# QUALITY PROGRAMS AND PERFORMANCE INDICATORS: THE COFFEE ROASTING INDUSTRY ON SOUTHEASTERN BRAZIL

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**Summary –** By means of the Structure-Conduct-Performance model and the Quality Theory, this study was carried out to verify the influence of the quality programs on the performance indicators of the coffee roasting and milling industry on Southeastern Brazil. The results pointed out an improvement in the majority of the studied indicators as the implantation of the quality programs were advanced.. The Wilcoxon's no-parametric statistical test was used for comparison among the means of the indicators, which were obtained during implantation of the programs and when the research was conducted. The test revealed that market share and returns on investments were statistically significant indicators, that is, they were improved as the quality programs were implemented. Also The Mann-Whitney no-parametric test was also used, for comparing the means among the indicators of both Groups. The test showed no statistical differences among the means of the Groups. According to the results, the following conclusions were drawn: the quality programs promoted the desired effect on those indicators of performance, on absolute terms; in spite of the quality programs being used by just a restrict number of coffee roasting industries, they were efficient in improving the indicators, so showing to be a viable competitive strategy for the coffee roasting sector.

**Keywords:** Quality programs, performance indicators, no-parametric tests, coffee industry.

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## 1. Introduction

The coffee roasting industry is a traditional segment in Brazilian agribusiness, and is composed by several companies and several brands, but is basically addressed to the internal market.

There are 1,630 coffee roasting and milling companies in Brazil, from which just a part (about 30 to 40) pertains to the large-scale group. According to ASSOCIAÇÃO BRASILEIRA DA INDÚSTRIA DO CAFÉ (ABIC, 2001), about 1,000 coffee bags are monthly processed, on average, by those companies.

The states of Minas Gerais and São Paulo are the largest coffee producers, which leads the companies to set up in these states in order to be near the raw material source, therefore reducing the transport costs. A total of 86.3% from all coffee roasting companies on Southeastern Brazil are located in these two states, where 86.77% of coffee brands are marketed. According to ZYLBERSZTAJN (1992), the internal deregulation of the coffee roasting market has been promoted a high increase in competition among the roasting companies, with prevalence of the largest ones and most agile in implanting and training for cost control, total quality, human resource policies, marketing of the differentiated products, verticalization, and modernizing integration of the commercial activities.

A number of authors, such as FREIRE et al. (2001) stated that the globalization phenomenon, to which the companies are submitted, imposes a new administrative, economical-financial and marketing posture upon the organizations. Therefore, a new competitive environment is generated, where the search for improvement of quality and productivity is the route to maintain the market slice already achieved**,** and specially to expand the company's participation into market.

According to GAZZONI (1998), the consumers' purchase decision that was almost exclusively conditioned by the criterion of lower price is actually a function of technical specifications and quality attributes. This author emphasized that, under the aegis of the market globalization, the quality reaches its maximum as a conditioner of the

business decisions and becomes the passport to the opening of most exigent markets and to the maintenance of most contended market niches. The quality attribute, a remarkable characteristic of the markets in the First World, is already preceding the requirement for price upon the buyers' decision analysis, whereas its positive reflexes are also noted in Brazilian local market.

To offer quality products, while maintaining or even reducing the production costs is the only alternative for survival of the companies. To reach this goal, however, it is necessary that the roasting companies undergo reformulation in qualification and certification of the product

In Parallel with the changes occurring in the roasting segment and the importance given to the quality of the product, the quality programs [5] appeared as a tool able to assure competitiveness to the companies in their activity branch. However, the studies measuring the impacts of the quality programs upon the performance of the companies are scarce.

