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Keywords: supply chain management, bullwhip effect, Cash Flow Bullwhip, multi criteria approach, MACBETH method.
Abstract: Moroccan producers of households' detergents suffered from cash flow bullwhip. This distortion of financial flow originated from the bullwhip effect produced during the COVID 19 pandemic. A recent study confirms that some performance attributes are correlated with the degree of exposure to the CFB. The relative significance of these performance criteria, however, is not immediately apparent. The objective of this research is to develop a multi-criteria mathematical model which will serve as a basis to assess the performance of the companies under study and to define the determinants of Cash Flow Bullwhip control using the MACBETH method. This research is conducted on a sample of Moroccan producers of household detergents. The findings indicate that the importance of financial variables is higher than that of supply-chain elements, and internal control factors. Good supply chain asset management, financial efficiency, financial liquidity, control activities, financial debt, and supply chain credibility are the main levers to control the CFB.

1 Introduction

Supply chain management is based on the efficient management of physical, information, and financial flows. Most companies have to deal with flow perturbations, and the most known perturbation is the bullwhip effect. The BWE is a distortion of physical flow, and refers to the fact that demand is more erratic as we go up the supply chain and farther from the final consumer. This distortion impacts also the flow of cash in the supply chain, and make it unpredictable and variable. This perturbation is introduced and named in 2013 by Tangsucheeva & Prabhu as the Cash Flow Bullwhip [1].

In the actual context, characterized by the multiple crises (COVID 19, inflations, wars, shortages…), good cash flow management is necessary to protect the existence of companies. In this sense, companies would benefit from controlling cash flow risks in general, and precisely controlling the Cash Flow Bullwhip, which was generated by the COVID 19 pandemic crisis [2]. This observation is more relevant for Moroccan manufacturers of household detergents which have been greatly disrupted by the COVID 19 pandemic. This research article aims to define the determinants of CFB control based on the application of multi criteria approach on a sample of Moroccan manufacturers of household detergents.

1.1 Problem statement

Supply chains suffer from Cash Flow Bullwhip, which is a cash distortion that deteriorates the company finances. CFB originates from the perturbations of the physical flows related to the bullwhip effect. That's said, previous research study demonstrated that there is a correlation between the company performance and the CFB. Indeed, a recent study conducted on the producers of detergent products demonstrated that companies with good performance on the financial, internal control, and supply chain levels, tend to be less exposed to CFB [2]. This finding is based on a diversity of performance criteria's, and the output of the research could not define which performance criteria or performance dimension is more important in the CFB control. In this regard, it will be interesting to define a hierarchy of these criteria by developing a model that can explain the degree of resilience of each company to the CFB.

1.2 Research objectives

The aim of this research is to develop a mathematical model that hierarchizes the degree of contributions of each determinant to the CFB control.

Thus, based on the data collected from a previous study [2], and the application of a multi-criteria method, the objective is to answer the following research questions:
- What is the profile of the most resilient company?
- What is the profile of the most exposed company to the CFB?
- What is the contribution of each performance criteria to the CFB control?
- Which performance dimension and criteria are more important to the CFB control?

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- Is there a combination of performance criteria's that can lead to a specific degree of CFB control?
- How can a company control the CFB?

1.3 Research contributions

This research is very interesting for all companies, especially in this context of supply chain perturbation and financial difficulties. Indeed, this study is helpful for firms suffering from CFB given that it will give deep insights on the determinants of CFB control. It will give the managers a better understanding of the levers that could be used to be less exposed and more resilient to the CFB.

For researchers, this article offers another angle to analyze the CFB and to identify potential levers to control CFB, through the study of a specific sample. The findings of this research could be applied and extrapolated on others type of companies in different countries and sectors.

On the other hand, given the timing of this research and the targeted companies for this study, this is also a contribution to the different researches related to impacts of COVID 19 pandemic on the economy.

This essay also aims to contribute to the various studies that have been done on the cash-flow bullwhip and bullwhip effect phenomena.

For this, the first part will serve as a brief literature review of the BWE and CFB, before addressing the relationship between the firm performance and CFB. The second part is dedicated to the selection of the appropriate multi-criteria method for this research. The third part is for presenting the tree structure of the multi-criteria model, using the M-MACBETH Method, and the deployment framework. Finally, results are presented, and recommendations are given in the conclusion.

2 Literature review

2.1 Theoretical fundaments of the Cash Flow Bullwhip

The term "bullwhip effect" has been introduced to describe the order variance amplification phenomenon between the elements of the supply chain in the 1990s. This phenomenon is common across various sectors. Forrester formalized the variance amplification effect using industrial dynamics and the Beer Game simulation experiment [3]. Numerous reviews have addressed the bullwhip effect. For instance, Geary, Disney, and Towill identified five ways to increase our understanding of the bullwhip and ten principles to reduce its influence [4]. Miragliotta reviewed bullwhip studies in three categories—empirical assessment, causes, and solutions—and then developed a new taxonomy to characterize this problem [5]. Giard and Sali used 13 coordinates to classify 53 bullwhip studies, including modeling approaches, demand models, measurements, and causes [6]. While some appraisals are more cerebral in nature, others try to present a novel perspective on bullwhips [7]. Another aspect of the BWE has been introduced in 2013 by Prabu, under the name of Cash Flow Bullwhip. Bullwhip effect-

related CFB is the disruption of cash flow [1]. The company's need for working capital is directly impacted by this cash flow distortion because it worsens the cash conversion cycle [1].

