


Effects of outsourcing on costs: estimating the conversion of fixed to variable costs


Efeitos da terceirização sobre os custos: estimação da conversão de custos fixos em variáveis

Efectos de la subcontratación en los costos: estimación de la conversión de costos fijos en variables


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Abstract

The evaluation of this perspective is the objective of this work, that is, to evaluate the impacts of outsourcing processes on fixed and variable costs. For this, an econometric model was formulated to capture fixed costs, variables and their changes, from outsourcing, and applied in a higher education institution, located in the southern region of Brazil. The data collected included the total cost, the amount of credits contracted, the semesters in which outsourcing began and the outsourced sectors, considering the period from 1995 to 2017. The results obtained revealed that outsourcing actually led to a reduction in fixed costs and an increase in variable costs. In addition, it was also found that fixed costs were reduced more intensely than the expansion of variable costs, over time, indicating that outsourcing generated cost reduction and that there are learning and management gains in the outsourcing processes.

Keywords: Outsourcing; Fixed costs; Variable costs; Cost function

Resumo

O objetivo deste trabalho é avaliar os impactos dos processos de terceirização nos custos fixos e variáveis. Para isso formulou-se um modelo econométrico que captasse os custos fixos, as variáveis e suas alterações, a partir de terceirizações ocorridas, e aplicou-se em uma instituição de ensino superior, localizada na região Sul do Brasil. Os dados coletados incluíram o custo total, a quantidade de créditos contratados, os semestres de início da terceirização e os setores terceirizados. O período analisado foi de 1995 a 2017. Os resultados obtidos revelaram que as terceirizações de fato conduziram a uma redução dos custos fixos e a uma ampliação dos custos variáveis. Verificou-se também que os custos fixos se reduziram de forma mais intensa do que a ampliação dos custos variáveis, ao longo do tempo, indicando que as terceirizações geraram redução de custos e que há ganhos de aprendizado e gestão nos processos de terceirização.

Palavras-chave: Terceirização; *Outsourcing*; Custo fixo; Custo variável; Função de custos

Resumen

La evaluación de esta perspectiva es el objetivo de este trabajo, es decir: evaluar los impactos de los procesos de outsourcing sobre los costos fijos y variables. Para dar respuesta al objetivo, se elaboró un modelo econométrico que reuniera costos fijos y variables y sus cambios a partir de subcontrataciones y

se lo aplicó a una institución de educación superior ubicado en el sur de Brasil. Los datos colectados incluyen costo total, cantidad de contratos de crédito, semestres de inicio de la subcontratación y sectores subcontratados, considerando el periodo de 1995 a 2017. Los resultados revelaron que las subcontrataciones efectivamente lograron una reducción de costos fijos y una ampliación de costos variables, siendo que nuevas subcontrataciones generaron un impacto más considerable en los costos variables en relación a los costos fijos en términos de elasticidad, indicando que hay beneficios de aprendizaje y gestión en los procesos de subcontratación.

Palabras clave: Subcontratación; Tercerización; Costo fijo; Costo variable; Función de costos

1 Introduction

The term outsourcing is used to refer to the idea of transferring activities from within the company to an external supplier company. The benefits of these transfers, according to Fonseca (2014), are diverse and can be grouped into business, technological, political and economic-financial advantages. In this last group, the advantages are concentrated in aspects related to costs, such as improved cost controls, cost reduction and transfer of fixed to variable costs.

The improvement in cost control was observed by Costa (2003) and the agility in companies' responses in terms of costs by Yang and Zhao (2016). With regard to cost variation, Cohen and Roussel (2013), Kumar and Kopitzke (2008) and Marquez-Ramos and Martines-Zarzoso (2014) found a significant reduction in costs with outsourcing processes. However, this reduction is not indisputable, as there is evidence of overestimated cost savings and even increased costs after outsourcing, as shown by Bryce and Useem (1998), Domberger and Fernandez (1999), Pepper (1996) and Vining and Globerman (1999) and Oliveira et al. (2013). Thus, it is noted that, although the research results are not yet conclusive, there is a predominance of finding in more recent studies that outsourcing brings a series of benefits, including cost reduction. The change in the researchers' perception was verified by Costa (2003) when detecting that their assessment changed throughout the 1990s, going from predominantly negative and neutral to neutral and positive. Added to this is the complexity of the relationships involved in the outsourcing process which, in specific cases, can result in different effects. (Kremic et al., 2006).

With regard to the ability to convert fixed costs into variable costs, Liu and Tyagi (2017) stands out, published in the International Journal of Research in Marketing (IJRM) – a magazine that is among the fifty journals with the highest impact factor in the world. In this study, the authors carry out a theoretical analysis of outsourcing, showing that one of the benefits of this process would be its ability to convert fixed costs into variable costs, which would constitute market equilibrium, because this is the trend in processes of outsourcing. Likewise, it is observed by Fonseca (2014) and empirically by Rezende (2008).