In this sense, a problem arises due the need for knowing if the Brazilian roasting companies, in their great majority, are already prepared to face the new situation characterized by intense competition that prevails mainly in the domestic market or, on the other hand, if they already incorporated any competitive strategies, such as the adoption of quality programs, aiming at the conquest of the referred market. It is also questioned if, once the quality programs are implemented, will they be really effective? In other words, do the adopting companies really obtain gains? The objective of this study is to verify whether the implantation of quality programs positively influences some indicators for performance, such as the market share, productivity, return on investments, annual gross revenue, production costs, and profitability of the roasting companies located on Southeastern Brazil.

[5] Quality Program is a systematized process that seeks to maximally reduce the failures happening over the company´s productive process, therefore providing a production free from defects.

## 2. Methodology

This study is based on the Industrial Organization Theory[6] from which the focus is centered in structure, in conduct and performance of the organizations. This approach allows to conjecture the strategies adopted by the coffee roasting companies in front of the market structure where they operate, as well as to analyze the performance indicators of those companies. The Total Quality Theory[7] is also used in order to investigate the influence of the quality programs upon the performance indicators.

### 2.1. Structure – Conduct – Performance Model

The Industrial Organization Model was used in evaluating the possible associations among the conduct variables used by the roasting companies and these companies' performance as well. The model utilizes the formation of an industrial system that approaches the basic conditions for supply and demand, determining the structural formation of the industry, that has direct influence on the conduct of the companies constituting the coffee roasting segment in Brazil. The structure of the Brazilian coffee roasting segment is characterized by a high number of low-scale roasting companies, that are regionally spread, as well as some large-scale companies that operate throughout the national territory. According to SAES and FARINA (1999), the Brazilian roasting market is framed into an oligopoly structure differentiated with competitive fringe, which means the existence of some large-scale companies able to stop the power in establishing the price for the product. In general, however, most roasting companies usually is the price taker.

This study specifically emphasizes the roasting companies' conduct as to the quality programs, therefore using the Structure-Conduct-Performance model. This model apprehends the context in which the roasting segment is inserted and allows to elaborate asso-

[6]MASON (1939), KOCH (1980), SHERER (1990), AZEVEDO (1996).
[7]GRESHNER (1980), BONILLA (1994), FROTA (2000), FUNDAÇÃO VANZOLLINI (2001).

ciations between quality programs, while a competitive strategy (conduct), and the companies' performance, based on those indicators previously selected.

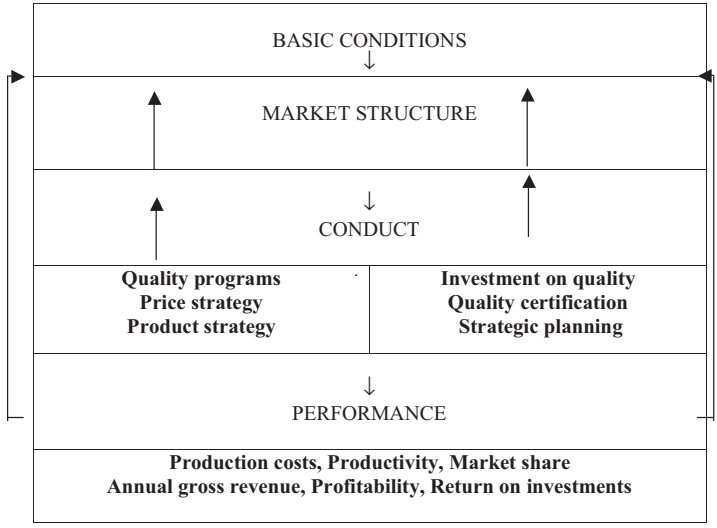
The importance of organizations to possess the performance indicators necessary to the evaluation of the adopted strategies and to redirect possible changes in future planning is emphasized by several authors. TAKASHINA and FLOWERS (1996) stated that indicators are essential to the planning and control of the organizations' processes the organizations, since they make possible the establishment of goals and the unfolding of these goals.

The Industrial Organization's empiric model may be observed in Figure 1.