Numerous research studies prior to the 2013 release of this idea by Tangsucheeva & Prabhu concentrated on the financial element of the supply in general and the cash conversion cycle specifically. Farris highlighted the importance of the cash to cash cycle as a criterion to assess the effectiveness of the supply chain in this regard and provided practical techniques for controlling it [8]. Tsai offered a modeling of the supply chain's cash flow risks by examining the standard deviations of the receipt, disbursement, and net flows for each period across a planning horizon [9]. To speed up the process of turning money into cash and increase the possibility of collection, Tsai suggested utilizing an asset-backed securities (ABS) strategy to finance accounts receivable. By collaborating to manage cash-to-cash cycles and sharing weighted average capital costs with trading partners, Randall and Farris proposed a strategy for improving the supply chain [10]. In order to raise the working capital for supply chain partners, Hofmann and Kotzab claim that collaborative strategies are more efficient than delaying suppliers' payments or collecting receivables early [11]. Tsai shown that companies face cash collection risks while aiming to boost sales, particularly those with limited financial means. A stochastic forecasting model that Tangsucheeva and Prabhu presented combines a Bayesian model for each customer's payment behavior with a Markov chain model for the business as a whole and all of its customers [12]. Tsai outlined how cost structure influences cash flow risk and how new technologies and Just in Time production philosophies can assist to reduce this risk [13]. To investigate the sources of the bullwhip effect and the impact of its interactions on the CFB, Goodarzi created a simulation model that incorporates a multi-stage supply chain as well as centralized and decentralized supply chains [14]. Their findings suggest that the CFB can be found in both centralized and decentralized supply chains, despite the fact that each link in the chain uses an "Order Up To" replenishment approach. At the level of the supply chain, Serrano examined how order variations affected supplier payment deadline variability as well as how they affected risk and how it propagated upwards in the chain [15]. Peng and Zhou developed three models based on different supply chain collaboration levels in order to analyse working capital optimization in a two-echelon supply chain with one supplier and one retailer [16]. The authors advise extending the payment period whenever the retailer's discount rate is higher than the supplier's regardless of the levels of cooperation. Badakhshan et al. developed a simulation-based optimization technique using a system dynamics simulation model and a genetic model. To reduce the total cost, BWE, and CFB for each SC member, the ideal financial and inventory selection criteria are identified [17]. Prabhu investigated the occurrence of CFB and the traditional bullwhip effect

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(BWE) from 2010-Q1 to 2020-Q4 using 238 semiconductor enterprises as a sample [18]. The authors found that the CFB and BWE of a semiconductor industry are positively correlated with procurement and payment lead times and negatively correlated with firm size, the degree of seasonality in demand, and the conservatism of the company's payment policy. By addressing the operational causes of this phenomenon, such as the accuracy of forecasts, batch orders, price volatility, rationing games, and lead times, a number of technologies can positively contribute to containing it, according to Lamzaouek's analysis of the effects of digital technologies on CFB [3]. CFB was investigated for its implications on the financial stability of Moroccan FMCG companies during the COVID 19 outbreak. The results of the survey show that SMEs and very small businesses suffered the most from the effects of CFB because of the increase in working capital needs and decrease in cash flow. The authors proposed an organizational plan to address this problem by increasing internal control mechanisms at the level of the purchasing, inventory management, sales, and cash management processes [2].

Another research looked at the impact of market share and price cross-sensitivity coefficient on the CFB and found a positive correlation between the rise in CFB and the growth in the price cross-sensitivity coefficient [19]. Prabhu studied how the cash-bullwhip in the supply chain was impacted by credit risk. The results of this study demonstrate that accounting for credit risk results in a greater transfer of cash and accounts payable from downstream to upstream members. This study also reveals how the account receivable turnover index effectively captures the cash-bullwhip effect of each supply chain link when credit risk is taken into consideration [20].

2.2 The relationship between CFB and company performance

CFB can be related to company performance. Indeed, in a recent study conducted on the detergent producers in Morocco, lamzaouek and al, analyzed the correlation between the degree of CFB exposure and a firm performance on the supply chain, financial, and internal control levels [2]. The results confirm that, all the best performing companies have a good level of CFB control. This finding confirms all the research articles about the correlation between the CCC and the firm performance, given that CFB is simply instability of the CCC. In this regard, Ravindra Kamath's research examined the link between dynamic liquidity measures and company profitability, using a sample of 99 companies from 1970 to 1984 [21]. His statistics support the idea that CCC is positively correlated to the firm performance. Soenen found that, depending on the sector, there is a strong negative correlation between the cash conversion cycle and total asset return [22]. This was consistent with his hypothesis that the shorter the cash cycle, the higher the profitability [23]. Lowering the net business cycle to a manageable level increases shareholder value, which is important for financial leaders to consider.

Other researchers have studied the link between CCC and firm performance, with seven articles published in 1996 to provide evidence for the idea that superior business performance results from effective operating cycle management [24]. Jose et al, used the Compustat database and a sample of 2,718 companies to examine the relationship between CCC and Return On Assets (ROA) and Return On Equity (ROE). Results showed that all industries except financial services had a significant negative correlation. Yung-Jang Wang applied the methodology to the Taiwanese and Japanese markets [25]. The results of a sample of 1,934 companies show a negative correlation between ROA and ROE and company performance, but the expected relationship is not significant at the industry level [26]. Deloof found a negative correlation between business performance and the number of days of accounts receivable, inventory, and accounts payable. This is consistent with the theory that extremely profitable companies can afford to give their suppliers shorter payment terms [26].