Thus, one of the benefits of outsourcing would be its ability to convert fixed costs into variable costs, allowing organizations greater flexibility and ability to adjust to demand in times of crisis. Therefore, the outsourcing of services and/or processes constitutes a form of structuring production and determining the resulting costs, acting as a resource rationalization mechanism. (Imhoff & Mortari, 2005).

Therefore, the question that drives this research arises, which is: How do outsourcing processes impact on fixed and variable costs? Seeking the answer to this question is the objective of this research, focusing on the conversion of fixed costs into variables and their elasticities. In other words, explicitly, the objective of this investigation is to evaluate the impacts of outsourcing processes on fixed and variable costs.

This research is justified by the fact that the national scientific production related to the topic (considering only the articles published in scientific journals in the area of Administration and Accounting classified from A1 to B2, from 2000 to 2020) is concentrated, fundamentally on two topics. The first concerns the labor aspect, highlighted by the publication of Bill No. 4.330/04, which authorized the hiring of third parties for core activities in companies, and its amendments to Bill No. 13.429/17, which also modified the temporary employment law (Law no. 6.019/74), according to Alves et al. (2015); Barbosa (2010); and Pereira (2004).

The second topic concerns the outsourcing of the information technology area (Prado, 2009; Prado & Takaoka, 2006; Stal & Morganti, 2011). In this set of national studies, researches that seek to assess the impact of outsourcing on the efficiency of companies, the effects of outsourcing on organizations and the reasons that lead companies to outsource (Girardi, 1999; Prado & Takaoka, 2002; Santos et al., 2013; Valois & Almeida, 2009).

When conducting this survey, there was a lack of studies that sought to identify the transfers of fixed costs to variables that could be established as resulting from the outsourcing process. There were also no articles that analyzed the elasticity of fixed and variable costs due to outsourcing, indicating the opportunity in scientific terms for the development of this research.

The article is divided into five sections. Section 2 presents the theoretical aspects of outsourcing and section 3 describes the methodological procedures used in the work. Next, section 4 demonstrates and analyzes the results found and section 5 brings the final considerations.

2 Theoretical Review

This section is subdivided into three parts. The first addresses issues related to outsourcing, the second briefly discusses the theoretical issue of cost functions and the third contains the formulation of research hypotheses.

2.1 Outsourcing: concept, advantages and disadvantages

Among many decisions related to the production process that managers need to take are those linked to activities that will be produced internally or for which third parties will be hired. (Besanko et al., 2006). It is known that the choices regarding the decision of vertical integration, vertical disintegration, internal or outsourced supply are not simple (Slack et al., 2018) and involve deciding on the degree of dependence on other companies. (Wolf, 2001).

When deciding to produce internally, the company manages all processes, internalizing responsibilities and vertically integrating the production process. (Porter, 2004). This integration must take into account both the estimates of cost savings provided by integration and must explore the broader strategic problems of integration, as well as some occasional administrative problems that arise in managing a vertically integrated entity (Porter, 2004).

However, increased competition and greater market instability have led to a growing trend towards specialization, through vertical disintegration (Almeida & Moura, 2005). As a result, companies began to transfer a large part of their production operations to specialized service providers (Fleury, 2003). This movement was called outsourcing in Brazil in the 1980s, when there was a significant increase in the process of transferring activities carried out by companies to third parties. (Ramalho, 2007).

However, other expressions have been used to define the transfer of activities from within the company to an external supplier company. Among them, we can mention "outsourcing". For practical reasons and for language standardization, in this research, the term "outsourcing" is used, being understood as the entire process of hiring workers by an interposed company, it is the relationship in which the work is performed for a company, but hired immediately by another. (Marcelino, 2007).

The outsourcing movements go back to the Japanese subcontracting system, when, in 1859, Japan opened its ports to imported products and machinery. However, it was from the 20th century onwards that the idea of outsourcing processes and capabilities became established as a way to achieve business benefits more quickly. (Davenport, 2005). In Brazil, this process started with the multinational automobile factories, which saw their organizational structures become very onerous, which motivated them to seek cost reduction through the outsourcing of services. (Mozzini, 2011).

In studies on outsourcing, the main arguments presented for contracting external services, as opposed to vertical integration, are: (i) cost reduction (Giosa, 1999; Bacic & Souza, 1997; Kakabadse & Kakabadse, 2000; Wolf, 2001; Porter, 2004); (ii) quality gain with the specialization of suppliers (Giosa, 1999; Kakabadse & Kakabadse, 2000; Porter, 2004); (iii) the focus on the company's main activity (Bacic & Souza, 1997; Kakabadse & Kakabadse, 2000; Wolf, 2001); and (iv) the reduction of hierarchical levels with greater agility in decisions. (Bacic & Souza, 1997; Wolf, 2001; Porter, 2004).