To analyze the performance of the coffee roasting companies, some variables were included into this model: market share, profitability, annual gross revenue, productivity, production cost, and return on investments. In this work, some comparative analyses for the performance indicators were performed among the roasting companies either adoptive and non-adoptive of programs or management of quality, a reason why these companies were divided into two different groups. The performance indicators' behavior in both groups were measured, on a generic way, in a Likert ordinal scale[8] with seven ranks varying from (-3), which is an unfavorable answer to the researched item (reduced/ much worsened) to (3), favorable answer (increased / much improved). This scale is used by each company, in order to point out a unique behavior or measure for each one of the performance indicators.

[8] The Likert scale, proposed by Rensis Likert in 1932, is a scale in which the respondents are asked to agree or disagree with the statements, and also to inform his/her concordance/discordance degree about these ones. A number reflecting the direction of the respondent's attitude in relation to each statement is given to each answer. The total punctuation of each respondent's attitude is given by the sum of the punctuations obtained for each statement (MATTAR, 1996).

**Figura 1 – Analitic Model for Structure, Conduct and Performance.**




Source: SCHERER (1990), adapted by SILVA JÚNIOR (2000 a).

According to CANTORSKI (2001), the paradigm Structure-conduct -performance was used in several studies carried out in Brazil, and the obtained results corroborate its validity, when analyzing the organization of an industry as a whole. However, neither of these works considers the impact resulting from the shocks external to industry, as well as they do not include the environmental variable as a competitiveness factor, in spite of taking into account the peculiarities of the agroindustry production chains. A number of works still use the technological development as an indicator for industry performance. These two variables were not used in the present study because the difficulty to use "proxies" for technological development and environmental factor.

Based on the theoretical outline of the Structure- Conduct - Performance model, what makes the companies as competitive ones is the conduct they engender. According to ESTEVES FILHO (1991), the com-

petitiveness is a result from the companies' strategic decisions, by which they try to distinguish themselves from their competitors through stocks of accumulated knowledge, investment policies, marketing, quality and human resources, production management, service amplitudes, and relationships with customers and suppliers. PORTER (1996) states that the essence of the formulation for a competitive strategy consists of relating a company with its environment or with its competitive environment. The companies pertaining to a particular industry, in response to a concurrent environment where they are inserted, will increase their returns on investment through the promotion of new products and processes, that is, by generation of new factors, by the increase of their productivity, and by the improvement in quality. Thus, PORTER (1996) defined the competitiveness, in wide sense, as the company's capacity to develop strategies that will make possible to obtain competitive advantages that will enable it to face the competition on a durable and sustainable way.

In this sense, the competitiveness pattern defined by PORTER might be used by the companies competing in an environment under intense competition as a conduct form. The quality programs might be used as a competitive tool that will enable the companies to improve their performance indicators. In this aspect, one may admit that the Industrial Organization Theory is intimately related to competitiveness, while this competitiveness be seen as a company's conduct.

From the analysis of the theoretical aspects accomplished previously, it is noticed that the approach relating the E-C-D model to the competitiveness matter generally suggests the conduct variable to be represented by competitive strategies adopted by the companies. On the other hand, the performance is related to competitive performance, as shown in Figure 2.


Figure 2 –The Porter model adapted to paradigm E-C-D.

In Figure 2, the industrial structure and the competitive strategies may be seen as the companies' s conduct, from which the companies will be able to distinguish in the branch where they operate.

## 2.2. The quality theory

According to FUNDAÇÃO VANZOLLINI (2001), Armand Vallin Feigebaum is the author of the concept for total quality control. Based on this approach, the quality is a strategic instrument that should worry all workers. More than a technique for elimination of defects in the industrial operations, the quality is an administration philosophy and a commitment with excellence. It is directed toward the exterior of the company, based on the customer's orientation, and not toward its interior, just aiming at the reduction in defects. Feigenbaum is recognized as a pioneer in the study of the quality costs. His greater contributions to quality teaching are some 19 steps for the improvement of quality and its four mortal sins.