According to Lazaridis et al., there is a negative correlation between accounts payable and firm profitability. They advise concentrating on working capital management and properly utilizing the various CCC components [27].

Padachi et al. (2006) found a positive correlation between CCC and ROA, but it was based on a small sample of 58 companies and Mauritius' unique market circumstances. Raheman et al and Uyar also found similar correlations between CCC and firm profitability [28,29]. The results confirm the absence of a link. Eljelly found an inverse relationship between company performance and the current ratio, but a weak relationship between the cash gap and business performance (Eljelly, 2004). According to Filbeck, effective working capital management can positively influence dividends and market returns [30]. Nazir et al found that ROA is positively correlated with current assets, company size and GDP growth rate, while ROA is negatively correlated with the level of aggressiveness of an investment. This suggests that an aggressive funding strategy produces a low return on assets [31].

3 Selection of the multi-criteria method
3.1 Multi-criteria methods – a brief literature review

Multi-criteria decision methods can be classified into three main categories: complete aggregation methods, partial aggregation methods, and local and iterative aggregation methods. Complete aggregation methods evaluate, on a single measurement scale, the usefulness of each action with respect to each of the criteria. All of these utilities are then aggregated to obtain the overall utility of each action. Partial aggregation methods keep ratings in their original unit of measure. They rather opt for the acceptance of incomparability with an approach of over-

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classification of synthesis or even partial aggregation. The multi-criteria comparison, criterion by criterion, associated with the weighting system defined by the decision-makers leads to the production of indices which, once aggregated, provide the ranking of the actions. Local and iterative aggregation methods have mainly been developed in the context of multi-objective mathematical programming. They alternate the steps of calculations (providing the successive compromises) and the steps of dialogue (source of additional information on the preferences of the decision maker [32]. This approach is addressed, in general, to problems with multiple objectives where the actions envisaged are very large in number and defined by explicit constraints.

The following figure presents the main techniques related to the three categories of multi-criteria methods (Figure 1).
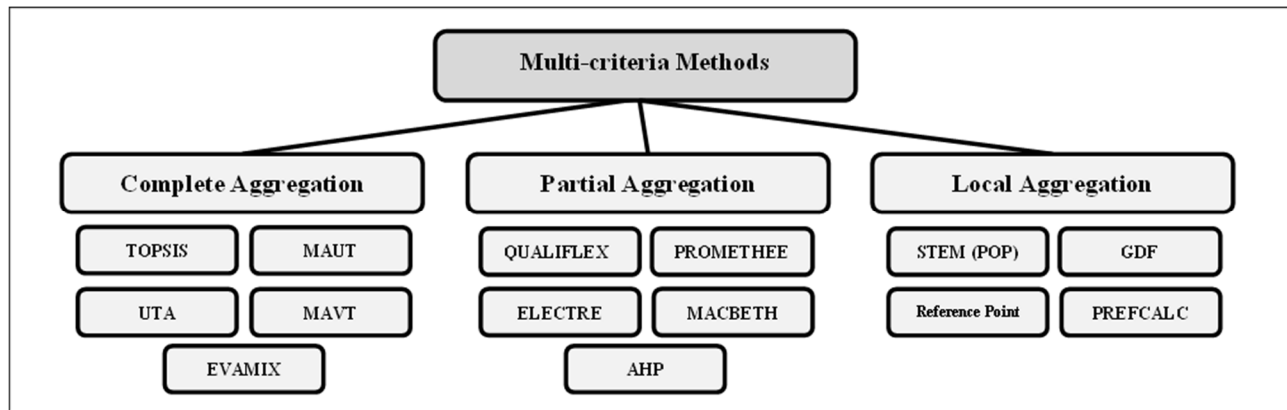

