{}^{E} - P\right] + V^{AF}_{(i,j)T}{}^{E} (33)$$

$$P_{(i,j)T}{}^{E} = IF_{(i,j)t}{}^{E} + P \quad (34)$$

$$V_{(i,j)T}{}^{E} = \left[V_{(i,j)T}{}^{E} + EBIT_{(i,j)T}{}^{E}\right] + V_{(i,j)T}^{AF}{}^{E} \quad (35)$$

II) Liquidation (T): Firm value plus free cash flow are insufficient to repay debt (interest plus capital) $V_{(i,j)T}{}^{E} + EBIT_{(i,j)T}{}^{E} < IF_{(i,j)T}{}^{E} + P$. Transaction costs (α) are incorporated as part of the model solution, being,

$$E_{(i,j)T}{}^{E} = 0 \quad (36)$$

$$P_{(i,j)T}{}^{E} = (1-\alpha)(V_{(i,j)T}{}^{E} + EBIT_{(i,j)T}{}^{E}) \quad (37)$$

$$V_{(i,j)T}{}^{E} = (1-\alpha)(V_{(i,j)T}{}^{E} + EBIT_{(i,j)T}{}^{E}) \quad (38)$$

Tax savings present value are not imputable once firm is over.

2) *Equations to estimate conditioned intermediate nodes value (t<T; t>0)*: Equations 33, 34, and 36 are the starting point. Intermediate values are obtained from: $\tilde{E}_{(i,j)t}{}^{E}$ (equation 30), $\tilde{P}_{(j,t)}{}^{E}$ (equation 31), and $\tilde{V}_{(j,t)}{}^{E*}$ (equation 32).

I) Firm continuity (t<T; t≥1): There is not firm liquidation risk if the addition between $EBIT^{E}$ and shareholders' equity present value is enough to cover debt cash flows: $\tilde{E}_{(i,j)t}{}^{E} + EBIT_{(i,j)t}{}^{E} \geq IF_{(i,j)t}{}^{E}$, with the following group of equations, noted with the suffix c that indicates conditioning to the referred estates,

$$E_{(i,j)t,c}{}^{E} = \left[\tilde{E}_{(i,j)t}{}^{E} + EBIT_{(i,j)t}{}^{E} - IF_{(i,j)t}{}^{E}\right] + V_{T-t(i,j)}^{AF}{}^{E} \quad (39)$$

$$P_{(i,j)t,c}{}^{E} = IF_{(i,j)t}{}^{E} + \tilde{P}_{(j,t)}{}^{E} \quad (40)$$

$$V_{(i,j)t,c}{}^{E} = \left[EBIT_{(i,j)t}{}^{E} + \tilde{V}_{(j,t)}{}^{E*}\right] + V_{T-t(i,j)}^{AF}{}^{E} \quad (41)$$

On equations 39 and 41, tax savings is obtained through equations 22 and 23.

II) Liquidation (t<T; t>0): Firm liquidation occurs if the addition between $EBIT^{E}$ and shareholders' equity present value is not enough to cover debt cash flows: $\tilde{E}_{(i,j)t}{}^{E} + EBIT_{(i,j)t}{}^{E} < IF_{(i,j)t}{}^{E}$. Default costs (α) represent a percentage of firm value,

$$E_{(i,j)t,c}{}^{E} = 0 \quad (42)$$

$$P_{(i,j)t,c}{}^{E} = (1-\alpha)(\tilde{V}_{(j,t)}{}^{E*} + EBIT_{(i,j)t}{}^{E}) \quad (43)$$

$$V_{(i,j)t}{}^{E} = (1-\alpha)(\tilde{V}_{(j,t)}{}^{E*} + EBIT_{(i,j)t}{}^{E}) \quad (44)$$

Tax savings present value does not compute as a result of firm liquidation and not transferring default values.

3) *Equations to estimate the initial conditioned value (t=1 →0)*: Finally, firm value and equity on *t=0* is obtained by intermediate values (*t<T; t>t=0*), These equations were

developed on the previous point. On this segment, we proceed to work from period *t=1* until *t=0*, (*t=1* →0). Equations are the following,

$$E_0^{\,E} = e^{-rf}\left\{\left[p_{jE(t1)}\left(E_{(i)t(1)}^{\,E} + EBIT_{(i)t(1)}^{\,E} - IF_{(i)t(1)}^{\,E} + V_{(i)t(1)}^{AF\,E}\right)\right] + \left[1 - p_{jE(t1)}\left(\widetilde{E}_{(j)t(1)}^{\,E} + EBIT_{(j)t(1)}^{\,E} - IF_{(j)t(1)}^{\,E} + V_{(j)(1)}^{AF\,E}\right)\right]\right\} \quad (45)$$

$$P_0^{\,E} = e^{-rf}\left(p_{jE(t1)}P_{(i)t(1)}^{\,E} + 1 - p_{jE(t1)}P_{(j)t(1)}^{\,E}\right) \quad (46)$$

$$V_0^{\,E} = e^{-rf}\left\{\left[p_{jE(t1)}\left(V_{(i)t(1)}^{\,E} + EBIT_{(i)t(1)}^{\,E} + V_{(i)(1)}^{AF\,E}\right)\right] + \left[1 - p_{jE(t1)}\left(V_{(j)t(1)}^{\,E} + EBIT_{(j)t(1)}^{\,E} + V_{(j)t(1)}^{AF\,E}\right)\right]\right\} \quad (47)$$

On this instance, we obtain expected firm value and equity conditioned to insolvency situations and incorporating tax savings.

3. Model Implementation: Hypothetical Case Analysis

In order to illustrate the proposed model, we will develop a hypothetical case scenario. We will try to use numbers as simplified as possible so we do not engross the objective. The objective is to estimate firm value (*V*), equity (*E*), and leverage (*P*) conditioned by continuity and liquidation scenarios. The latter will occur when firm does not have positive results in order to repay debt.

3.1. Assumptions and Initial Data

On *t=0*, we assume firm value applying discounted cash flow model is $1.000, with a result (*EBIT*) of $100 and weighted cost of capital (k_o) of 10%. Net firm value at initial estate (V_0^A) goes up to $900. Risk free rate (*rf*) is 5% annually, and cost of debt (*i*) is 8%. Debt ratio is 45% of firm value, thus leverage (*P*) is $450. It has the same behavior as a bullet bond, from *t=0* until *T-t* they only pay interests. On *T*, they repay debt. We assume that stochastic variables are expected results (*EBIT*), firm value (*V*), and cost of debt (*i*), having the same geometric Brownian motion since they share the same parameters. We assume that volatility (σ) of these previous variables is constant at 34%. It was obtained through the MAD method (Copeland & Antikarov, 2001) since it is a privately held company. Marginal earnings tax rate is 35%, and the firm is enabled to deduct interest tax savings from this imputable rent. In order to simplify the case, we assume that time horizon goes from t=0 until t=4. On the liquidation scenario, we fix transaction, default and dissolution costs (α) of 1%.