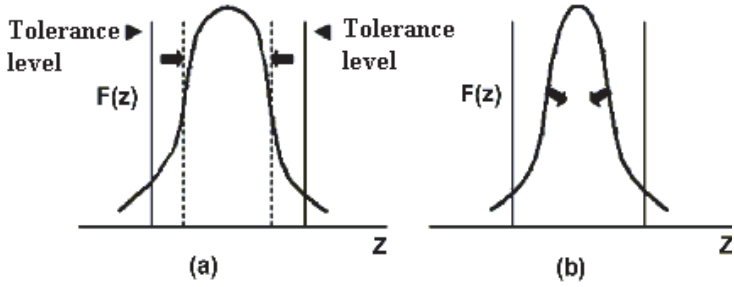
Juran and Deming were two pioneers in the movement for quality. For Nipponese, these investigators were the inspirers of the Japanese industrial miracle initiated in the 50$^{th}$ decade. Just in the 80-ies, the North Americans became acquainted with their ideas. These ideas were the base of a revolution for quality that reestablished the confidence on the national industry, but it would be unfair to associate the movement to these two gurus. On North American, Philip Crosby provided a great help with his theory of the zero defect. On Japan, Kaoru Ishikawa and Genichi Taguchi are two additional names. Ishikawa was the pioneer and gave a Japanese stamp to Deming and Juran' teachings , when creating the seven famous tools of the statistical quality control, besides being also the great inspirer of the quality circles. Taguchi gave strong impulse to the promotion of the industrial design, which marked the second phase of the quality movement in Japan after the first phase, that was based on the statistical control (FUNDAÇÃO VANZOLLINI, 2001).

These authors gave a great contribution to the development of the Quality Management process, at global level. In spite of this contribution, the traditional focus for quality has been systematically developing. In the last years, the approach is that the levels of defects must be reduced, and simultaneously the consumers' needs must be satisfied. The innovation consists basically of satisfying the customers' demands, without changing the quality process in its essence,

under the industrial viewpoint. The matter of became a focus of the companies' attention, which perceived that quality, besides being a competitive tool, became a matter of survival in front of market opening and with the incitement of competition. Figure 3, illustrates the change occurring in the approach of quality in the companies.

In Figure 3 (b), one may observe that the levels of tolerance are systematically decreasing. The objective of the companies is to maximally reduce the levels of defects and, simultaneously, to satisfy the consumers' needs.

Some authors, such as DEMING (1982), already have proclaimed that a rigid control on quality of the products would reduce the costs as a in response to less errors, less delays and better use of resources. On their turn, these results would lead the company to have better productivity, which would allow for a best price policy, keeping the company in its activity branch and amplifying its market.




Source: SILVA JÚNIOR (2000 b).
Figure 3 - (a) – Traditional focus for Quality – (b) – Modern focus for Quality.

GITLOW (1993) stated that the emphasis given to quality may conduct to the desired results, as a better reworking, higher productivity, lower unit cost, flexibility of the prices, higher competitiveness, higher sale, higher profits, more jobs, and also safer jobs. On their turn, the consumers acquire a better-qualified products at lower prices, while the suppliers obtain foreseeable businesses, in the long run, and the investors retain the profits.

## 3. Statistical Procedures

The analyzed data were used, in their majority, into ordinal scales, which reflected the information, obtained through questionnaire, of the sample units. According to SIEGEL (1979), an difficulty inherent to data obtained in ordinal scales is the pure and simple use of parametric statistical techniques. The parametric statistics should not be used on those data collected in an ordinal scale. This work used the no-parametric statistics that, according to SIEGEL (1979), is the necessary tool to work with data collected under the form of ranks.

To reach some of the objectives proposed in the study, that is, the verification of the evolution of the performance indicators among the coffee roasting companies adopters and non-adopters of quality programs, the Mann-Whitney [9] statistical U Test was used, which is useful to compare the means of two independent groups. In analysis, the means of the performance indicators were compared before and after the coffee roasting companies to adopt, or not, the quality programs. The Wilcoxon U Test was also used, since it is useful to test the equality of means after a control group suffering some type of treatment.