Figure 1 Matrix of decision-maker judgments in relation to the quality criterion

3.2 The choice of the multi-criteria method

The present mathematical modeling has two main goals that can be summarized into one statement. First, develop a good multi-criteria model and evaluate the empirical support for it. Then review the company's overall performance of the companies. After the previous review and comparison of the multi-criteria methods, two techniques are determined to be the most appropriate: AHP and MACBETH. They possess qualities that make the evaluation process practical, including the simple operating concept, mathematical consistency, and the binary comparison principle. Given the software's accessibility, the MACBETH technique (Figure 2) will ultimately be chosen. It makes it easier to translate the decision-view maker's and his assessment of the performance in order to uncover his model of reasoning.
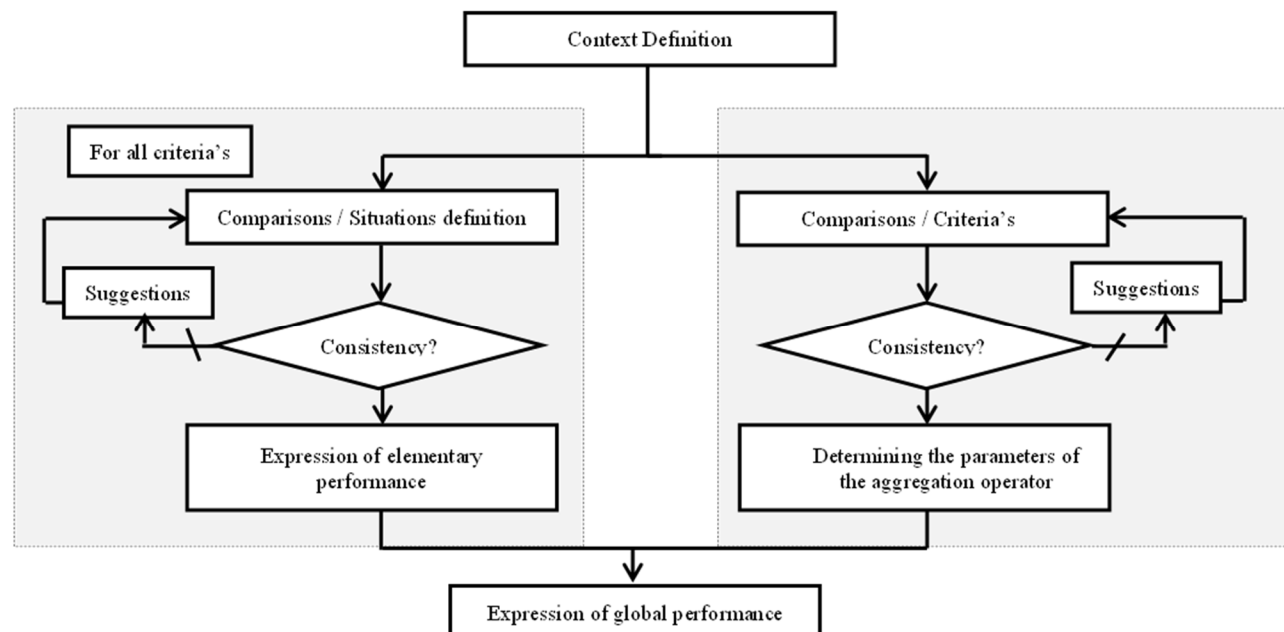

Figure 2 Evaluation process of the MACBETH method

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3.3 The logic of the MACBETH method

MACBETH (Measuring Attractiveness by Categorical Based Evaluation Technique), is an approach to measure attractiveness by an evaluation technique based on categories, it was developed in the 90s by Bana e Costa and Vansnik. This is an interactive process that allows, from a finite set of elements, to build an interval scale to quantify the attractiveness of these elements according to the opinion of an evaluator. This method is one of decision support systems based on single synthesis criterion. This method is particularly suitable for the aggregation of the evaluation criteria when both absolute and relative information are necessary and when different information of quantitative and qualitative types must be treated. In addition, the MACBETH method is associated with a decision support system called M-MACBETH which

contributes to the implementation of the multi-criteria set to the evaluation support process.

MACBETH makes it possible to translate the semantic judgments made by a decision-maker on a numerical scale. Let "S" be a finite set of actions and "P" a "strict weak order" preference relation allowing to measure the attractiveness between the elements of S (, x P y if and only if the decision maker judges that x is more attractive than y) [33]. The MACBETH method is indeed an interactive procedure which consists in asking the decision maker to verbally judge the difference in attractiveness between two actions x and y of S (x being more attractive than y) using semantic categories.

During this interactive process, a matrix of categorical judgments will be constructed. For example, if the decision maker evaluates the 12 actions A, B, C, D, E,… and L according to the Quality criterion, we will have the matrix presented below on Table 1 [33].

Table 1 Matrix of decision-maker judgments in relation to the quality criterion

Quality	A	B	C	D	E	F
A	Null	Weak	Moderate	Moderate	Very strong	Extreme
B		Null	Weak	Weak	Very strong	Extreme
C			Null	Very weak	Strong	Very strong
D				Null	Strong	Very strong
E					Null	Moderate
F						Null

4 Defining the CFB control determinants using the MACBETH method

4.1 Data gathering

The definition of CFB control determinants is based on quantitative data collected previously from a field study

[2]. This data concerns companies operating in the same branch of activity, which is the production of detergents products. This data assesses the performance of seven companies (C1, C2, C3, C4, C5, C6, C7) over criteria's that were proven to be correlated to cash flow bullwhip control [2]. Table 2 summarizes all the criteria's used:

Table 2 Description of the criteria's

Performance dimensions	Performance criteria's	Description
Internal Control Performance	**Control Activities**	Existence of rules and procedures which aim to provide reasonable assurance that the instructions of the management to control the risks likely to affect the achievement of the objectives.
	Control Environment	Existence of policies, processes, and institutional structures for internal control implementation across the board.
	Risk Assessment	Existence of iterative methods for locating and analyzing risks that could compromise a company's goals.
	Information and Communication	Existence of pertinent and high-quality data from internal or external sources to aid in the operation of the other internal control components.
	Monitoring	Existence of an evaluation intended to confirm the existence and proper operation of each of the five internal control principles and the components.
Supply Chain Performance	**Supply Chain Reliability**	Concerns the percentage of Orders Delivered in Full, the delivery Performance to Customer Commit Date, the delivery at perfect condition, and with accurate documentation.
	Supply Chain Responsiveness	Is measured by the cycle time, which concerns the regular average actual cycle time for completing customer orders.
	Supply Chain Flexibility	Concerns the upside supply chain flexibility, the upside supply chain adaptability, and the downside supply chain adaptability.
	Supply Chain Costs	Concerns the cost of goods sold.
	Supply Chain Asset Management	Concerns the Days Sales Outstanding, inventory days of supply, and days payable outstanding.
Financial Performance	**Financial Debt**	Concerns the self-financing rate, the solvency ratio, the debt ratio, the minimum payback period, and the weight of interest.
	Financial Profitability	Concerns the revenue growth rate, the production growth rate, the gross profitability rate, the economic rate of return, the asset rotation, and the margin rate.
	Financial Efficiency	Concerns the working capital requirements.
	Financial Liquidity	Concerns the current ratio and the acid-test ratio.