3.2. Projecting EBIT, i, and V

Our first step consists on estimating inputs to project stochastic variables: expected results, firm value, and financial cost of debt. We set up two different situations, asymmetry and mesokurtic curve (*E=0; K=3*); and negative asymmetry and platikurtic curve (*E=0.05; K=2.8*). This latter is set up to evidence non normal behavior through fat tails. Tables that show initial inputs (equations 1 to 16) to project variables and to apply backward processes with implicit probabilities are exposed on the appendix on tables A.1 to A.9. Then, we will present trees that we used in projecting initial stochastic variables. We must highlight that the financial cost of debt has a counter cyclical behavior to the results and firm value ones. So, on the up (*u*) scenario on EBIT and V projecting variable, cost of debt (*i*) diminishes as a result of a lower perception of firm financial risk. In contrast, on the down (*d*) scenarios, cost of debt rises.

EBIT E=0, K=3 (equation 25)					*EBIT E=-0.05 K=2.8 (equaiton 25)*				
0	1	2	3	4	0	1	2	3	4
$ 100.00	$ 141.22	$ 199.42	$ 281.61	$ 397.67	$ 100.00	$ 139.82	$ 198.92	$ 322.10	$ 1,532.57
	$ 70.13	$ 99.03	$ 139.84	$ 197.48		$ 69.39	$ 98.18	$ 151.86	$ 513.28
		$ 49.18	$ 69.44	$ 98.06			$ 48.46	$ 71.60	$ 171.90
			$ 34.48	$ 48.70				$ 33.75	$ 57.57
				$ 24.18					$ 19.28

Table 1. Projecting EBIT *(Source: Own elaboration)*

V E=0, K=3 (equation 26)					*V E=-0.05 K=2.8 (equation 26)*				
0	1	2	3	4	0	1	2	3	4
$ 900.00	$ 1,143.84	$ 1,615.28	$ 2,281.02	$ 3,221.15	$ 900.00	$ 1,132.57	$ 1,611.24	$ 2,608.98	$ 12,413.82
	$ 568.02	$ 802.12	$ 1,132.72	$ 1,599.57		$ 562.07	$ 795.26	$ 1,230.04	$ 4,157.57
		$ 398.32	$ 562.49	$ 794.33			$ 392.51	$ 579.92	$ 1,392.43
			$ 279.33	$ 394.45				$ 273.41	$ 466.34
				$ 195.88					$ 156.19

Table 2. Projecting V from V_0^A *(Source: Own elaboration)*

i E=0. K=3 (equation 29)					*i E=-0.05 K=2.8 (equation 29)*				
0	1	2	3	4	0	1	2	3	4
8.000%	5.610%	3.934%	2.759%	1.935%	8.000%	5.551%	3.877%	2.700%	1.543%
	11.297%	7.922%	5.555%	3.896%		11.186%	7.854%	5.728%	4.606%
		15.953%	11.187%	7.845%			15.914%	12.149%	13.752%
			22.529%	15.798%				25.768%	41.062%
				31.814%					122.606%

Table 3. Projecting cost of debt (i) *(Source: Own elaboration)*

3.3. Tax Savings as an Option Portfolio

We will determine tax savings which input is given on tables 1 and 3. Table 4 estimates a long call, in other words, operative earnings tax as long EBIT is higher than zero. Table 5 estimates a short call. Si, if results are higher than interests, then we must calculate interest tax savings. Otherwise, its value is zero.

long call (C(A)) E=0. K=3 (operative tax)					*long call (C(A)) E=-0.05 K=2.8 (operative tax)*				
0	1	2	3	4	0	1	2	3	4
$ 35.00	$ 49.43	$ 69.80	$ 98.56	$ 139.19	$ 35.00	$ 48.94	$ 69.62	$ 112.73	$ 536.40
	$ 24.54	$ 34.66	$ 48.94	$ 69.12		$ 24.29	$ 34.36	$ 53.15	$ 179.65
		$ 17.21	$ 24.31	$ 34.32			$ 16.96	$ 25.06	$ 60.17
			$ 12.07	$ 17.04				$ 11.81	$ 20.15
				$ 8.46					$ 6.75

Table 4. operative tax on the long call *(Source: Own elaboration)*

short call (C(i)) E=0. K=3					*short call (C(i)) E=-0.05 K=2.8*				
0	1	2	3	4	0	1	2	3	4
$ 12.60	$ 8.84	$ 6.20	$ 4.35	$ 3.05	$ 12.60	$ 8.74	$ 6.11	$ 4.25	$ 2.43
	$ 17.79	$ 12.48	$ 8.75	$ 6.14		$ 17.62	$ 12.37	$ 9.02	$ 7.25
		$ -	$ 17.62	$ 12.36			$ -	$ 19.13	$ 21.66
			$ -	$ -				$ -	$ -
				$ -					$ -

Table 5. Tax savings conditioned to the existence of results higher than interests *(Source: Own elaboration)*

Through equation 21, we obtain the terminal value for each node since it is strike at the end of the exercise.

Tax savings (C(A)-C(f)) E=0. K=3. (equation 21)					*Tax savings (C(A)-C(f)) E=-0.05 K=2.8 (equation 21)*				
0	1	2	3	4	0	1	2	3	4
$ 12.60	$ 8.84	$ 6.20	$ 4.35	$ 3.05	$ 12.60	$ 8.74	$ 6.11	$ 4.25	$ 2.43
	$ 17.79	$ 12.48	$ 8.75	$ 6.14		$ 17.62	$ 12.37	$ 9.02	$ 7.25
		$ -	$ 17.62	$ 12.36			$ -	$ 19.13	$ 21.66
			$ -	$ -				$ -	$ -
				$ -					$ -

Table 6. Option portfolio to estimating tax savings conditioned to the existence of results higher than interests *(Source: Own elaboration)*

Finally, we estimate tax savings present value in t=0 (equation 22 and 23) where the backward process uses implicit probabilities contained on table A.9 on the annex.

Tax savings present value E=0. K=3 (equation 22 y table A.9)										*Tax savings present value E=-0.05 K=2.8 (equation 22 y table A.9)*									
	0		1		2		3		4		0		1		2		3		4
$	**145.40**	$	152.57	$	137.63	$	91.70	$	60.94	**$**	**232.65**	$	291.11	$	374.82	-$	288.36	$	48.59
		$	126.64	$	164.58	$	184.65	$	122.72			$	191.68	$	265.91	$	320.23	$	145.08
				$	64.28	$	135.16	$	247.12					$	107.97	$	224.24	$	433.20
						$	-	$	-							$	-	$	-
								$	-									$	-

Table 7. Tax savings present value *(Source: Own elaboration)*

If we would have applied traditional model (equation 19), without considering contingent value of results and interests, constant tax savings would have been $252. It drives us to overestimating them when the company faces a scenario with negative results or lower than the period interest. Table 7 presents tax savings value assuming a normal behavior ($145.4) and assuming a platikurtic curve ($232.65). Since results behavior related to the interest rate is counter cyclical, higher tax savings occur in middle nodes (lower results and higher interests).

3.4. Firm and Equity Value Conditioned by Continuity and Liquidation Scenarios

We will calculate firm and equity value conditioned by firm continuity or liquidation. On the first step, we will project stochastic variables (tables 1, 2, and 3). In order to calculate interests on every node, we used equation 28. Values are exposed on tables 8 and 9.