## 4. Results

To characterize the sample from the coffee roasting companies located on Southeastern Brazil, they were divided into two groups (1 and 2), in order to facilitate the analyses concerning to the indicators under study. Group 1 represents the companies that do not use any quality program, while Group 2 represents the companies that use some management program or a total quality control.

It is worth to emphasize that from those 42 companies under study, only 12 have adopted a management program or the total quality control, whereas the other ones did not adopt any program type.

[9] Details related to no-parametric tests may be found in SIEGEL (1979) and FONSECA AND MARTINS (1996).

### 4.1. Characterizing the quality programs adopted by companies

In Figure 4, it can be verified that six companies (50%) were framed into methodology "others"; five (42%) used the methodology of the ISSO series; one used simultaneously the methodology proposed by Deming; and one (8%) used the HACCP[10] methodology together with the GMP[11] methodology, which is a complement for the HACCP methodology. The methodology "others" refer to the methodologies generated in the companies themselves, which are based on the principles 5S's [12] and Total Quality.

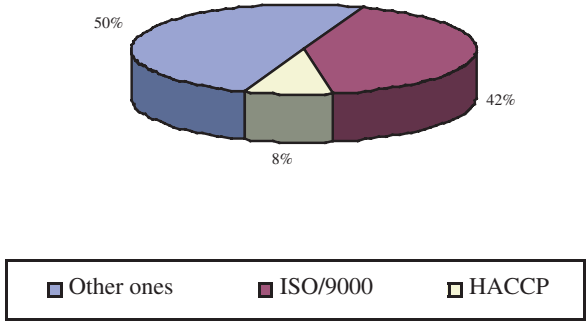



Figure 4 - Methodology referring to the quality programs used by companies of Group 2.

### 4.2. Evolution of the performance indicators in the companies adopting and not adopting the quality programs

The studies companies were asked to answer how well their performance indicators were (productivity, profitability, annual gross

[10] HACCP – Hazard Analysis and critical control points - is a quality program used in food industries.
[11] GMP – Good Manufacture Practice - is configured into an indispensable prerequisite for implantation of HACCP.
[12] 5S´s – Methodology that was originally began in Japan and means Seiri = refusal (arrangement), Seiton = organization, Seisou = cleaning, Seiketsu = hygiene (neatness and health), Shitsuke = kept order (self-discipline).

revenue, return on investments, market share and production costs), at the time when the programs were implanted, and how well these indicators were during the period of information collection. The answers were measured by Likert ordinal scale An arithmetic mean was calculated for the answers regarding the studied indicators, during both analyzed periods, which may be visualized in Table 1.

**Table 1 – Comparison among the performance indicators of the coffee roasting companies pertaining to Group 2, over the period the quality programs were implanted and when the research was conducted**

| Indicators | Mean (1)* | Mean (2)** | **Variation $\Delta(\mu_2-\mu_1)$*** ** |
|---|---|---|---|
| Productivity | 1.33 | 1.41 | 0.08 |
| Profitability | 1.16 | 1.25 | 0.09 |
| Annual Gross Revenue | 0.83 | 0.66 | -0.17 |
| Return on Investments | 0.33 | 1.08 | 0.75 |
| Market share | 0.66 | 1.16 | 0.5 |
| Production Costs[13] | 0.91 | 1 | 0.09 |

* Means obtained upon implantation of the programs.

* * Means obtained when some time was elapsed after implanting the programs.

* * * Variation occurring in the means of the indicators resulting from the adoption of the quality program.