For Giosa (1999), the best outsourcing is the one that, at the same time as it reduces operating costs, improves the product sold. To achieve these advantages together, it is necessary to have a precise evaluation of the costs and the product in both modalities. (Giosa, 1999). Bacic and Souza (1997) emphasize that, in addition to reducing costs and rationalizing the organizational structure, outsourcing makes it possible to concentrate efforts on the business itself.

Outsourcing also presents advantages to the outsourced company, according to Leiblein and Miller (2003), as it allows the external manufacturer to produce goods and services more efficiently and at lower costs. These advantages arise from the specialization and magnitude of the market, enabling outsourced workers to appropriate benefits such as economies of scale and scope.

Focusing on the issue of costs, object of analysis of this article, it appears that several studies, such as Arima, Tonini and Capezzutti (2002), Valença and Barbosa (2002), Kremic, Tukul and Rom (2006), Prado (2009), Ferruzzi et al. (2011), showed that outsourcing generates reduction and greater ability to predict costs. It is worth remembering that cost reductions may be associated with economies of scale, according to Arima; Tonini and Capezzutti (2002), to the learning curve, according to Pindyck and Rubinfeld (2010), and to greater precision in investment estimates, according to Hehn (1999).

In addition to these advantages, there is the fact that outsourcing processes allow the conversion of fixed costs into variable costs. This statement was developed both in mathematical modeling, as observed in the work of Liu and Tyagi (2017), which indicates that this result is a market equilibrium, as well as from a theoretical (Fonseca, 2014) and an empirical point of view by Rezende (2008).

Disadvantages of the outsourcing process include: (i) difficulty in finding the ideal partnership (Giosa, 1999; Wolf, 2001; Porter, 2004); (ii) exposure of the company's confidential business to external sources (Bacic & Souza, 1997; Wolf, 2001); (iii) suppliers do not have characteristics compatible with those of the company (Bacic & Souza, 1997; Kakabadse & Kakabadse, 2000; Wolf, 2001) and (iv) increased

dependence on third parties (Giosa, 1999; Wolf, 2001; Kakabadse & Kakabadse, 2001; Kakabadse & Kakabadse, 2000).

Finally, from a theoretical and empirical point of view, there is a diversity of benefits arising from outsourcing processes, and these processes have solidified in organizations today, whether public or private. As an example, we can cite information from the Departamento Intersindical de Estatística e Estudos Socioeconômicos [DIEESE] (2017) which show that outsourcing has taken large proportions in Brazil and its scope is constantly expanding into new sectors and services. It should be noted that the milestone of twelve million outsourced workers has already been reached in 2017.

2.2 Cost Functions

From a theoretical point of view, the operation of any business generates costs, which are the monetary amounts spent on the consumption of resources. (Souza & Diehl, 2009; Vendruscolo & Alves, 2007). This means that production costs are “all those incurred in producing the volume and mix of products during the period”. (Atkinson et al., 2000, p.126).

Therefore, production costs are affected by cost drivers or drivers, so that a change in the cost driver will result in a change in total cost, and are also classified into fixed and variable costs. (Horngren et al., 2000). Therefore, one of the best known classifications is the one that takes into account the relationship between the total cost and the volume of activity in unit of time, segmenting the total costs into fixed costs, which are invariant with production, and variable costs that depend on production volume. (Martins, 2003). Thus, the total cost (CT) is the sum of the fixed costs (CF) plus the variable costs (CV), that is:

$$CT = CF + CV \quad (1)$$

Other relevant costs for production decisions are average costs (CMe) and marginal costs (CMg). The average total cost or average cost (CMe) is the cost per unit of product and is the result of dividing the total cost by the level of production. As well as the average fixed cost ($CFMe$) is the fixed cost divided by the production level (Q) and the average variable cost ($CVMe$) is the variable cost divided by the production level. That is:

$$CMe = \frac{CT}{Q} = \frac{CF}{Q} + \frac{CV}{Q} = CFMe + CVMe \quad (2)$$

Marginal cost (CMg) is the change in variable costs (CV) when there is a change in the level of production (Q), since the fixed cost does not change (Pindyck & Rubinfeld, 2010). Thus, the marginal cost informs how much it will cost to increase production by one unit and is mathematically defined by the derivative of the total (CT) or variable (CV) cost in relation to the production volume (Q) and can be expressed by:

$$CMg = \frac{\Delta CT}{\Delta Q} = \frac{\Delta CV}{\Delta Q} \quad (3)$$

Having knowledge of the types of costs, it is possible to estimate a cost curve, defined as cost functions, identifying the different moments of reorganization the company's production structure and evaluating the changes that occurred in fixed and variable costs. For Klein (1978, p. 132), the cost function is “a bivariate relationship, generally, that associates the product with the total cost” and shows the lowest possible cost that would be incurred by the company to generate a certain level of production. (Vendruscolo & Alves, 2009). For this reason, they are called cost functions, costs are perceived as a function of production volume plus a constant called fixed costs.

