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**Incidence of BASC Certification in the Productivity of Companies
in the City of Medellin - Colombia through Discriminant Analysis**

Abstract:

This research analyzes the impact of Business Anti-Smuggling Coalition (BASC) certification in the productivity of companies in the city of Medellin. For this, productivity indicators were calculated in 60 companies certified in BASC. Then, discriminant analysis technique was used to explain the ownership and discrimination, resulting in a correlation between certified companies and increased productivity rates. From the discriminant function obtained it was concluded that both Gross Profit / Value Added (IP1), Net Income / Value Added (IP3) and operating profit / Operating capital (IP5), presented significant differences and improved statistical indicator value added / Working Capital (IP4) during the years 2008 to 2010.

Keywords: Productivity, certification, pointer, function, correlation, discriminant analysis.

1 Introduction

Globally, trade in goods and services have increased; and more and more business organizations are incorporated in international transactions with the relevant requirements and the risks involved in such activity (Young and Esqueda, 2005; Valdevira, Diaz and Sans, 2009). These authors support that the more complex you configure the supply chain of a company, the more vulnerable it becomes to shocks and disruptions. Similarly, the requirements that must be met in order to market products in foreign markets have increased, product safety and consumer end is one of them, so that organizations must shield their operations from illegal activities that have historically developed alongside the global trade of products and services, as Perusset (2007) holds. To prevent such situations internationally, various organizations, which also involves governments, have established a standardized set of strategies to prevent interruptions and problems caused by activities such as drug trafficking, terrorism and smuggling, in order that the companies that implement them are not related to these activities, and to give warranty to customers about the security of its processes and products (Correa and Gómez, 2010; Maruchek, Greis, Mena and Cai, 2011). Strategies such as the implementation of the management system BASC, for its acronym in english for "Business Anti-Smuggling Coalition", aims to standardize logistics processes to improve product safety and the processes themselves, it can then be expected that the implementation of this management system has implications for the productivity of the organizations that carry out it, in other words, the BASC certification helps not only to improve processes safety, but also significantly affects other aspects of the organization such as cost, agility, customer confidence, etc (Correa, 2009). Because of this it is important to gauge the effects of this type of certification in operations and business performance as a whole (Iturralde, Maseda y Ruiz, 2005).

In this research paper it is studied the incidence of BASC certification in the productivity of companies of the city of Medellin. For this, it was developed a methodology where the companies certified with BASC submitted their financial statements to the Superintendency of Corporations in the years of 2008 and 2010, and it was used the multivariate technique of discriminant analysis (MDA).

Subsequently, the results of the evaluation of productivity are presented as a result from the BASC certification, for what it was necessary the verification of the assumptions of the Saphiro & wilk, and Box tests, to check normality and equal variance-covariance matrices, respectively, of the variables under study, which allowed to analyze significant differences and behavior in selected indicators.

1.1 Theoretical references

As the opening of the markets grow, the measures to ensure safe trade become more stringent, and this requires the implementation of procedures to ensure that the entire product flow from its production and transportation, especially in the latter, result in high quality products with the confidence levels to meet customer needs, while preserving the security not only of themselves but also of organizations, their employees and even of the same states. Ibarra (2008) maintains that companies must concentrate their efforts in standardizing processes, and governments in coordinating their institutions to achieve the goals mentioned above. These efforts are reflected in the implementation of strategies that enable them to increase productivity, and to provide a better service for its customers and consumers (Fariñas, 2011).

Ibarra (2007) highlights the role played by entrepreneurs and governments who must find a way to minimize the negative impacts and address threats posed by large-scale commercial transactions. Hence the importance of building partnerships to regulate logistics and curb all external activities that may affect the normal activities of the organization, however, the increase of the members participating in the chain can also generate weaknesses and vulnerabilities that must be identified and attempt to correct. Of the above it is concluded that the key to the safe trade is to standardize the processes developed by each of the participants to fulfill that purpose (Pfohl, Kohler and David, 2010; Manuj and Mentzer, 2008).