The objective of this analysis is to verify the improvement the performance indicators achieved after implantation of the quality programs, compared to those presented at the moment the research was carried out. The results point out that most of the studied indicators were improved, in absolute terms, when comparing both analyzed periods, except for the annual gross revenue, from which the value was reduced (D = -0,17). The explanation for this fact might be related to low prices practiced by most coffee roasting companies, that have no

[13] In the questionnaire addressed to roasting companies, the Likert scale referring to production costs is different from other scales of the other indicators.

quality control and offer a low-qualified product, which promote a strong competition and may lead the sale volumes to decline in those companies where the quality programs were adopted. The highest variation in indicators occurred in the return on investments (D = 0.75). It is worth to emphasize that most of the companies adopting the quality programs are the large-scale ones, and the quality programs provide these companies with a higher competition power, which might explain the great variation in the return on investments.

The Wilcoxon's no-parametric statistical test was also used in order to establish a comparison among the means of the indicators. The test is useful to testing a variable after it suffered some type of treatment or effect.

The adopted nullity hypothesis[14] is that the means of the indicators are equal, against the alternative hypothesis the means are different. Table 2 shows the values of z and a found in this analysis.

Table 2 – Values found for z and $\alpha$ to comparison among the means of the indicators

| Nullity Hypotheses | z calculated | p-value ($\alpha$) |
|---|---|---|
| **$H_0$ $\mu$pro= $\mu$pro** | **-0.137** | **0.891ns** |
| **$H_0$$\mu$luc= $\mu$luc** | **-0.447** | **0.655ns** |
| **$H_0$ $\mu$fat= $\mu$fat** | **-0.816** | **0.414.s** |
| **$H_0$ $\mu$ri= $\mu$ri** | **-1.930** | **0.054*** |
| **$H_0$ $\mu$pm= $\mu$pm** | **-1.677** | **0.096*** |
| **$H_0$ $\mu cp_1$= $\mu cp_2$** | **-0.264** | **0.792ns** |

Note: The alternative hypotheses are that the means of the indicators under ordinal scale are different between the situations 1 and 2. Pro = productivity, Luc = profitability, Fat = annual gross revenue, Ri = return on investments, Pm = market share, Cp = production costs.
* Significant at 10% probability, according to the calculated $\alpha$.
ns = no-significant.

[14] The nullity hypothesis expression requires some care; according to SIEGEL (1979), the probability for finding a value in a distribution is not necessarily null.

The statistical comparison of the means, according to Wilcoxon test, show that only the market share and the return on investments presented significant improvement, as the quality programs have been implemented, while the others indicators presented no statistical differences, according to the referred test.

The companies adopting and not adopting the quality programs were asked about the evolution of the performance indicators, for the last three years. Those indicators were measured based on a Likert ordinal scale, where the ranks varied from (-3) to (3), passing through (0), in which (-3) would mean an unfavorable answer; (3), favorable answer; and (0) meaning no evolution in indicators. Table 3 presents the results of both groups and their respective indicators.

Table 3 – Means of the performance indicators of groups (1) and (2), in the last three years 1998, 1999, 2000

| Indicators | Group Mean (1) | Group Mean (2) | **Variation** $\Delta$ ($\mu_1$-$\mu_2$) |
|---|---|---|---|
| **Productivity** | **0.43** | **1.41** | 0.97 |
| **Profitability** | **-0.03** | **0.75** | 1.08 |
| **Annnual Gross Revenue** | **0.13** | **0.5** | 0.36 |
| **Return on Investments** | **-0.66** | **0.41** | 1.07 |
| **Market share** | **0.23** | **0.91** | 0.68 |
| **Production Costs** | **0.36** | **0.75** | 0.39 |

Source: Research Data.

The means for each indicator were obtained, by summing each answer of the Likert scale, and dividing it by the number of respondent companies in each Group. It is observed that, for all indicators, the performance of the companies adopting some quality

program was superior, a result already expected. The highest variation occurred in the profitability indicator (D = 1.08) and the lowest in the annual gross revenue indicator (D = 0.36). The means were subjected to Mann-Whitney's no-parametric test, as described in the statistical procedures. This test applicability consists of comparing the means from which the data cannot be paired[15], since both samples are independent ones.