In Figure 1, the Total, Variable and Fixed cost functions are represented as a function of the quantities produced. Since the cost function is an implicit function of the production function (FP), then, if the FP presents constant returns to scale, the cost function will be represented by a straight line, part (a) of Figure 1, having marginal costs (CMg) constants for any level of production, represented by α_1 ; and if the returns are variable, part (b), the cost function will be represented by a third-degree polynomial, with decreasing marginal costs until it equals the average cost and then increasing and above the average.

The angles formed by the lines that tangent the total cost curve (α_i) represent the marginal costs and the angle formed by a line that starts from the origin to a specific point of the total costs function (β) represents the average costs. Technologies that result in constant returns have lower and lower average costs for higher levels of production. Technologies with variable returns, on the other hand, generate a “U” - shaped average cost function. In part (b) of Figure 1, angle β represents the smallest possible angle by this definition and therefore the minimum average cost point. Thus, the cost functions can be represented by a line or a third degree polynomial.

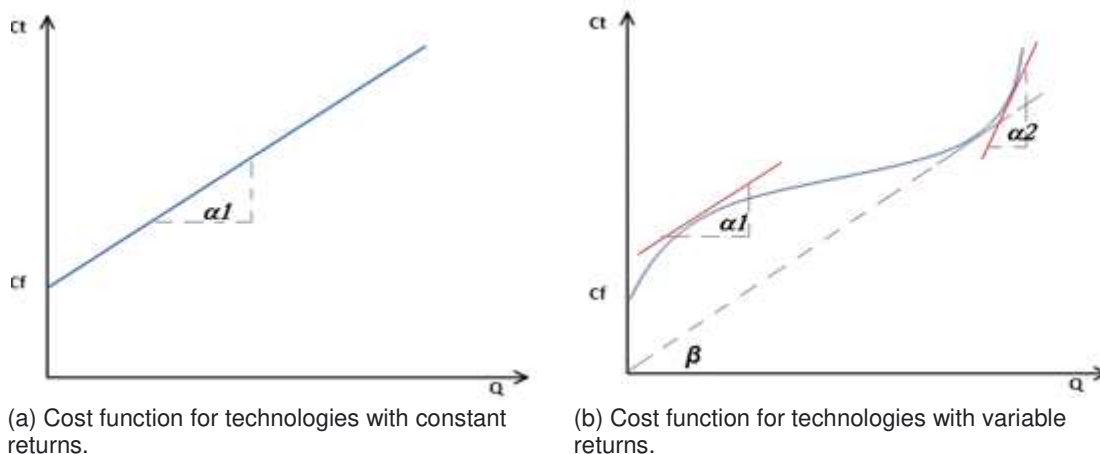


Figure 1 – Total Cost Functions

Source: Adapted from Mas-Colell and Whinston (1995).

It is noteworthy that, in empirical studies, it should be taken into account the fact that the plants in operation may not be producing in the segment in which there may be diseconomies of scale, therefore, the results generate only a second degree exponential function. Therefore, to estimate a total cost function, one must start with a third-degree polynomial (Pindyck & Rubinfeld, 2010; Gujarati & Porter, 2012), as represented in equation (4), and test the significance of the parameters as suggested by Stock and Watson (2004):

$$CT_t = C_0 + \beta_1 Q_t + \beta_2 Q_t^2 + \beta_3 Q_t^3 + u_t \quad (4)$$

where CT_t represents the total cost, C_0 the fixed cost, β_1 , β_2 and β_3 are the parameters that measure the sensitivity of the variable cost to a variation of one unit in production, Q_t the quantity produced, u_t is the residue (includes the influence of other explanatory elements of costs that are not computed in the model) and time. Given the cost curve formats for variable returns. The expected signs of the coefficients of parameters β_1 and β_3 are greater than zero and parameter β_2 must be less than zero. (Gujarati & Porter, 2012).

It is noteworthy that the coefficient C_0 represents a theoretical fixed cost and not exactly the effective average fixed cost of the company in the period. This fact is fundamentally due to the distance between the observations (sample values) and the intercept, that is, information is analyzed in units of thousands or millions, with no information on the shape of the curve for low values, such as units or hundreds. So, it is a positional point and what matters is the sign of its displacement and not its magnitude itself.

One way to avoid this lack of information is to work with the average cost curve, estimating a quadratic function and evaluating its parameters according to equation (2):

$$CMe_t = \beta'_0 + \beta'_1 Q_t + \beta'_2 Q_t^2 \quad (5)$$

where CMe_t is the unit cost in period t , Q the quantities produced and the beta's are parameters of function. The expected signs for these parameters are: $\beta'_0 > 0$, $\beta'_1 < 0$ e $\beta'_2 > 0$. If the production function has constant returns to scale, equation (5) is now represented by the same elements, with the exception of the quadratic term for the quantity produced, keeping the expected signs for β'_0 and β'_1 .