Illegal activities listed above could affect any company, regardless of the activities which are engaged wherefore should ensure the safety of the products from the moment you start to set up the logistics network, again, the emphasis is on the need for collaborative strategies between each of the participants in the supply chain to reach the achievement of safe trade (Sarathy, 2006), the costs incurred to achieve safe production and distribution for products can be balanced by achieving a better performance in the operational and financial organization and the confidence that you can get from new customers. According to the above, the Management Systems and Safety Control can impact on some key factors of the organizations, which somehow affect their productivity and profitability as the latter is merely a reflection of the effectiveness and organizational performance (Chacón, 2007).

Moreover Diaz (2008), points out that the implementation of security measures requires the deployment of a range of strategies to international transactions, these are related to the measures taken by companies to secure and protect the products and the supply chain, which requires changes within business structures.

There are several factors that are necessary to achieve deeper safety in commercial transactions; working with governments in the development of new tools that encourage safety regulation, better methodologies for information management of products throughout their life cycle from design to disposal, monitoring technologies along the supply chain and building friendly relations with suppliers and customers (Maruchek et al. 2011).

1.2 Benefits of safe trade

Internally, companies can make huge profits with safe trade, some of which result in increased productivity and improved financial results.

Blanchard (2006), mentions a study by Stanford University in which there's a disclosure of some of the benefits that companies have had by implementing management systems for safety in the supply chain, among them are the improvement in product safety, improved inventory management, improved visibility of the supply chain, improved product handling, increased speed of processes, agility at solving problems and increasing the customer satisfaction.

Additionally, to ensure safety, it is necessary to establish structures that facilitate information processing and analysis of all activities for planning decisions and control of operations in international trade (Finch, Sanchez Velez and Alvarez, 2011).

1.3 BASC Management System for safe trade

The Business Alliance for Secure Commerce, "Business Anti-Smuggling Coalition" (BASC) for its acronym in English, was created as an alternative answer to answer all those threats that trade in goods or services are faced with daily. It was created in 1996 as a proposal for Mattel to implement activities and procedures for companies developing international trade operations were not objects of illegal actions of criminal organizations to transport weapons, drugs and stop the great amount of cargo theft and messed that were being presented. The success of the proposal was so high that it was necessary to create an organization to certify an international standardization of these processes (BASC Colombia, 2010). In this way, companies can also achieve greater participation in international trade order (Osorio, 2010). This system of control and security management in the organizational challenge comes as consisting of greater collaboration among chain participants to address common problems that affect all (Tamayo, Higueta and Castrillon, 2010).

One of the advantages of the BASC Management System is the possibility that the company will become an AEO (Authorised Economic Operator), this name is given to organizations involved in international trade and give guarantee of confidence and security in their operations. BASC Management System contributes to the achievement of this qualification as the entire organization undertakes to comply with the rules established by the safety program of the World Customs Organization (Ibáñez and Castillo, 2011).

Because organizations do not operate in a vacuum; several parties may have a legitimate interest in the proposal of the organizations for control and safety. These are, among others: employees, customers / suppliers, community, shareholders, contractors and government agencies; this rule is intended to assist organizations in developing a proposal for Control and Security Management in International Trade, while protecting companies, their employees and other persons whose safety may be affected by their activities. Many of the characteristics of effective management cannot be distinguished from the proposed practices of quality management and business excellence.

Del Valle and Ospina (2009) argue that the BASC certification allows the improvement of internal processes of organizations and suggest that its implementation is almost mandatory in companies involved in international trade, this policy being designed for use in all organizations of all sizes, independently of the nature of their activities. It is expected that its application is proportionate to the circumstances and needs of each particular organization.