E=0, K=3 (equations 25, 26, 28, and 29)					
0	1	2	3	4	Concepts
$ 900.00	$ 1,143.84	$ 1,615.28	$ 2,281.02	$ 3,221.15	*V*
$ 100.00	$ 141.22	$ 199.42	$ 281.61	$ 397.67	*EBIT*
$ 36.00	$ 25.25	$ 17.70	$ 12.41	$ 458.71	*P*
	$ 568.02	$ 802.12	$ 1,132.72	$ 1,599.57	*V*
	$ 70.13	$ 99.03	$ 139.84	$ 197.48	*EBIT*
	$ 50.84	$ 35.65	$ 25.00	$ 467.53	*P*
		$ 398.32	$ 562.49	$ 794.33	*V*
		$ 49.18	$ 69.44	$ 98.06	*EBIT*
		$ 71.79	$ 50.34	$ 485.30	*P*
			$ 279.33	$ 394.45	*V*
			$ 34.48	$ 48.70	*EBIT*
			$ 101.38	$ 521.09	*P*
				$ 195.88	*V*
				$ 24.18	*EBIT*
				$ 521.09	*P*

Table 8. Projecting firm, results, and debt values (Source: Own elaboration)

E=-0.05 K=2.5 (equations 25, 26, 28, and 29)					
0	1	2	3	4	Concepts
$ 900.00	$ 1,132.57	$ 1,611.24	$ 2,608.98	$ 12,413.82	*V*
$ 100.00	$ 139.82	$ 198.92	$ 322.10	$ 1,532.57	*EBIT*
$ 36.00	$ 24.98	$ 17.45	$ 12.15	$ 456.94	*P*
	$ 562.07	$ 795.26	$ 1,230.04	$ 4,157.57	*V*
	$ 69.39	$ 98.18	$ 151.86	$ 513.28	*EBIT*
	$ 50.34	$ 35.34	$ 25.77	$ 470.73	*P*
		$ 392.51	$ 579.92	$ 1,392.43	*V*
		$ 48.46	$ 71.60	$ 171.90	*EBIT*
		$ 71.61	$ 54.67	$ 511.89	*P*
			$ 273.41	$ 466.34	*V*
			$ 33.75	$ 57.57	*EBIT*
			$ 115.95	$ 634.78	*P*
				$ 156.19	*V*
				$ 19.28	*EBIT*
				$ 634.78	*P*

Table 9. Projecting firm, results, and debt values with asymmetry and kurtosis *(Source: Own elaboration)*

On the second step, we will estimate intrinsic values without any conditioning to continuity or liquidation scenarios. Again, on the backward process, we will use implicit probabilities as part of the transformation (Appendix table A.9)

E=0, K=3 (equations 30, 31, 32, and table A.9)					
0	1	2	3	4	Concepts
$ 662.93	$ 1,026.44	$ 1,533.64	$ 2,222.69	$ 3,221.06	*E*
$ 369.11	$ 404.09	$ 425.06	$ 440.53	$ 458.71	*P*
$ 1,032.04	$ 1,430.53	$ 1,958.71	$ 2,663.22	$ 3,679.76	*V*
	$ 367.40	$ 624.49	$ 1,001.86	$ 1,452.24	*E*
	$ 371.98	$ 424.56	$ 453.18	$ 467.53	*P*
	$ 739.38	$ 1,049.05	$ 1,455.04	$ 1,919.77	*V*
		$ 147.99	$ 311.15	$ 654.21	*E*
		$ 357.55	$ 439.48	$ 485.30	*P*
		$ 505.53	$ 750.63	$ 1,139.51	*V*
			$ -	$ -	*E*
			$ 312.28	$ 438.72	*P*
			$ 312.28	$ 438.72	*V*
				$ -	*E*
				$ 217.86	*P*
				$ 217.86	*V*

Table 10. Firm, equity, and debt value *(Source: Own elaboration)*

E=-0.05 K=2.8 (equations 30, 31, 32, and table A.9)					
0	1	2	3	4	Conceptos
$ 586.94	$ 348.12	-$ 2,205.84	$ 45,158.23	$ 13,538.04	*E*
$ 396.35	$ 436.40	$ 458.55	$ 386.25	$ 456.94	*P*
$ 983.29	$ 784.52	-$ 1,747.29	$ 45,544.48	$ 13,994.98	*V*
	$ 795.45	$ 1,386.12	$ 2,414.24	$ 4,345.20	*E*
	$ 403.58	$ 458.86	$ 472.51	$ 470.73	*P*
	$ 1,199.03	$ 1,844.98	$ 2,886.75	$ 4,815.93	*V*
		$ 338.68	$ 703.41	$ 1,485.65	*E*
		$ 392.98	$ 490.17	$ 511.89	*P*
		$ 731.66	$ 1,193.58	$ 1,997.53	*V*
			$ -	$ -	*E*
			$ 334.16	$ 518.68	*P*
			$ 334.16	$ 518.68	*V*
				$ -	*E*
				$ 173.71	*P*
				$ 173.71	*V*

Table 11. Firm, equity, and debt value with asymmetry and kurtosis *(Source: Own elaboration)*

On the third step, we will calculate present value conditioned to the proposed scenarios. The backward induction process with the transformation coefficient (appendix table A.9) is applied from $t=1 \rightarrow 0$.

E=0, K=3 (equations 33, 34, 35, 36, 37, 38, 39, 40, 41 and table A.9)					
t=0	1<t<T			T	Concepts
0	1	2	3	4	
$ 1,057.19	$ 1,294.98	$ 1,852.99	$ 2,583.58	$ 3,221.06	*E*
$ 441.49	$ 429.34	$ 442.77	$ 452.95	$ 458.71	*P*
$ 1,498.68	$ 1,724.32	$ 2,295.75	$ 3,036.52	$ 3,679.76	*V*
$ 1,498.68	$ 513.33	$ 852.45	$ 1,301.35	$ 1,452.24	*E*
	$ 422.82	$ 460.21	$ 478.18	$ 467.53	*P*
	$ 936.15	$ 1,312.66	$ 1,779.54	$ 1,919.77	*V*
		$ 189.66	$ 465.41	$ 654.21	*E*
		$ 429.34	$ 489.82	$ 485.30	*P*
		$ 618.99	$ 955.23	$ 1,139.51	*V*
			$ -	$ -	*E*
			$ 311.02	$ 438.72	*P*
			$ 310.67	$ 438.72	*V*
				$ -	*E*
				$ 217.86	*P*
				$ 217.86	*V*

Table 12. Conditioned firm, equity, and debt value *(Source: Own elaboration)*

E=-0.05 K=2.8 (equations 33, 34, 35, 36, 37, 38, 39, 40, 41 and table A.9)					
t=0	1<t<T			T	Concepts
0	1	2	3	4	
$ 1,130.51	$ 754.07	$ -	$ 45,179.81	$ 13,538.04	*E*
$ 471.15	$ 461.38	$ 1,794.05	$ 398.40	$ 456.94	*P*
$ 1,601.66	$ 1,215.45	$ 1,792.06	$ 45,578.22	$ 13,994.98	*V*
$ 1,601.66	$ 1,006.19	$ 1,714.86	$ 2,860.56	$ 4,345.20	*E*
	$ 453.92	$ 494.21	$ 498.29	$ 470.73	*P*
	$ 1,460.10	$ 2,209.07	$ 3,358.84	$ 4,815.93	*V*
		$ 423.49	$ 944.58	$ 1,485.65	*E*
		$ 464.59	$ 544.83	$ 511.89	*P*
		$ 888.08	$ 1,489.42	$ 1,997.53	*V*
			$ -	$ -	*E*
			$ 304.43	$ 518.68	*P*
			$ 304.09	$ 518.68	*V*
				$ -	*E*
				$ 173.71	*P*
				$ 173.71	*V*

Table 13. Conditioned firm, equity, and debt value with asymmetry and kurtosis *(Source: Own elaboration)*

On table 14, we summarize values and, as it occurs with the traditional discounted cash flow method, it underestimates firm (*V*) and equity value (*E*) assuming unconditioned constant behaviors. Moreover, it overestimates tax savings since it assumes that is unconditioned. The numerical model adapts itself to different continuity or liquidation scenarios as the company could be able to cancel interests depending on the results.