2.3 Formulation of the Research Hypothesis

When transferring part of a company's activities to third parties, it is possible that a portion of fixed costs, which were previously immutable, are being transferred, transforming such expenses into various variable expenses, at least in the short term, according to Arima; Tonini; Capezzutti (2002). What happens is that the company that outsources its activities can avoid a significant part of the fixed costs of facilities, equipment, information technology, rents, salaries, insurance and logistical expenses in general. (Brazil, 1993).

Some works analyze the impact of outsourcing on costs, they present objectives that are close to this research. For example, the authors Bacic and Souza (1997, 2002) discuss a model that seeks to justify externalization from a quantitative perspective, considering the possibilities of increasing production volume and reducing fixed costs. In this model, if the expected decrease in internalized production costs is greater than the cost of external supply, it is recommended, from a quantitative point of view, to outsource. (Bacic & Souza, 1997, 2002).

When analyzing a company's sales force, Ross et al. (2004) studied whether the company should create its own sales force or outsource it. The analysis is cost-based and assumes that the direct sales force is a fixed cost and that the cost of the outsourced sales force varies with sales. In this sense, when there is a sales volume in which the costs of direct sellers are equal to the costs of outsourced sellers, there is an indication that, for a sales volume above this amount, companies must use a direct sales force. (Ross et al., 2004).

However, these studies do not assess the transformation of fixed costs into variable costs with the outsourcing process. The investigation by Liu and Tyagi (2017) performs this approach, and it is this analysis that motivated this research. These authors theoretically examined the effects of outsourcing on the conversion of fixed costs into variable costs, analyzing both companies, the one that outsourced services and the one that started to perform these activities. Then, they built a mathematical model to assess the balance based on the formulated hypotheses. The model generates a balance in which the outsourcing process invariably results in a transformation of fixed costs into variable costs. (Liu & Tyagi, 2017). Thus, it is based on the findings of these authors that the hypothesis that underlies this research was built, explained below:

Hypothesis 1: Outsourcing processes generate a transfer from fixed costs to variable costs.

However, considering that several works presented in this section claim that costs are reduced as a result of outsourcing processes, then a second hypothesis was formulated:

Hypothesis 2: the process of converting fixed costs into variable costs is not integral, that is, costs should reduce over time.

3 Methodological Procedures

In this work, a research methodology based on a single case study is used. (Martins, 2008; Yin, 2015). Given the objective of measuring the effect of outsourcing processes on costs, a quantitative approach is used.

Next, the systematization of this study in the empirical and theoretical dimensions is presented. From a practical perspective, the sample, variables (definition and operationalization) and aspects associated with data processing are identified. In the conceptual approach, a phenomenological model is developed and the statistical artifact is displayed to qualify the model's fit to the data.

3.1 Sample

The organization (called the X University for data confidentiality purposes) chosen for the study is an important higher education institution in southern Brazil. It is a private confessional university that has more than 3,000 employees and offers a wide range of activities (undergraduate, graduate, etc.) that reach around 30,000 students.

X University went through several outsourcing processes as of the year 2002. Sequentially, the outsourced sectors were: food, maintenance and gardening, vehicle fleet, cleaning and pouch. It is noteworthy that the last four sectors mentioned are managed in an integrated manner between the educational institution and the service provider.

This sample was chosen given the theoretical character that is sought to be evaluated in empirical terms and the fact that X University went through a variety of outsourcing processes in different periods, which allows evaluating their effects on costs.

3.2 Data: Collection, Structure and Treatment

Data were obtained from the financial controllership of X University, covering the years 1995 to 2017 (half-yearly intervals where $t=0$ corresponds to the 1995/1 semester. These data refer to: operating cost and expenses excluding whether the financial costs; number of credits contracted by the undergraduate student population; qualitative information stating whether the processes were being carried out internally or if they had been outsourced. These processes and the dates of occurrence were: food (2002/1); maintenance and gardening (2003/1); vehicle (2004/1); cleaning (2005/2); and pouch (2007/2).

The compilation of these data resulted in a tabulated base where each element indicates the observation of a characteristic. Each column stores data referring to a quantity of the same species (7 in total) and the rows the measurements of these quantities in different semesters (44 in total).

The cost values were inflated for 2017, by Indices Geral de Preços - Disponibilidade Interna (IGP-DI) from Fundação Getúlio Vargas, so that they could be compared over time. Costs were adjusted due to structural changes that occurred in the institution over the period of analysis so that they could reflect the same production structure as in the base year, except for the effects of outsourcing. For this, the costs arising from the activities of the stricto sensu graduate programs created in the period of analysis were deducted from the total costs. Since, in 1995/1, X Universidade had only two graduate programs and, in

2017/1, it offered 20 *stricto sensu* graduate courses, it is understood that this had a strong impact on the institution's costs. With this procedure, the production structure of 1995/1 was maintained.