BASC management system is one way to ensure product safety and traceability; that is, through this strategy it can achieved a higher level of quality of services and products while incurring less costs, which may mean a step towards collaborative planning, process redesign and organizational innovation (AECAF, 2008, Lee and Whang, 2003; Pibernick, Zhang, Kerschbaum, and Schröpfer, 2011; Speier, Whipple, Closs and Douglas, 2011).

Medina (2010), points out that there is a need, within companies linked to exports, to increase productivity by modernizing their management systems and the technology they use, BASC is an optimal alternative to achieve this.

1.4 Productivity Indicators

This research analyzes the relationship between BASC certification and business productivity. In this sense, Berechet and San Miguel (2006) show that the productivity indicators allow to set a relationship between the amount of goods and services produced and the amount of resources used, turning into a crucial factor in determining the efficiency of resources. Thus, productivity becomes a key element in the creation of value and wealth within organizations, energizing not only the resources in the organization itself but also in the market (and Toirac Miranda, 2010).

Table 1.: Productivity Indicators

Indicator	Equation
IP1	$\frac{\text{gross profit}}{\text{Value added (sales-payments to suppliers + inventories)}} \times 100$
IP2	$\frac{\text{operating profit}}{\text{Value added (sales-payments to suppliers + inventories)}} \times 100$
IP3	$\frac{\text{Net}}{\text{Value added (sales-payments to suppliers + inventories)}} \times 100$
IP4	$\frac{\text{Value added (sales-payments to suppliers + inventories)}}{\text{Working capital (current assets and fixed)}} \times 100$
IP5	$\frac{\text{Operating income}}{\text{Working capital (current assets and fixed)}} \times 100$
IP6	$\frac{\text{Net}}{\text{Working capital (current assets and fixed)}} \times 100$

Source: Prepared by author.

Martinez (2009) argues that the operational indicators together with financial, increasingly demonstrate their importance and usefulness when making decisions, however Bortesi (2005) states that there are some aspects that are not necessarily be described quantitatively, but in their own way contribute to the productive performance of enterprises. Generally the increase in productivity is also related to an increase in the quality of products but Rincon (2001) argues that the increase in

productivity can lead to a decrease in the quality if processes are not controlled. Good performance of business productivity can result from innovation, in this regard there are several sources of business innovation among which can be identified information technology, organizational redesign and training (Torrent and Ficapal, 2010), these elements are provided and implemented by the BASC Management System.

Within an organization, productivity indicators can be measured with respect to a given production factor, which is why there is the possibility of presenting a wide variety of indicators relating to different areas; Toirac and Miranda (2010) argue that the most important are those related to: labor productivity, the productivity of the use of materials and capital productivity. In Table 1, we present the productivity indicators used in this research.

1.5 Assessment of the impact of BASC certification on productivity through discriminant analysis

Discriminant analysis is a statistical technique for identifying the variables or characteristics that distinguish one group from another, it also suggests the number of variables to consider in order to rank the elements within their respective group optimally, the dependent variable in this type of analysis is taken as the membership of a particular group, the independent variables are the characteristics that supposedly differentiate the elements of each group. BASC management system is related to factors such as the enterprise infrastructure, the way they work, innovation and research, which significantly affect the productivity performance (Alvarez, Becerril, and Moral, 2011; Cuesta, 2012; Hernandez, 2005; Sanabria, 2011), hence the need to assess this impact.

Avendaño and Varela (2010) used discriminant analysis to measure the impact of the adoption of standards by companies, which concluded that both competitiveness and productivity are positively influenced by the adoption of standards, and that those companies that did could stay in the market and increase their participation.

On the other hand, the study by Suarez (2000) demonstrates the effectiveness of the methodology proposed by the discriminant analysis for the classification of the level of profitability because of the ease that this provides for handling multiple variables.

Also, Vivanco, Martinez and Taddei (2010), make use of the methodology that provides the discriminant analysis to determine the levels of competitiveness of various companies according to specific variables. Discriminant analysis takes into account the systemic behavior of organizations and attempts to identify the variables that best describe the behavior of the system through certain tools that assess the similarity or difference between them (Colonel and Cardona, 2009; Mutis, 2003).