Value	*DCF*	*OR E=0, K=3*	*OR E=-0.05, K=3*
V	$ 1,252.00	$ 1,498.68	$ 1,601.66
E	$ 802.00	$ 1,057.19	$ 1,130.51
P	$ 450.00	$ 441.49	$ 471.15

Table 14. DCF and binomial model summary *(Source: Own elaboration)*

In order to approximate better to business stochastic behavior characterized by its dynamism and turbulence, it is valid to assume that variables would adopt fat tails biases on the distribution curve. Based on this idea, the proposed model captures asymmetry and kurtosis expressed on values of tables 13 and 14. Consequently, the wide range of expected values that explain present value is higher while incorporating potential positive and negative events.

4. Conclusion

Companies live on a turbulent environment full of improbable events that are not captured by the mean behavior found on the normal probability distribution. Under these circumstances, traditional valuation models like the discounted cash flow model are useless to value ongoing companies; in particular, closed companies that operate on emerging contexts or growing segments. Intrinsic value generated by the discounted cash flow model assumes lineal and growing behaviors unconditioned to contingent scenarios of losses and earnings. Consequently, it impacts on firm and equity value and, eventually, on how we must treat tax savings.

As a first solution of this problem, we developed an experimental numerical model which is based under a binomial distribution. Its main contribution consists on the treatment of firm and equity value related to potential continuity and liquidation scenarios. Moreover, it assumes the existence of tax savings avoiding the debate under which rate should be discounted. On both cases, it adopts real option theory to value tax savings as a result of leverage and determining firm value incorporating solvency and dissolution scenarios. This model complements the tradition binomial stochastic process with the Edgeworth transformation. It allows incorporating asymmetry and kurtosis abandoning the assumption of normal behavior. The presented example assumes a counter cyclical behavior among results, firm value and debt cost. At the same time, results are analyzed under the traditional version and with higher moments. On the latter, the magnitude of potential values is higher since the model abandons dispersions that are only explained by the standard deviation. Thus, our model fulfills the objective of approaching a more realistic behavior.

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APPENDIX

Random Variable xj (equation 2)				Associated Probability b(x) (equation 3)			
1	2	3	4	1	2	3	4
			-2.00				0.0625
		-1.73				0.125	
	-1.41		-1.00		0.25		0.25
-1.00		-0.58		0.5		0.375	
	0.00		0.00		0.5		0.375
1.00		0.58		0.5		0.375	
	1.41		1.00		0.25		0.25
		1.73				0.125	
			2.00				0.0625

Table A.1 *(Source: Own elaboration)*

Edgeworth Expansion W(x) with E=0 y K=3 (equation 4)					Edgeworth Expansion W(x) with E=-0.05 y K=2.8 (equation 4)				
0	1	2	3	4	0	1	2	3	4
				1					0.974
			1					0.974	
		1		1			0.974		1.034
	1		1			0.974		1.034	
1		1		1	0.974		1.034		1.025
	1		1			1.034		1.025	
		1		1			1.025		0.597
			1					0.597	
				1					-0.758

Table A.2 *(Source: Own elaboration)*

g(x)=b(x), w(x) with E=0, K=3 (eq.3 x eq.4)					g(x)=b(x), w(x) with E=-0.05 K=2.8 (eq.3 x eq.4)				
0	1	2	3	4	0	1	2	3	4
				0.0625					0.06
			0.125					0.12	
		0.25		0.25			0.24		0.26
	0.5		0.375			0.49		0.39	
0		0.5		0.375	0.00		0.52		0.38
	0.5		0.375			0.52		0.38	
		0.25		0.25			0.26		0.15
			0.125					0.07	
				0.0625					-0.05
	1	1	1	1		1.00	1.02	0.97	0.81

Table A.3 *(Source: Own elaboration)*

Weighted corrected probabilities E=0, K=3					Weighted corrected probabilities E=-0.05, K=2.8				
0	1	2	3	4	0	1	2	3	4
				0.0625					0.08
			0.125					0.13	
		0.25		0.25			0.24		0.32
	0.5		0.375			0.49		0.40	
0		0.5		0.375	0		0.51		0.48
	0.5		0.375			0.51		0.40	
		0.25		0.25			0.25		0.19
			0.125					0.08	
				0.0625					-0.06
	1	1	1	1		1	1	1	1

Table A.4 *(Source: Own elaboration)*

Parameters for standardization with E=0 and K=3				Parameters for standardization with E=-0.05 y K=2.8			
			Mean (equation 5)				Mean (equation 5)
1	2	3	4	1	2	3	4
			0				-0.40466
		0				-0.08655	
	0				0.01744		
0				0.02958			
			Variance (ecuación 6)				Variance (equation 6)
1	2	3	4	1	2	3	4
			1				0.40950
		1				0.86668	
	1				0.98281		
1				0.99912			
			Deviation				Deviation
1	2	3	4	1	2	3	4
			1				0.63992
		1				0.93096	
	1				0.99137		
1				0.99956			

Table A.5 *(Source: Own elaboration)*

Variable xj standardized E=0. K=3 (equation 7)				Variable xj standardized E=-0.05 K=2.8 (equation 7)			
1	2	3	4	1	2	3	4
			-2.000				-2.4930
		-1.732				-1.7675	
	-1.414		-1.000		-1.4441		-0.9303
-1.000		-0.577		-1.0305		-0.5272	
	0.000		0.000		-0.0176		0.6324
1.000		0.577		0.9713		0.7131	
	1.414		1.000		1.4089		2.1950
		1.732				1.9535	
			2.000				3.7577

Table A.6 *(Source: Own elaboration)*

μ (equation 12) E=0, K=3					μ (equation 12) E=-0.05 K=2.8				
0	1	2	3	4	0	1	2	3	4
				-0.004885					0.024781
			-0.004885					-0.004849	
		-0.004885					-0.004831		
	-0.004885					-0.004733			
0.000000					0.000000				

Table A.7 *(Source: Own elaboration)*

Implicit probabilities (equation 14) E=0. K=3					
0	1	2	3	4	Nodes
1	0.5000	0.2500	0.1250	0.0625	0
	0.5000	0.2500	0.1250	0.0625	1
		0.2500	0.1250	0.0625	2
			0.1250	0.0625	3
				0.0625	4
Implicit probabilities (equation 14) E=-0.05 K=2.8					
0	1	2	3	4	Nodes
1	0.398836	0.113273	-0.012543	-0.058846	0
	0.601164	0.285563	0.125816	0.046303	1
		0.315601	0.159746	0.079513	2
			0.155855	0.080233	3
				0.075622	4

Table A.8 *(Source: Own elaboration)*

Certain equivalent coefficients (equations 15 y 16) E=0, K=3					Certain equivalent coefficients (equations 15 y 16) E=-0.05 K=2.8				
1	2	3	4	Nodes	1	2	3	4	Nodes
0.5	0.5	0.5	0.5	0	0.3988	0.2840	-0.1107	4.6915	0
0.5	0.5	0.5	0.5	0	0.6012	0.7160	1.1107	-3.6915	0
	0.5	0.5	0.5	1		0.4750	0.4406	0.3680	1
	0.5	0.5	0.5	1		0.5250	0.5594	0.6320	1
		0.5	0.5	2			0.5062	0.4977	2
		0.5	0.5	2			0.4938	0.5023	2
			0.5	3				0.5148	3
			0.5	3				0.4852	3

Table A.9 *(Source: Own elaboration)*

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Supplier–customer negotiation model: the vendor receives a bonus for holding the inventory

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ABSTRACT

This article proposes a model based on economic order quantity (EOQ) for the negotiation between supplier and customer when a benefit is derived to the supplier from taking responsibility for the inventory holding costs. In turn, the customer can afford a smaller batch size since the holding savings enable it to place a greater number of orders.