3.3 Variables

From what was presented in the previous section and discussed in the reference, the measured quantities are grouped into response (dependent) and explanatory (independent) variables. Given the nature of the observations, costs are assumed as the response variable and credits and outsourced sectors as explanatory variables. It is noteworthy that the outsourcing that took place at X University was included as dummy variables. Such variables capture the effect of a quality or attribute (Gujarati & Porter, 2012), which, in this case, would be the impact on the costs of outsourcing processes. In this research, the outsourcing attribute assumes the value "1" from the semester in which the service was contracted. In the semesters prior to this event (outsourcing), the dummy variable assumes the value "0".

In summary, the variables were named as follows:

CT_t = total operating cost in semester t (quantitative variable dependent on the real type with monetary unit (reais));

Q_t = number of credits contracted in t semester (quantitative variable independent of the integer type where 1 unit corresponds to contracting 15 hours of activity).

$Cafeteria_t$ = cafeteria outsourcing dummy in semester t (1 if outsourced and zero otherwise);

$Maintenance_t$ = maintenance and gardening outsourcing dummy in t semester (1 if outsourced and zero otherwise);

$Vehicles_t$ = vehicle outsourcing dummy in t semester (1 if outsourced and zero otherwise);

$Cleaning_t$ = cleaning outsourcing dummy in t semester (1 if outsourced and zero otherwise);

$Pouches_t$ = outsourcing dummy of the processes involving the pouches in t semester (1 if outsourced and zero otherwise).

3.4 Model

In section 2.1 (outsourcing: concept, advantages and disadvantages), stand-out works (theoretical and empirical) that investigate the role of outsourcing in the conversion of CF fixed costs to CV variables. Additionally, in section 2.2 (cost functions), it is revealed that the total cost CT is a third-degree polynomial function of the quantity produced Q . In view of this, a phenomenological model is developed to:

- Evaluate the transformation of costs due to the production volume through outsourcing;
- Estimate the behavior of the total operating cost in terms of contracted credits.

In the cost conversion dimension, they are broken down into the total cost of X University, fixed and variable costs in additive portions that precede and follow the outsourcing processes. Therefore, the total operating cost in t semester is given by:

$$CT_t = \overbrace{(CF_t + \widetilde{CF}_t)}^{\text{Fixed}} + \overbrace{(CV_t + \widetilde{CV}_t)}^{\text{Variable}} + u_t \quad (6)$$

where u_t is the residuals. Variables with or without the diacritical mark (\sim) are associated with costs before and after the adoption of outsourcing, respectively.

The training law that lists the costs prior to the implementation of outsourcing is a univariate relationship explained exclusively by the number of credits, that is:

$$\begin{aligned} CF_t &= \beta_0 \\ CV_t &= \beta_1 Q_t + \beta_2 Q_t^2 + \beta_3 Q_t^3 \end{aligned} \quad (7)$$

where β_0 is the estimated parameter to represent the fixed cost without outsourcing and β_i ($i \in \{1, 2, 3\}$) is the adjustment parameter associated with cost sensitivity to the variation in the number of credits. On the other hand, the behavior of costs after the use of outsourcing processes is a multivariate relation dependent on explanatory variables and weighted by a F function that depends on the vector of outsourced sector $S_t = (Cafeteria_t, Maintenance_t, Vehicles_t, Cleaning_t, Pouches_t)$, that

$$\begin{aligned} F(S_t) &= Cafeteria_t + Maintenance_t + Vehicles_t + Cleaning_t + Pouches_t \\ \widetilde{CF}_t &= \alpha_0 F(S_t) \\ \widetilde{CV}_t &= (\alpha_1 Q_t + \alpha_2 Q_t^2 + \alpha_3 Q_t^3) F(S_t) \end{aligned} \quad (8)$$

where α_i ($i \in \{0, 1, 2, 3\}$) is the adjustment parameter due to outsourcing.

The choice of $F(S_t)$ so that dummies are additive and weighted results in subsequent outsourcing being given greater weight than previous ones. This makes sense because when starting the first outsourcing process in an organization, there is a learning cost in that process, whether in terms of negotiating or controlling operations, for example. There is also a need to create a sector or an area to manage the outsourced, as well as an increase in auditing activities on these employees and activities of the legal department to establish and monitor contracts. With the expansion of outsourcing processes, these costs do not grow at the same rate, and start to have a more intense impact on the differentiation between total fixed and variable costs.

Associating equations (6), (7) and (8) the following model emerges

$$CT_t = \gamma_0 + \gamma_1 Q_t + \gamma_2 Q_t^2 + \gamma_3 Q_t^3 + u_t \quad (9)$$

given that $\gamma_i = \beta_i + \alpha_i F(S_t)$, $i \in \{0,1,2,3\}$ is the parameter that measures the sensitivity of the operating cost against outsourcing processes for a variation of one unit in credit contracting. The assessment of outsourcing impacts was also verified via the average cost function in equation (5), keeping the same identification of the parameters in equation (9).