These authors realize the effectiveness of discriminant analysis methodology to establish membership of a company or a group that has some variables that determine the competitiveness, profitability and productivity of the group.

1.6 Mahalanobis Distance

For the selection of the variables that best discriminate on the analysis of the incidence of BASC certification in the productivity of companies in the city of Medellín, we used the D2 Mahalanobis distance which is a generalized distance measure and it's based on the squared Euclidean distance,

which conform to unequal variances, the selection rule in this process is to maximize the D2 Mahalanobis distance. The multivariate distance between group a and group b is defined as , eq. (1):

$$D = (n - k) \sum_{i=1}^p \sum_{j=1}^p W_{ij}^{-1} (X_i^{(a)} - X_i^{(b)}) (X_j^{(a)} - X_j^{(b)}) \quad (1)$$

Where n is the number of valid cases, k is the number of groups, $X_i^{(a)}$ is the mean of the group on the i-th independent variable, $X_i^{(b)}$ is the mean of group b in the i-th independent variable, and W_{ij}^{-1} is an element of the inverse of the variance-covariance matrix within-groups. Being the total variability of the form, Eq. (2).

$$T_{ij} = W_{ij} + V_{ij} \quad (2)$$

The total covariance is equal to the covariance within groups, plus the covariance between groups.

Thus, the probability $P(K_i/D)$ of an object j, scoring discriminant $D = (y_{j1}, \dots, y_{jm})$ belonging to the i-th group can be estimated by Bayes rule, Eq. (3).

$$P(K_i/D) = \frac{P(D/K_i)P(K_i)}{\sum_i^m P(D/K_i)P(K_i)} \quad (3)$$

$P(K_i)$ is the prior probability and is an estimate of the confidence that an object belongs to a group if there is no previous information.

Escobedo and Salas (2008) argue that with the Mahalanobis distance it can be explained best the change that suffers a particular variable since it is analyzed in its own context, bearing in mind the correlation that this one possesses with regard to others.

Like any other statistical technique, the application of it has to be preceded by a check of the assumptions made by the model. Discriminant analysis is based on the following assumptions: multivariate normality, equal variance-covariance matrices, linearity and absence of multicollinearity and singularity.

Next, it is proposed and structured the model for the application of discriminant analysis in analyzing the impact of BASC certification in business productivity in Medellin during the years of 2008 to 2010 and thus determinate whether there are significant differences for the group of companies studied.

2 Methodology

This is a research where a qualitative, descriptive and quantitative analysis was used, supported by multivariate discriminant analysis (MDA) to test whether two different periods showed the evolution of indicators of productivity resulting from BASC certification in the sector analyzed, for this, items required of companies in Medellin were studied. To carry out this research, we used the indicators presented on Table 1, using the ADM, to find the estimate of the years evaluated.

The population of this research consisted of 60 companies of the city of Medellín certified by the Business Alliance for Secure Commerce (BASC) that submitted their financial statements between 2008 and 2010.

It was taken as sources the financial statements of the Superintendency of Corporations (2011), and information recorded in BASC-Colombia and the Chamber of Commerce associated with the

financial statements of 2008 and 2010. From where it was taken various financial items for the indicators of productivity of organizations in the city of Medellin - Colombia.

To analyze the variables associated with the selected indicators, we used discriminant analysis using SPSS Statistics 19 software, application used to establish discriminant functions and to study the various statistics related to productivity indicators established; this methodology allowed to analyze whether financial indicators evaluated in the same context present significant differences in the two selected periods. Then, it was proceeded to verify compliance with the assumptions required to apply discriminant analysis and thus calculate and set the objective function to determine which indicators discriminate the better. it was also calculated the accuracy of the model to predict the future behavior of the indicators in the sector.