Taking the original situation in which the customer supports both holding and ordering cost as an initial point, the paper analyses the benefits for the supplier and customer in a new situation in which the supplier supports the holding of the inventory. The customer would agree to change to the new scenario due to the savings in the holding cost. The provider would also agree if a bonus is achieved as compensation for the investment in holding costs.

The model provides clues for a win-win negotiation between a supplier and a buyer.

KEYWORDS

Inventory costs; optimal batch; EOQ model; inventory management model.

1. Introduction

The first models of inventory system management were published at the beginning of the last century. Their purpose was to minimize the overall inventory management costs. Harris (1913) developed one of these early pioneering models, known as the economic order quantity (EOQ) model, which still enjoys great popularity. This model and extensions of it were collected together in the book "Quantity and Economy in Manufacture", published by Raymond in 1931. Years later, Whitin (1953) proposed a significantly revised approach in "The Theory of Inventory Management" and in "Inventory control research: a survey", published in 1953 and 1954, respectively.

Since then a large number of proposals have appeared, designed to deal with special situations or needs arising from the current context. The model assumes that all the costs are charged to the customer and optimizes the total inventory management costs. More recently some adaptations that take both points of view (customer and supplier) into account have been published. For example, Yang et al. (2007) commented on the current requirement for the economic order quantity (EOQ) to be attuned to the economic production quantity (EPQ) to combine both manufacturers' and suppliers' best interests. Gümüs et al. (2008) provided another approach, seeking a win-win relationship between the customer and the supplier by finding a point of equilibrium between the inventory managed by the latter (the vendor-managed inventory, or VMI) and the quantity required by the former. Yadollahi et al. (2017) proposed deterministic models strive to optimize the safety stock levels in line with the planned service levels at the retailers. Toptal & Çetinkaya (2015) examined the optimal length of the selling period in the context of a novel inventory replenishment problem faced by a supplier of a new, trendy, and relatively expensive product with a short life.

Against this background, Marimon & Llach (2013) proposed a model that provides clues to conducting the negotiation about the lot size in a win-win environment between a supplier and a buyer in the particular situation in which the vendor provides a reward when an order is placed. The fundamental assumption is that the responsibility for the entire process of inventory replacement is taken by the supplier instead of the customer.

There is a complementary situation to the previous one, which occurs when the holding cost is supported by the vendor and the customer only pays for each order placed. This situation is very common nowadays, since, in the middle of the last century, the advantages of decreasing the batch size order quantity were spread all across the world

through paradigms such as just in time, lean production or agile production (Chapman & Carter, 1990; Thomas & Griffin, 1996; Maloni & Benton, 1997). Particularly, this practice has spread throughout the automotive industry, in which the relationship between a supplier and an assembler is based on long-term agreements established in a win-win negotiation (Dyer, 1996; Holweg, 2007). The provider receives a bonus that vouches for the investments that this kind of contract requires (e.g., a long-term contract with stable conditions in terms of price, quality and quantities). In these cases a common supplier strategy is to move the inventories near to the assembly line (this is the investment required). Therefore, the holding cost is transferred from the customer to the supplier. It allows the replenishment frequency to increase; consequently, the batch size decreases. Moreover, the smoothing of the material flow allows an improvement of the supplying service in terms of reliability and the strength of the relationship between the supplier and the assembler.

There are more situations to which the model can be applied. Its application will be feasible when the supplier finds other benefits from holding the inventory of its customers (e.g., having a better understanding of the final consumer due to the fact that the supplier controls and monitors the demand evolution and obtaining valuable information on its final market).

The aim of this paper is to propose a model to establish a batch size policy that enables negotiation in a win-win agreement between a supplier and a customer. In this agreement the holding inventory cost is the responsibility of the provider, which in return obtains a bonus or premium.

To accomplish this aim, we present two different scenarios:

- Scenario "1" is the original EOQ situation in which both holding and ordering costs are supported by the client (it is analysed in the second section of the paper).
- Scenario "2" is the situation in which the holding cost is supported by the supplier, which is willing to pay for it due to an extra annual benefit or annual bonus (B) that it obtains. This scenario is analysed in the third section.

Scenario "1" is used as a baseline to compare with the situation after the agreement (scenario "2") and to assess the incremental benefit that the two actors obtain in the agreement, changing the initial batch size replenishment policy for another batch size policy. This comparison is made in the fourth section, which provides the conditions that have to be accomplished to reach the agreement between supplier and customer. The fifth

section reviews the model through a practical example that helps to provide an understanding of the rationale behind the analysis proposed. Finally, some conclusions are drawn.

2. Scenario "1": the basic model of economic order quantity (EOQ)

This is the original scenario for the EOQ (Harris, 1913), in which the client is responsible for both costs: ordering and holding. The model involves the following parameters:

D: Annual demand

e: Cost of placing an order

i: Holding cost (measured as a percentage)

v: Purchasing cost (per unit)

In his original version, Harris (1913) only analysed two types of costs: holding and ordering costs. In this way the function of the total annual costs is obtained in the function of the batch size (Q). The optimal quantity that minimizes the total annual management inventory cost is

$$Q_1 = \sqrt{\frac{2De}{iv}}$$

(1)

in which the subscript "1" refers to scenario 1. In this case the total cost payable by the customer is

$$TC_1 = \sqrt{2Deiv}$$

(2)

wherein, again, the subscript "1" means scenario 1.

Figure 1 shows the composed total cost (adding the annual holding cost and annual ordering cost) payable by the customer. There is no reference to the supplier in this first scenario.