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4.2 Construction of the CFB control model

The logic of breaking down the overall performance into its component parts must be considered in order to streamline this measurement. The MACBETH method enables the partial performance assessment while also allowing the aggregation of the performance's components into a single global dimension by using a hierarchical approach. Three pillars—financial, supply chain and internal control—make up the entire CFB control system (Figure 3). Each pillar is made up of a group of criteria's that have already been measured and connected to the CFB Control [2]. Consequently, the tree structure takes on the following form:
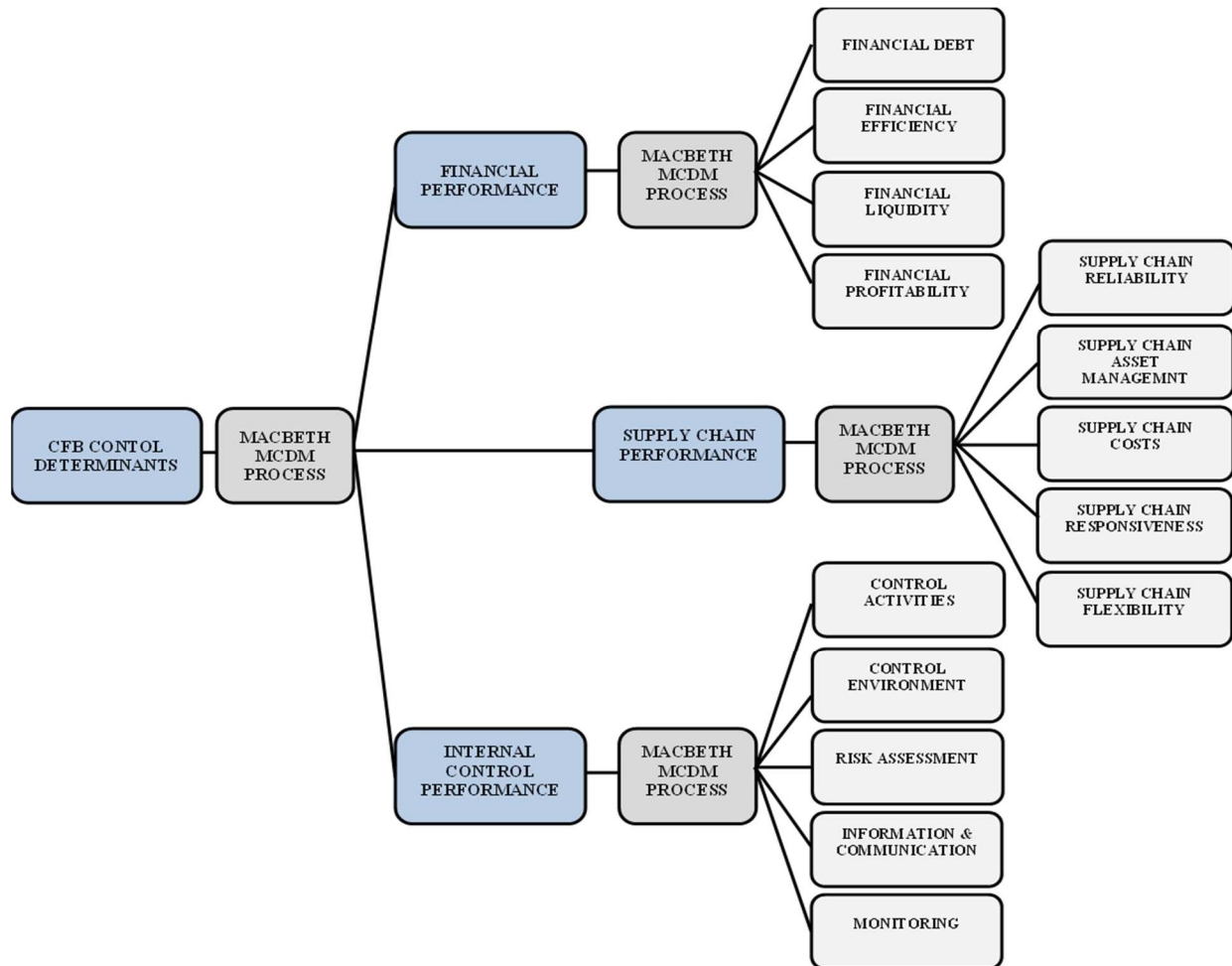

Figure 3 Cash Flow Bullwhip control determinants tree

4.3 Application of the MACBETH method

An established framework has been used to determine the CFB control determinants. The suggested framework lessens inconsistency, by using the DELPHI and MACBETH tools. The Delphi technique was developed in 1963 by Dalkey and Helmer. It is a methodical approach for gathering the views of multiple experts who are put through a series of in-depth questionnaires while taking into account the input of other experts. Interviewees avoid direct dialogues since they do not converse among themselves. Experts participate on a series of questionnaires during a Delphi study. After each round, they are free to peruse the interim findings and given the chance to reconsider their conclusions in light of the opinions of the other experts throughout the questionnaire rounds. The convergence of the expert opinions determines how many rounds of the Delphi process there will be.