Finally, with the statistics, specifically the means of the indicators for the sector, it was analyzed and evaluated the behavior of different financial productivity indicators selected in the two periods 2008 and 2010 to analyze the impact of BASC certification in the indicators of productivity of companies in Medellin.

3 Results

First, the model assumptions mentioned above were checked (Javalgi Koch, 1998), Table 2 shows the results of normal data for the periods 2008 and 2010 respectively associated with the Shapiro & Wilk test.

Tabachnick and Fidell (2001) point out some details about the robustness of this technique in relation to the size of samples, suggesting a sample size of 20 similar groups to which the model is robust. In our research we used 60 samples, so the model is robust according to the size specifications also suggested by Blanca (2004).

Table 2.: Shapiro & Wilk test for normality checking of productivity indicators for 2008 and 2010 respectively.

Indicator	Shapiro-Wilk 2008			Shapiro-Wilk 2010		
	Statistical	Samples	Sig.	Statistical	Samples	Sig.
IP1	0,726	60	0,160	0,802	60	0,163
IP2	0,96	60	0,248	0,932	60	0,202
IP3	0,872	60	0,120	0,889	60	0,170
IP4	0,481	60	0,149	0,495	60	0,095
IP5	0,954	60	0,163	0,912	60	0,190
IP6	0,782	60	0.150	0,878	60	0,149

Source: Prepared by author.

3.1 Homogeneity of variance-covariance matrices

The assumption of equal variance-covariance matrices for the years 2008 and 2010 was proved with the test box, as shown in Table 3.

Table 3.: BOX test results.

M de Box		62,444
F	Aprox.	2,812
	gl1	21
	gl2	51212,449
	Sig.	0

Source: Prepared by author

The results of the test statistic $M = 62,444$ and a value of $F = 2,812$ with an associated probability $p = 0$ prevents accepting the null hypothesis of equal covariance discrimination groups, ie, the explanatory capacity of separation of the clusters is good.

3.2 Linearity and multicollinearity and singularity

The assumptions of linearity and multicollinearity and singularity will not be reviewed, since the construction of the discriminant analysis model used the stepwise method, taking into account the tolerance criterion to select the variables that are included. Thus, those variables having a high correlation with the remaining multiple variables will yield a low tolerance and would not be considered ahead of the construction of the discriminant function (Rodriguez and Moreno, 2011).

3.3 Selection of the variables that best discriminate

To determine which variables discriminate independently between 2008 and 2010 groups, it was estimated the D2 distance of Mahalanobis and Wilks Lambda for each. To the above, it was used all selected variables presented in Table 2. With these productivity indicators once used the technique of discriminant analysis, discriminant functions were constructed. The end result of the model is shown in Table 4 and in Eqs. (4) and (5).

$$Z_1 = IP1*(4,442) + IP2*(11,370) + IP3*(-4,219) + IP4*(0,970) + IP5*(-5,403) + IP6*(3,294) - (2,579) \quad (4)$$

$$Z_2 = IP1*(4,918) + IP2*(-4,617) + IP3*(7,649) + IP4*(0,944) + IP5*(3,650) + IP6*(-5,561) - (2,602) \quad (5)$$

Table 4.: Coefficients of the classification function

	YEAR	
	2008	2010
IP1	4,442	4,918
IP2	11,37	-4,617
IP3	-4,219	7,649
IP4	0,97	0,944
IP5	-5,403	3,65
IP6	3,294	-5,561
(Constant)	-2,579	-2,602

Source: Prepared by author

As a result of the application of discriminant analysis it can be said that productivity indicators studied show significant differences, generating results in a Type I error of 30% and a Type II error of 46.7% for a 61.7% efficiency rating as shown in Table 5.