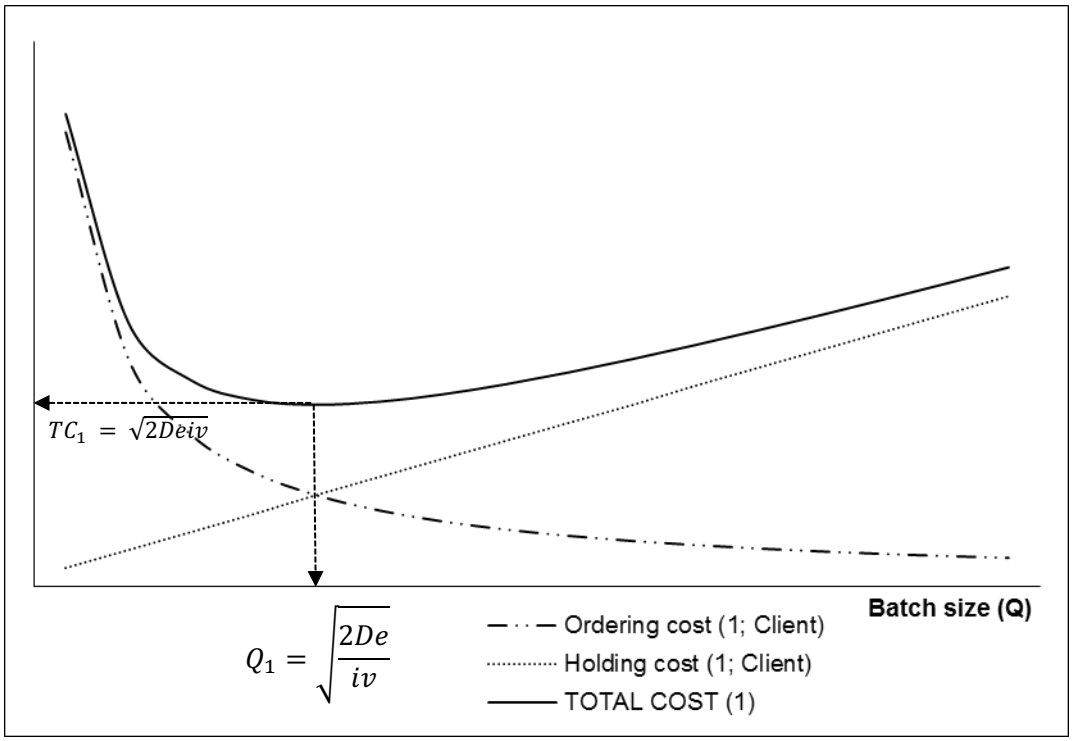

Figure 1. Inventory costs as a function of the batch size in scenario "1".

Number "1" in the legend means scenario "1", and "Client" means that the cost is charged to the client. In this scenario the word "Supplier" does not appear.

3. Scenario "2": the holding cost is supported by the supplier.

In scenario "2" the holding cost is supported by the supplier; as compensation, the supplier receives an extra annual bonus B.

Some assumptions are proposed:

- The ordering cost remains invariant across the two scenarios. This is very likely, because nothing relevant has changed in scenario "2" that might suggest a modification of this.
- The unit annual holding cost remains the same in the two scenarios. This is also quite reasonable to assume due to the fact that the associated cost of managing the inventory depends intensively on the nature of the product.
- The annual bonus B achieved will remain invariant to the batch size.

First, the analysis that the customer performs to assess the decision on whether to accept the agreement is shown in the first subsection. Second, a parallel analysis from the supplier perspective is discussed (second subsection). Finally (third subsection), the

confrontation of the two views offers the conditions that guarantee both actors a better situation in scenario "2", allowing an agreement to be reached.

The first and second subsections analyse how each actor (supplier and customer) achieves a better position in scenario "2". In addition, the overall situation in "2" is better than the original scenario "1": the global cost is lower in "2". In other words, the *status quo* of scenario 2 generates a benefit (B) that appears due to the new kind of relationship established between the two partners.

3.1. The customer view

The customer will accept a new scenario if its total cost (TC) in the new situation (scenario "2") is lower than that in the current situation (scenario "1"). Note that the first subscript refers to the scenario ("1" or "2") and the second to the actor (customer or supplier). Note also that the net cash flow for the customer is the total cost.

The subscript "customer" is redundant in the original situation, since all the costs are payable by the customer. Nevertheless, we keep both subscripts to be consistent with the notation used for scenario "2".

$$\mathrm{TC}_{1,\mathrm{Customer}} > \mathrm{TC}_{2,\mathrm{Customer}}$$

(3)

$$\sqrt{2\mathrm{Deiv}} > \mathrm{TC}_{2,\mathrm{Customer}}$$

(4)

Due to the fact that the only cost for the customer is the holding cost,

$$\sqrt{2\mathrm{Deiv}} > \frac{\mathrm{D}}{\mathrm{Q}_{2,\mathrm{Customer}}}\ \mathrm{e}$$

(5)

Operating, it is found that

$$\mathrm{Q}_{2,\mathrm{Customer}} > \frac{1}{2}\sqrt{\frac{2\mathrm{De}}{\mathrm{iv}}}$$

(6)

In turn, it implies that

$$Q_{2,Customer} > \frac{1}{2} Q_1$$

(7)

The customer will agree to change to the new scenario if the new batch size is greater than half the size in the original scenario. This condition provides the minimum batch size and is imposed by the customer. In other words, the customer will be able to place at least twice the number of orders that it was placing in scenario "1". The savings on the holding cost compensate for the higher costs of ordering.

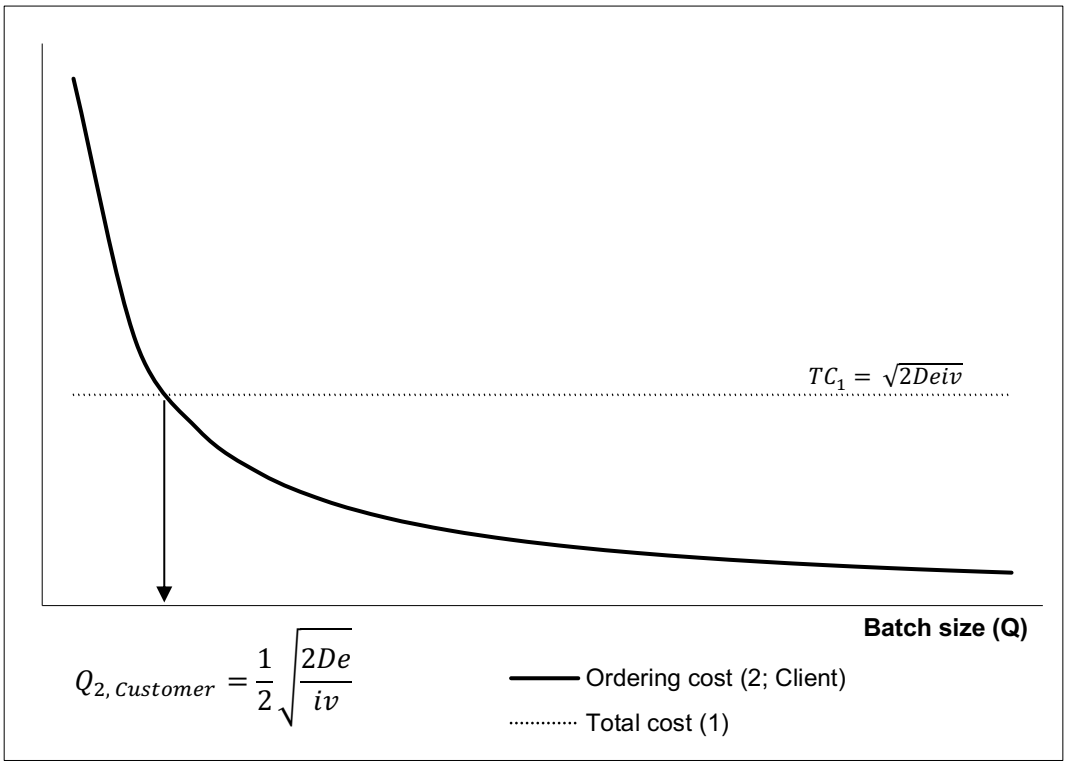

Figure 2. Ordering costs for the customer in scenario "2".