For this research purpose, MACBETH is first used to compare the performance of the companies using the quantitative values of the chosen criteria. After that, DELPHI technique is used makes sure that all decision-makers agree on the relative importance of each performance compared to the CFB control. As a result, any potential contradiction in the judgment-eliciting process is eliminated. Finally, MACBETH identifies inconsistent judgments that need to be changed and suggests potential judgment alternatives. The suggested framework can be found in Figure 4.

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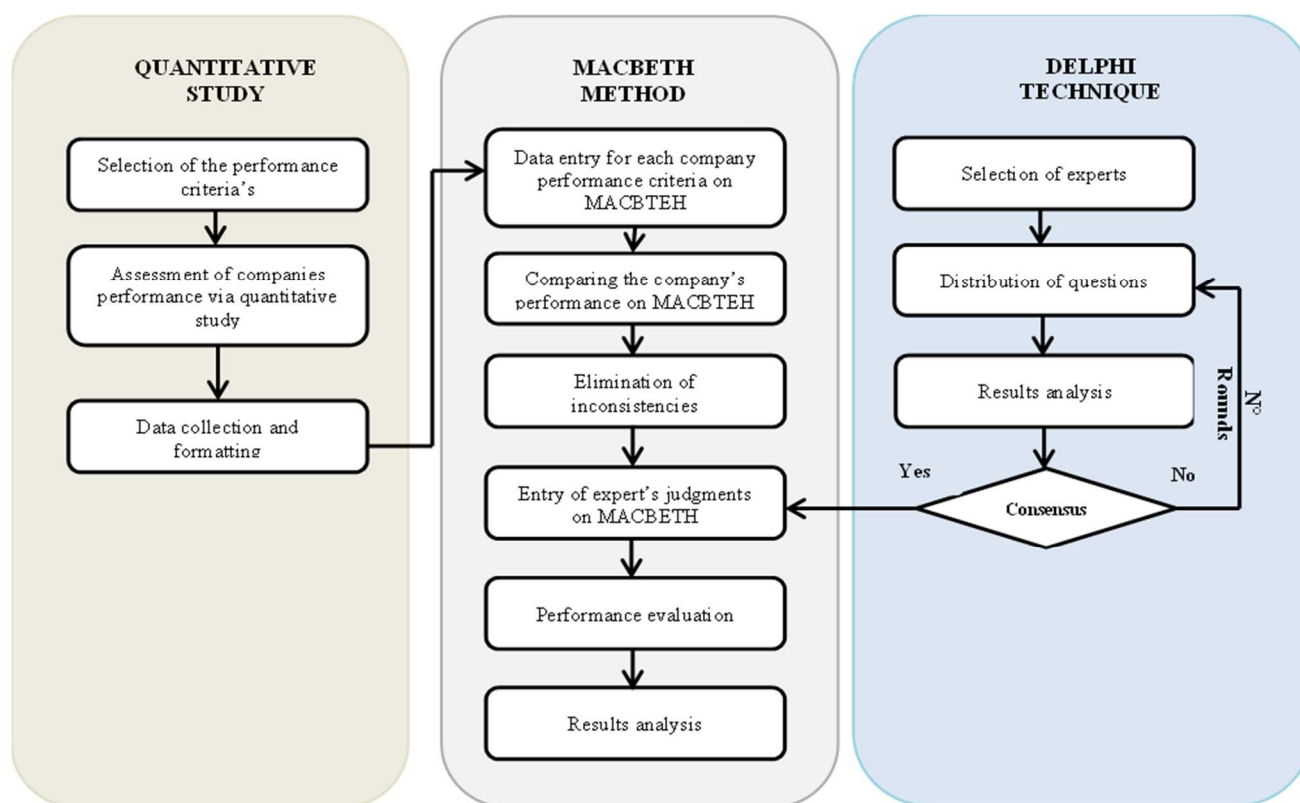Hicham Lamzaouek, Hicham Drissi, Abdelsamad Chouar

Figure 4 CFB control determinants framework

4.4 Results presentation

The software generated the following outcomes given the judgments the decision-maker introduced into the model (Table 3):

Table 3 Matrix of expert judgments'

14	[SCASST]	[ER]	[LR]	[AC]	[DR]	[SCREL]	[CE]	[RASS]	[SCFLEX]	[SCRESP]	[SCCST]	[PR]	[IC]	[MG]	[toutes inf]
[SCASST]	no	very weak	weak	moderate	strong	v.strong	v.strong	v.strong	extreme	extreme	extreme	extreme	extreme	extreme	positive
[ER]		no	vweak-weak	weak-mod	mod-strg	strg-vstr	strg-vstr	vstrg-extr	vstrg-extr	vstrg-extr	vstrg-extr	vstrg-extr	vstrg-extr	vstrg-extr	positive
[LR]			no	weak	moderate	strong	strong	v.strong	v.strong	v.strong	v.strong	v.strong	v.strong	v.strong	positive
[AC]				no	weak-mod	mod-strg	mod-strg	strg-vstr	strg-vstr	strg-vstr	strg-vstr	strg-vstr	strg-vstr	strg-vstr	positive
[DR]					no	moderate	moderate	strong	strong	strong	strong	strong	strong	strong	positive
[SCREL]						no	weak-mod	mod-strg	mod-strg	mod-strg	mod-strg	mod-strg	mod-strg	mod-strg	positive
[CE]							no	moderate	moderate	moderate	moderate	moderate	moderate	moderate	positive
[RASS]								no	weak-mod	weak-mod	weak-mod	weak-mod	weak-mod	weak-mod	positive
[SCFLEX]									no	weak	weak	weak	weak	weak	positive
[SCRESP]										no	vweak-weak	vweak-weak	vweak-weak	vweak-weak	positive
[SCCST]											no	very weak	very weak	very weak	positive
[PR]												no	very weak	very weak	positive
[IC]													no	very weak	positive
[MG]														no	positive
[toutes inf]															no