Table 5.: Classification results

	YEAR	Predicted membership group		Total
		2008	2010	
	2008	42	18	60
Original	Count	2010	28	60
		2008	70	100
	%	2010	46,7	53,3
		2008	46,7	53,3

Source: prepared by author

3.4 Assessment of productivity in companies of Medellin

When reviewing the statistics (stocking) of the selected indicators of the companies in the city of Medellín, Gross Profit / Value Added (IP1) Operating Income / Value added (IP2), Net Income / Value Added (IP3), Value Added / Working Capital (IP4) Operating Income / Operating Capital (IP5) and Net Income / Operating Capital (IP6), it was found that the value added indicator / Working Capital (IP4) is the only one that presented a good behavior during the years of 2008 and 2010 as shown in Table 6.

Table 6.: Stockings of financial indicators

	YEAR	STOCKINGS	Desv. tip.
2008	IP1	0,4005	0,35973
	IP2	0,0589	0,07406
	IP3	0,0382	0,07347
	IP4	1,7968	1,47517
	IP5	0,0805	0,1113
	IP6	0,0532	0,12617
2010	IP1	0,3905	0,3093
	IP2	0,0321	0,09521
	IP3	0,0196	0,08335
	IP4	1,9392	1,89564
	IP5	0,0543	0,14326

IP6 0,024 0,11996

Source: Prepared by author

4 Discussion

In analyzing the discriminant functions generated in Table 5 it can be concluded that indicators such as (IP1), (IP3) and (IP5) discriminate well, improving from one period to another, which means that they differ from year to year. However for the case of the other indicators, there is no evidence of the same behavior during the years 2008 and 2010.

With respect to the average productivity indicators presented in Table 6 of the selected indicators it can be concluded that the only indicator that improved was the value added / Operating Capital (IP4) in the course of the years analyzed, so it can be inferred that the items associated with this indicator are positively affected by the BASC certification of companies in Medellín. Importantly, the added value and working capital are related to operational processes and therefore are also associated with the productivity of the firm. The results obtained in this study are consistent with methodologies and analysis previously made, in which productivity is assessed through indicators and positive results are obtained by strategies that involve the participation of organizations in international markets (Hannula, 2002 and Merino, 2012).

Likewise, research by Fontalvo, Mendoza and Morelos (2011) and Fontalvo, Morelos and Sickie (2011) have shown that standardization processes with different rules positively affect in improving indicators of organizations in different business sectors. Which also could be demonstrated in this research. Similarly, it is noted that using the methodology developed in this study offer alternatives for performance evaluation of productivity different than those developed by Ballesteros and Ballesteros (2006), Diaz (2009) and Gomez (2010) that offer reliability and effective results. Similarly, the results of this research are consistent with the approaches of Avendaño and Varela (2010) who claim that the adoption of standards positively affects the competitiveness and productivity of the company or sector that implements them, as these represent standardization of processes and production of healthy products.

5 Conclusion

In this research we worked with the indicators of 60 companies in Medellín, the model presented an acceptable effectiveness in classifying the two populations. In the original sample, the accuracy of the model in 2008 is 30% and in 2010 is 46.7%, for an overall average rating of 61.7% of companies, demonstrating acceptable reliability for predicting behavior of financial indicators in the sector specifically looking indicators IP1, IP3 and IP5.

From the results and the discussion of this research we can conclude that despite significant differences in indicators IP1, IP3 and IP5 in both periods studied, there's only statistical evidence that BASC certification affected the improvement of the behavior of the productivity indicator Value Added / Working Capital (IP4) in the course of the years analyzed in Medellín companies certified with BASC. However, the incidence of BASC certification in productivity can change in another business sector or other indicators.

From studies like this, some other analysis in different business sectors can be made to facilitate decision-making about which variables, items and indicators are redundant to the improvement of the production situation of organizations, and to analyze other indicators that affect the positioning

thereof. For future studies it is recommended to increase the number of indicators and incorporate indicators of competitiveness; and there's an invitation to analyze the behavior of other business sectors through this methodology.

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