The figure shows the dotted line of the total cost of the previous scenario (scenario "1"). The inventory costs were completely supported by the client. This is the acceptable threshold for the customer to change its current situation, and it yields the minimum batch affordable for the customer in the hypothetical scenario "2".

3.2. Supplier view

This subsection analyses the supplier decision: accepting scenario "2" or remaining in the original situation. The baseline is scenario A again, in which no costs are payable by the provider. In the new situation (scenario "2"), the supplier holds the stock, but in return it receives an annual bonus B. In this case the starting point for the negotiation of scenario "2" will be a nil net cash flow (CF). We need to talk about the net cash flow and not only the costs, since the supplier receives positive contributions to the cash flow (the bonus) and negative contributions (costs). Therefore, the necessary condition imposed by the supplier is:

$$\mathrm{CF}_{1,\mathrm{Supplier}} < \mathrm{CF}_{2,\mathrm{Supplier}}$$

(8)

$$0 < \mathrm{B} - \frac{\mathrm{Q}_{2,\mathrm{Supplier}}}{2}\ \mathrm{iv}$$

(9)

$$\mathrm{Q}_{2,\mathrm{Supplier}} < \frac{2\mathrm{B}}{\mathrm{iv}}$$

(10)

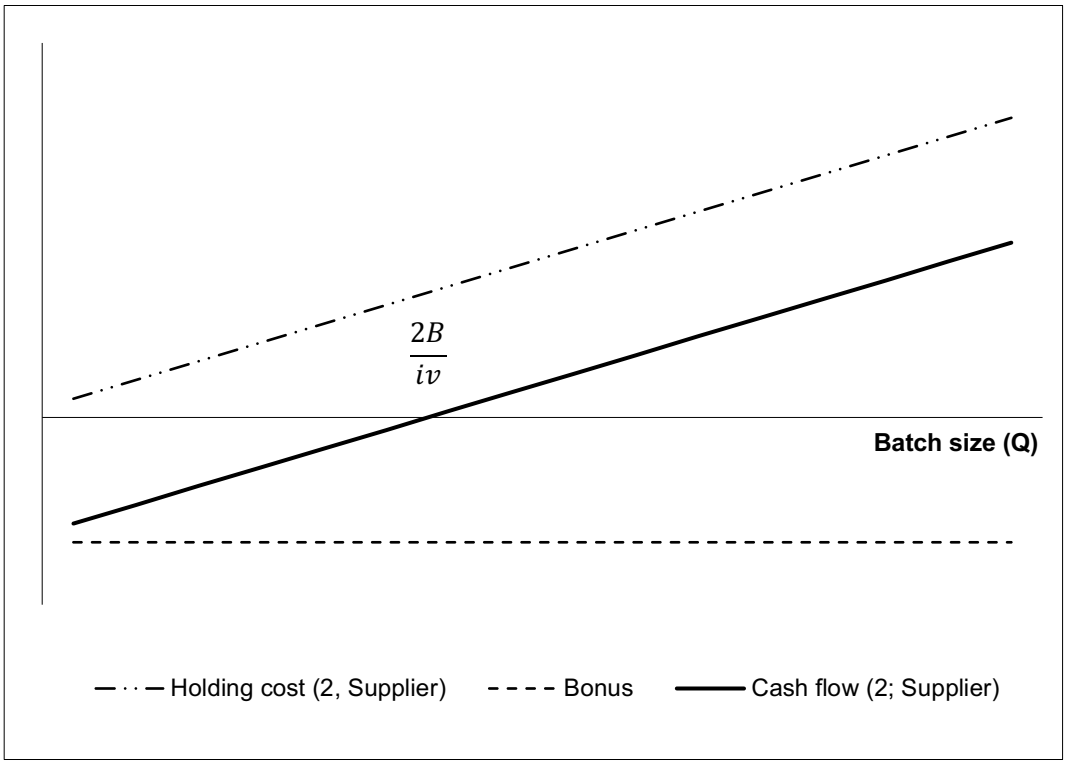

Figure 3. Holding cost, bonus and cash flow for the supplier in scenario "2".

Following our notation, number "2" in the legend of Figure 2 means scenario "2" and "Supplier" means that the cost is charged to the supplier. In this scenario the word "Client" does not appear.

The supplier will agree to accept the new scenario when the batch size is less than 2B/iv, which is just the size that makes the holding cost minus the bonus equal to zero (this is, the total net cash flow equal to zero). This is shown in Figure 3 at the point at which the net cash flow cuts the threshold of zero. This condition is imposed by the supplier and establishes the maximum batch size.

4. Comparison of the two scenarios.

Table 1 summarizes the analysis of both the client and the provider in terms of costs, total cash flow and batch size. For scenario "1" only one column is needed, since the supplier is not considered. The notation uses one subscript for the batch size variable ("1" or "2" referring to the scenario). Scenario "2" is composed of two columns. One summarizes the analysis from the customer view and establishes the minimum batch size, whereas the other summarizes the supplier view establishing the maximum batch size.

	Scenario 1	Scenario 2	
	Client	Client	Supplier
Holding cost	$\frac{Q_1}{2}iv = \frac{1}{2}\sqrt{2Deiv}$	0	$\frac{Q_2}{2}iv$
Ordering cost	$\frac{D}{Q_1}e = \frac{1}{2}\sqrt{2Deiv}$	$\frac{D}{Q_2}e$	0
Total cost	$\sqrt{2Deiv}$	$\frac{D}{Q_2}e$	$\frac{Q_2}{2}iv$
Cash flow	$-\sqrt{2Deiv}$	$-\frac{D}{Q_2}e$	$B - \frac{Q_2}{2}iv$
Batch size	$Q_1 = \sqrt{\frac{2De}{iv}}$	$Q_2 > \frac{1}{2}Q_1$	$Q_2 < \frac{2B}{iv}$

Table 1. Costs and batch sizes for the two scenarios considered.

To make the negotiation possible, both actors need to reach a better situation after the agreement: their respective cash flows in scenario "2" should be greater than those in scenario "1". The customer needs a batch greater than $Q_1/2$ and the supplier a value below 2B/iv. Thereafter, the necessary condition to start a negotiation is:

$$\frac{Q_1}{2} < Q < \frac{2B}{iv} \quad (11)$$

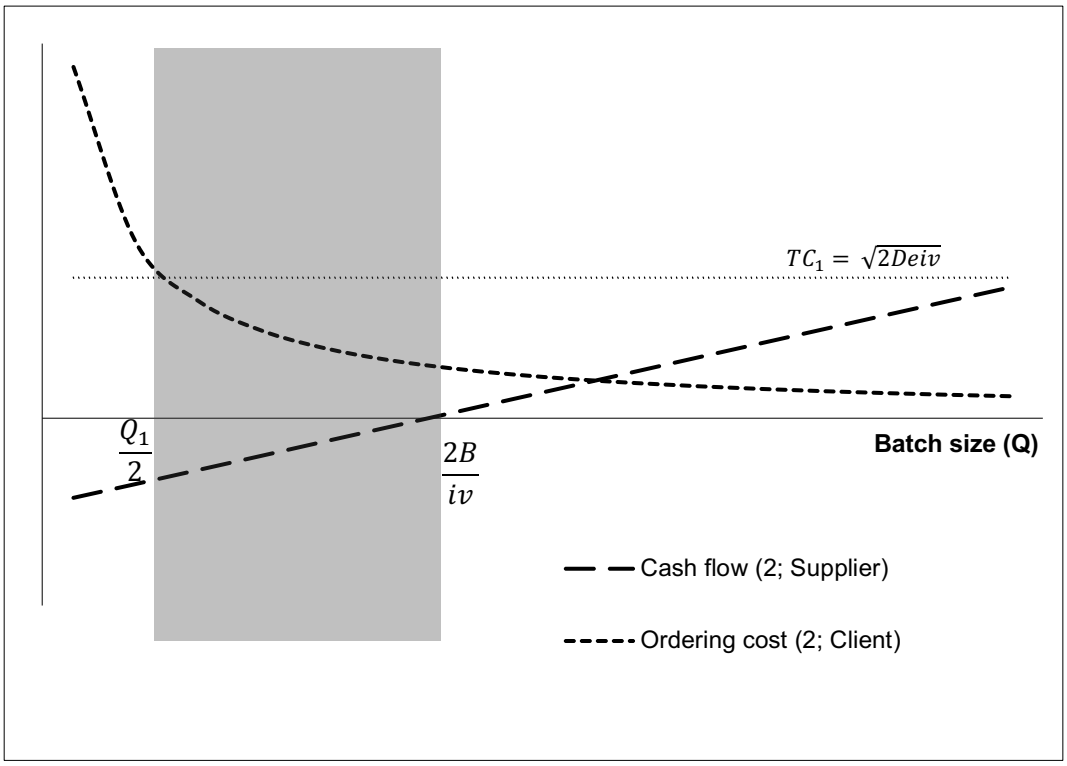

Figure 4. Area of feasible negotiation.

Let us analyse the minimum value of B that makes the negotiation feasible. This will happen when this area is so narrow that it is reduced to a vertical line.

$$\frac{Q_1}{2} = \frac{2B}{iv}$$

(12)

$$B = \frac{1}{4} Q_1 \, iv$$

(13)

$$B = \frac{iv}{4} \sqrt{\frac{2De}{iv}}$$

(14)

$$B = \frac{1}{4} \sqrt{2Deiv}$$

(15)

$$B = \frac{1}{4} CT_1$$

(16)

The minimum bonus B that the supplier needs to assume the holding cost of the inventory is a quarter of the total cost that in scenario "1" was the responsibility of the customer. To make it feasible, a reward or bonus B for the supplier is required when scenario "2" is considered. This bonus first makes it worthwhile for the supplier to support the holding cost and second allows the client to increase its ordering cost, keeping the total inventory cost lower than in the original situation in scenario "1".

As suggested, this bonus is the benefit for the supplier in terms of a larger and stable term agreement, more favourable price conditions, frequency of replacement, cooperation in product development, sharing information or other kinds of conditions. Lee et al. (2004) analyse some results of the cooperation between clients and providers that can be components of this bonus (e.g., improving the forecasting accuracy, increasing the information available as a result of sharing systems between purchaser and provider, etc.)

5. Practical example

To facilitate the comprehension of the model, we show below an example of a situation in which the customer orders batches from the supplier of a size suggested by the economic batch formula proposed by Harris (1913). Assume that the annual demand (D) is 120 units, the ordering cost (e) is €3,000 and the unit cost of the component (v) is €5,000. In addition, the storage cost (i) is 25% per year. With these parameters, the customer orders 5 batches of 24 units each from its supplier during the course of the year. In this way both the annual cost of placing orders (5 batches * €3,000 each batch) and the cost of storing the stock (12 storage units * €5,000/unit * 0.25) are €15,000: thus, €30,000 in total.

At this point the supplier offers the customer a change in the inventory provisioning strategy, proposing to supply from an idle installation owned by the supplier contiguous to the customer location. Accordingly, the inventory will be managed by the supplier and the customer will receive any order placed immediately, without any delivery time. From the practical point of view, it means that from now on the holding cost will be supported by the supplier. In consideration, the customer will assure a long-term contract and other benefits that the supplier estimates to amount to €20,000 per year. These benefits (bonus) include issues such as shared information about the product, about the market and even about technology.

On the basis of this information, the customer calculates how many orders could be placed with the original €30,000 (the total cost that supports scenario "1"). The maximum number of orders that it can afford is 10, implying that the minimum batch size is 12 units. On the other hand, the supplier also undertakes an analysis. Due to the fact that the supplier does not incur any cost in the current situation, it will agree to the new contract (scenario "2") if the net cash flow is greater than zero. In other words, the holding cost that it now supports must be lower than the bonus "B" (€20,000). The average stock that it will be able to hold is 16 units (16 units * €5,000 * 0.25 = €20,000). Therefore, the maximum batch size is 32 units.

Therefore, the agreement is feasible, establishing a new batch size policy between 12 and 32 units. Within these limits both agents achieve a better position than in the initial or current situation. The second practical conclusion drawn from this case is that the minimum bonus that makes the agreement feasible for the supplier is €7,500 (€30,000 / 4), according to expression (16). If the bonus is less than that, the provider cannot be

compensated for the holding cost in the worst situation from its point of view (when the batch size is 32 units).

6. Conclusion

A new model that provides the framework for an agreement between a customer and a supplier is proposed that leads to the establishment of a new batch size in the replenishment policy. The model provides the necessary condition that has to be achieved to guarantee the agreement that allows the initial or original size batch used, in which the customer takes charge of all the inventory costs (i.e., holding and ordering costs), to be changed to a new batch size policy in which the holding cost is supported entirely by the supplier. If the necessary condition is accomplished (the customer needs a batch greater than half the initial size batch and the supplier a value below 2B/iv), then the agreement is possible, resulting in a better situation for both the customer and the supplier in terms of the inventory cost.

Therefore, the model proposes a batch size interval in which the agreement is possible. Another question concerns the relative power of the two actors in this plot. When the power of the provider and the buyer is unbalanced, the negotiation will end up near an extreme.

The paper also analyses the minimum amount for the annual bonus (B) that makes the agreement feasible. It is shown that this is a quarter of the total cost in the original situation (scenario "1") supported by the customer. This is really a logical consequence of the aforementioned necessary condition expressed in expression (11).

In addition, if the necessary condition is accomplished and the agreement is set, other advantages are obtained for the provider and for the customer, although they were not intended. The provider is able to develop more reliable demand forecasting systems and improve its understanding of the maturity cycle of the product, enabling it to optimize its investments related to the manufacturing process and gain better knowledge of the customer preferences and necessities. On the other hand, the customer improves the replenishment reliability, increases its knowledge of the component or product purchased and enjoys a more competitive purchasing price.

Finally, our study shows that, despite the enduring validity of the model of optimization of inventory management costs proposed by Harris (1913), there is a large number of new scenarios in which the supplier and customer can jointly achieve win-win strategies that

will globally improve the value chain but will not penalize economically either of the operators involved.

The limitations of the model are in accordance with the assumptions listed at the beginning of section 3 and the general constraints imposed by the original EOQ model. Relaxing these constraints will provide clues to developing wider-scoped models suitable for common situations between customers and providers.

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