3.5 Adjustment and Robustness of the Model

In order to adjust the model parameters (β_i e α_i com $i \in \{0,1,2,3\}$) to the data, the statistical method of nonlinear multivariate regression was used (Konishi, 2014). To assess the significance of the estimated parameter values, the t test was used and, in particular, the p-value calculation (Mitelhammer et al., 2000). Here, the variable is assumed to have statistical significance if the p-value is less than a significance level α . In general, α is set below 5% or $\alpha \leq 0.05$. As a computational resource, Mathematica 12.2 software was used to adjust by the Ordinary Least Squares method.

The parameters, to adequately represent a cost function, must meet the following restrictions:

$$\overbrace{\alpha_0, \beta_0}^{\text{parameters of CF}} > 0 \quad \overbrace{\alpha_1, \beta_1}^{\text{associated to } Q} > 0 \quad \overbrace{\alpha_2, \beta_2}^{\text{associated to } Q^2} < 0 \quad \overbrace{\alpha_3, \beta_3}^{\text{associated to } Q^3} > 0 \quad (10)$$

If these assumptions are met and the combinations are adequate, there would be an average (theoretical) fixed cost for the period, decreasing costs up to a certain level of contracting credits and increasing costs after reaching a minimum average cost, where it would be over using the optimal scale of production. Furthermore, the values of α_1 and α_3 must be positive, indicating an increase in variable costs with the outsourcing process.

Residual analysis was performed by testing homoscedasticity and normality. The homoscedasticity hypothesis refers to the existence of homogeneity in the variances of the regression errors (Gujarati & Porter, 2012). The test used for this analysis was Levene's (1960). This test uses the deviations in relation to the mean of the groups (treatments), being able to take the absolute value of the deviations (Levene absolute) or the squares of the deviations (Levene squared).

Regarding normality, Jarque-Bera (JB) and Anderson-Darling tests were used. JB test indicates whether the residuals are normally distributed, with two degrees of freedom, verifying whether the skewness and kurtosis values deviate from measures 0 and 3, respectively (Hill et al., 2003). Anderson-Darling test works with the quadratic differences between the empirical and the hypothetical distribution to assess the normality of the distribution of a given variable (Tenreiro, 2013). Both tests have the null hypothesis that the distribution is normally distributed. The results found with the application of the proposed model are described below.

4 Presentation and Analysis of Results

This section contains the analysis of the results of the estimation process. First, the analysis of the descriptive statistics of the data is presented and, subsequently, the result of the estimation of the cost function is evaluated.

4.1 Descriptive Data Analysis

Due to the preservation of the confidentiality of the researched data, this section addresses the effects of distributions without reporting values. From this, it is possible to assess the existence or not of leverage effects in the estimation process and the normality of the data without exposing the values.

Considering the data distribution, the total cost and credits present a slightly asymmetric distribution. The total cost variable has a positive asymmetry of 0.497, so, it has a longer tail to the right, starting from its highest point. The variable credit, on the other hand, has a negative asymmetry of -0.36, because it contains values concentrated to the left of its highest point. The distribution by quartiles can be seen in Figure 2.

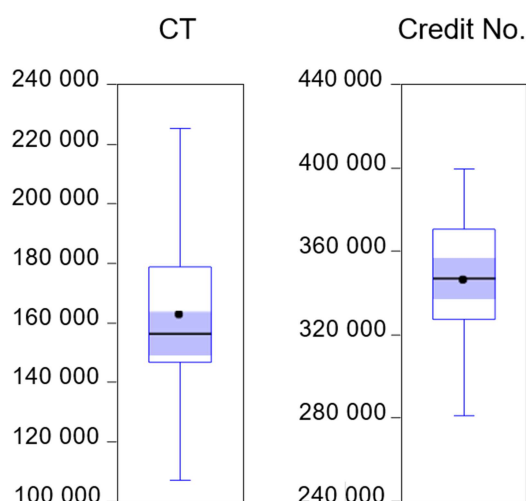


Figure 2: Distribution of costs and credits

Source: Prepared by the authors.

Note: Dummy scale data for information preservation.

However, in both distributions, with a significance level of 0.05, the hypothesis that they are normal cannot be rejected, since, for costs, Jarque-Bera (JB) statistic, which combines information from both kurtosis and asymmetry coefficient was 1.75, with a p-value of 0.41 and, for the credits variable, it was 1.94, with a p-value of 0.37. Furthermore, no problems were found arising from aberrant observations that could cause leverage effects in the estimation and, therefore, distort the estimated parameters. These results indicate that the sample has the desirable elements for analysis of regression models.

4.2 Analysis of Results

The total cost function was estimated according to equation (9) with dummies to characterize the outsourcing moments that assumed values equal to 1 for periods in which the outsourcing process would have occurred and would be in operation, being inserted in an additive way, generating a process of weighting as described in the methodology section and which is identified in Table 1 as Model 1. To assess the stability of the model and compare it with other functional forms, two more models were formulated, which are included in Table 1.