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All scores for each of the criterion families were compiled into a value tree. Figure 5 shows that the financial criterion family has a net domination of the weight, with a score of 44.39, followed by the supply chain criterion family with a score of 30.85, and finally the internal control criterion family with a score of 24.76.
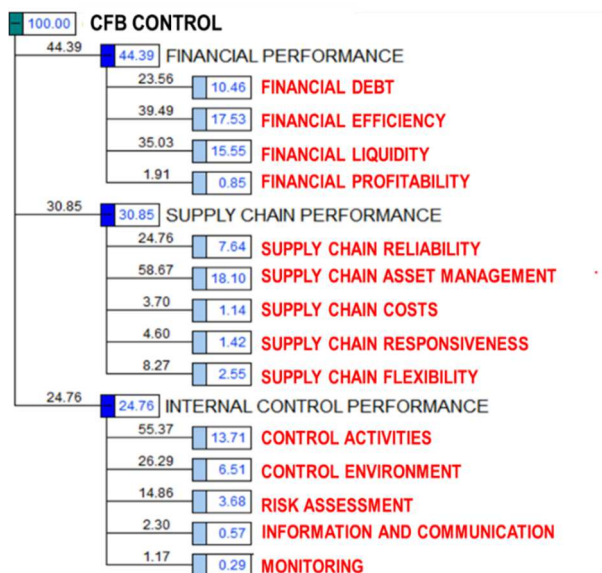

Figure 5 Value tree

An overall scale of the weights of the criteria shows that the weight of the criterion supply chain asset management is very important with a score of 18.10, followed by the weight of the criterion financial efficiency with a score of 17.53. They far exceed the weights of those of the

monitoring (0.29), information and communication (0.57), financial profitability (0.85), supply chain costs (1.14), supply chain responsiveness (1.41) and supply chain flexibility (2.55) criteria (Figure 5).

An overall scale representing all option scores (Figure 6) shows that the C2 option (company 2) is the most attractive with a score of 95.97, and the C6, andC7 are the least attractive with scores of 15.13, 16.74 respectively.
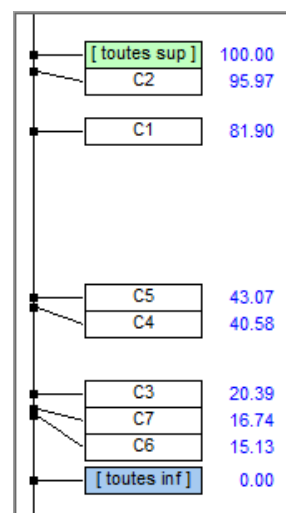

Figure 6 Overall scale of option scores

According to the profile of option C2, only 3 of the 14 criteria have low ratings. It consists of the monitoring of internal controls, supply chain costs, and supply chain flexibility (Figure 7).
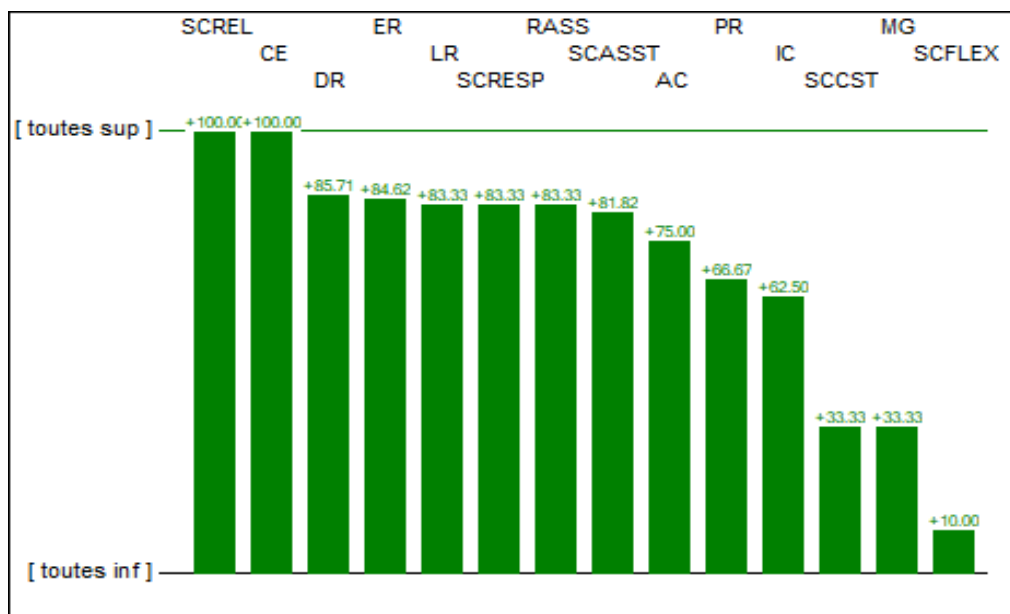

Figure 7 Profile of option C2

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4.5   Results analysis

The MACBETH multi-criteria analysis is finalized by a hierarchy of families of criteria, criteria and options according to their weights and their importance. The final choice of the CFB control determinants is based on the maximum score of the evaluations.