The proposed nullity hypothesis is that the means of the indicators in both groups are the same, against the alternative hypothesis that the means of these indicators are different. This test is useful to verify if the means of the performance indicators in the companies adopting some quality program are statistically different from those companies that did not adopt these programs.

Table 4 presents the values calculated from statistics z**,** for comparison among means**,** as well as the significance level a that the manuals and statistics software denominate p-value. The observance of p-value[16] is advantageous because it provides the exact significance of the test, so avoiding the use of arbitrary values for $\alpha$, such as 1%, 5% and 10% probability.

According to Mann-Whitney's statistical test of U Proof, only the means of two from the studied indicators were statistically different between groups. The means of the productivity and market share indicators in the companies of Group 2 were statistically higher than those of the companies that did not adopt the quality programs.

[15] Comparison among the means or proportions of two subgroups, in cases of a same variable.

[16] P-value - It provides the exact probability that serves as a base for accepting or rejecting an estimated coefficient.

Table 4 – Values of z and p-value calculated by Mann-Whitney's U Proof for comparing the means of the indicators in Groups 1 and 2

| Nullity Hypotheses | z calculated | p-value (α) |
|---|---|---|
| **$H_0$ μ$proG_1$= μ$proG_2$** | **-1.711** | **0.087*** |
| **$H_0$μ$lucG_1$= μ$lucG_2$** | **-0.896** | **0.370ns** |
| **$H_0$ μ$fatG_1$= μ$fatG_2$** | **-1.138** | **0.255ns** |
| **$H_0$ μ$riG_1$= μ$riG_2$** | **-1.230** | **0.219ns** |
| **$H_0$ μ$pmG_1$= μ$pmG_2$** | **-1.693** | **0.090*** |
| **$H_0$ μ$cpG_1$= μ$cpG_2$** | **-1.185** | **0.236ns** |

The tests refer to the means of both Groups under ordinal scale. The hypotheses are the means of the indicators under ordinal scale are different between both Groups. Pro = productivity, Luc = profitability, Fat = annual gross revenue, Ri = return on investments, Pm = market share, Cp = production costs.
* Significant at 10% probability, according to the calculated α. ns = no-significant.

In absolute terms, in spite of the companies adopting some quality program they had presented higher means than those ones not adopting this program; in statistical terms, there are no differences in the other indicators of both groups, except for those two indicators previously mentioned.

## 5. Conclusions

According to the theory of the total quality, the results pointed out that there was an improvement in most studied indicators, as the quality programs proceeded on their implantation, in other words, the means of the indicators increased in absolute terms, except for the variable annual gross revenue. Yet, Wilcoxon's no-parametric statistical test was used in order to establishing a comparison among the indicator means obtained during the implantation of the programs and

when the research was under way. The test revealed that only the market share and the return on investments were the indicators showing to be statistically significant, that is, they exhibited an improvement as the quality programs were implemented.

It was also tried to compare the behavior of the performance indicators in both companies' groups during the last three years. In this comparison, the companies pertaining to Group 2 showed the best absolute means for all studies indicators in relation to the companies pertaining to Group 1. However, when they were statistically compared by Mann-Whitney's no – parametric test, with the means of Group 1, only two of the indicators were shown significant, that is, the productivity and market share.

Based on the present study, the inference is that the quality programs are still seen as a relatively new tool by the coffee roasting sector. The sector that has been absorbing all the transformations resulting from deregulation by the federal government hold an incipient level of business administration, a fact contributing to no-adoption of the competitive strategies such as the quality programs.

Finally, it is concluded that the quality programs promoted the desired effect on the studied performance indicators, in absolute terms. Although just a restrict number of coffee roasting companies have been used the quality programs, these ones were efficient in improving those indicators, which shows that they may be a viable competitive strategy for this sector.

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