According to the tree of values proposed by MACBETH, the family of financial criteria dominates with a weight of 44.39, followed by the family of logistics criteria, which receives a score of 30.85, and the family of internal control criteria, which receives a rating of 24.76. This seems logical, since the subject of CFB control is mainly financial with a strong link to the company's supply chain activity.

As for the determinants in of the CFB control, we find in order of importance the following criteria:

- Supply chain asset management (18.10): which reflects the proper management of the three components of the cash conversion cycle, namely the number of days of accounts receivables, the number of days of inventory on hand and the number of days of accounts payables. Indeed, the company that optimally manages its inventory in terms of planning and consumption will be more resilient to CFB. This is also the case if the company has well-controlled supplier and customer payment deadlines.

- Financial efficiency (17.53): which reflects the level of the company's working capital requirement. This is justified by the fact that the more the company reduces its WCR, the more it will be preserved from variations in cash caused by the BWE.

- Financial liquidity (15.55): which reflects the ability of the company to meet its immediate financial obligations through its treasury.

- For the "control activities" criterion (13.71): which reflects the existence of rules and procedures aimed at providing reasonable assurance that management's instructions for controlling the risks related to the Purchasing-Suppliers process, management process inventory, treasury process and Sales-Customer process.

- Financial debt (10, 46): which reflects the financial health of a company which can be assessed by its ability to repay all its debts, by its ability to self-finance.

- Logistics credibility (7.64): which reflects the proportion of orders received and honored perfectly. The importance of logistics credibility is justified by the fact that it contributes to the acceleration of physical flows, which also makes it possible to accelerate financial flows relating to customer payments. This contributes to the relief of the company's cash flow, and to the reduction of cash flow variability.

The criteria that have little importance in relation to the mastery of the CFB are:

- Monitoring (0.29). Indeed, the existence of an assessment intended to confirm the proper functioning of the internal control components does not seem to have as much importance in the control of the CFB as the internal control activities.

- Information and communication (0.57). Indeed, the existence and dissemination of data relating to internal control does not seem to improve the control of the CFB.

- Financial profitability (0.85). Indeed, the ability of the company to be profitable and profitable does not lead to the mastery of the CFB.

- Logistics costs (1.14). Indeed, the control of the costs of the goods sold does not influence the control of the CFB.

By comparing the profile of the companies, we can deduce that C2 has better control of the CFB in comparison with the company C6, due to its excellent performance in terms of the supply chain asset management, financial efficiency, financial liquidity, financial debts, and supply chain credibility. This confirms the importance of these previously stated CFB control determinants.

4.6   Discussion

The multi-criteria modeling allowed identifying the relative importance of CFB control criteria. The finding is that the C2 company which is the least exposed to CFB is very efficient in terms of the supply chain asset management, financial efficiency, financial liquidity, control activities, financial debt, and supply chain credibility. These results can be explained by the following:

• An efficient internal control system which is reflected in the existence of iterative techniques for identifying and assessing the risks associated with the purchasing and payment process, the cash management process, the inventory management process, and the sales and collection process. This internal control system manages supplier payment deadlines, customer payment deadlines, inventory flow, and customer risk assessment. It ensures synchronization of debts and deliveries, compliance with invoices, cash conversion cycles, order authorization thresholds, and inventory accuracy. It guarantees inventory accuracy appropriate inventory valuation, and adequate stock levels and rotation. It controls the customer risk, to prevent non-payment, the customer credit and discount authorization rules, the follow-up of unpaid debts and bad debts, the old receivables, and secures the invoicing process in order to avoid late payment by customers.

• A credible supply chain that allows you to control the flow time of stocks, by executing a perfect order each time, which accelerates the flow of stocks and avoids flow distortions over time.

• A responsive supply chain that allows control of the flow time of inventory, guaranteeing a stable cycle time for the execution of customer orders, which contributes to reducing the CCC variation and controlling the CFB.

• Financial efficiency, allowing reducing the variation of the CCC by lowering the cycle time.

• A good level of financial indebtedness, which translates into good self-financing capacity and a low level of indebtedness, helping to reduce the risks of variations in

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the cash conversion cycle and consequently to reduce exposure to CFB.

- A good level of financial liquidity making the company less vulnerable to variations in the Cash Conversion Cycle, and to CFB.

5 Conclusions and recommendations

This research allowed presenting and analyzing the results of the MACBETH model which was used to identify the determinants of CFB control at the level of Moroccan producers of household detergents. From the results, it can be concluded that several factors contribute to this control. Financial factors are more important, followed by supply chain factors, and finally internal control factors. Thus, for a company to be more resilient to CFB, it is recommended that it:

- Performs in supply chain asset management by optimally managing its inventory in terms of planning and flow.
- Improves its financial efficiency in order to reduce its WCR.
- Improves its financial liquidity which will allow it to be less weakened by its immediate financial obligations.
- Implements an effective internal control system enabling it to contain the risks associated with the processes: acquisitions and payments, inventory and warehousing, sales and collections, and treasury management.
- Reduce its financial debt to have more capacity to self-finance and honor its debts.

Improves its logistical credibility which contributes to reducing and accelerating its flow of goods, and consequently reducing the variability of cash flows.

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