The regression parameters of Model 1 present the expected signs as indicated in the restrictions evidenced in the relations (10). Thus, the estimated model meets the theoretical expectation of variable returns represented by a third-degree polynomial with decreasing marginal costs for initial production values and, subsequently, increasing for high production values, according to Mas-Colell and Whinston (1995). This same format was also found by Vendruscolo and Alves (2009) in a study on costs in the mobile telephony sector in Brazil.

Finally, in addition to the theoretical adequacy of the model, the statistical results resulting from the estimation of Model 1 indicate high robustness. In other words, all estimated coefficients have a statistical significance of 1%, with a high coefficient of determination (0.9892) and homoscedastic errors by Levene's test (0.944). However, the sample residues have a normal distribution only for the Anderson-Darling test (0.342).

Once Model 1 has been validated from a theoretical and statistical point of view, the parameters and their implications are analyzed. Thus, it is verified that CF_t before the outsourcing processes is positive and its variation resulting from the outsourcing process was negative \widetilde{CF}_t . These results indicate that in the outsourcing process there was a reduction in fixed costs. About variable costs, it appears that the parameters of the variables $F(S_t)Q_t$, $F(S_t)Q_t^2$ e $F(S_t)Q_t^3$ indicate an increase in variable costs after outsourcing, validating the formulated hypothesis that outsourcing processes generate a transfer of fixed costs to variable ones, results that are in line with those obtained by Liu and Tyagi (2017), Fonseca (2014) and Rezende (2008).

Model 2 results from a standard estimation towards the inclusion of dummies, so, they are added as independent variables and allow us to verify that the results obtained in Model 1, in terms of transfers from fixed costs to variables, are also perceived in this model. However, the level of significance of the quadratic variables for Q are not significant, which would indicate a simple linear model. Furthermore, the coefficient of determination is significantly reduced and the errors do not have a normal distribution.

Table 1
Total cost regression model statistics

	Model 1	Model 2	Model 3
Variables	Estimates	Estimates	Estimates
CF_t	30 004 ***	921 758.80***	638 350.70 ***
$\bar{C}F_t$	-274 408 ***		
Q_t	9.343 ***	-2.842 *	-1.276 ***
Q_t^2	-4.0×10^{-4} ***	2.16×10^{-6}	
Q_t^3	5.6×10^{-11} ***		
$F(S_t)Q_t$	1.119 ***		0.301 ***
$F(S_t)Q_t^2$	-1.2×10^{-6} ***		
$F(S_t)Q_t^3$	1.1×10^{-12}		
<i>Cleaning</i>		Redundant variable	-117 774.3 ***
<i>Pouches</i>		-350996.53 ***	-105 693 ***
<i>Maintenance</i>		493067.73 ***	-134 970.7 ***
<i>Cafeteria</i>		-393073.73 ***	-72 562.1 ***
<i>Vehicles</i>		-373833.33 ***	-135 744.7 ***
<i>Cleaning</i> Q_t		-0.086868 ***	
<i>Pouches</i> Q_t		1.052818 ***	
<i>Maintenance</i> Q_t		-1.343549 ***	
<i>Cafeteria</i> Q_t		1.127750 ***	
<i>Vehicles</i> Q_t		0.922410 ***	
Regression Statistics			
R^2 adjusted	0.9892	0.5426	0.5538
JB	12.11 (0.02)	93.17 (0,000)	99.96 (0,000)
Andreson-Darling	0.581 (0.342)	1.480 (0,000)	1.07 (0,007)
Levene	45.00 (0.944)	1.47 (0,240)	1.31 (0,278)

Source: Prepared by the authors.

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%. Values in parentheses are the p-values of the tests.

Considering the fact that Model 2 indicates a linear regression, Model 3 was estimated, which is a mixture of Models 1 and 2. Therefore, for variable costs, the dummies enter in an additive way and, for fixed costs, they are independently incorporated, considering a linear relationship between the variables. For this model, the statistics improve a little compared to Model 2, but they still do not reach the significance levels of Model 1 and also show the conversion of fixed costs into variable ones.

Considering the distance of the variables distribution in relation to the origin of the coordinate axes, the model presented in equation (5) was estimated, which when estimating the CMe eliminates this weakness, with the impacts on fixed costs being measured by the displacement of the cubic function. Table 2 shows these estimated models using the same additive, independent and mixed dummies technique, in addition to a linear model.

Table 2
Statistics of regression models by average cost

	Model 4	Model 5	Model 6
Variables	Estimates	Estimates	Estimates
CF_t	9.935598 **	2.249526 ***	1 011.17**
$\bar{C}F_t$			-49 145.1***
Q_t	-4.71×10^{-5} *	-4.85×10^{-6} ***	-4.124619 *
Q_t^2	5.79×10^{-11} *		5.05×10^{-6} *
$F(S_t)Q_t$	8.42×10^{-6} *	8.34×10^{-7} ***	3.745139 *
$F(S_t)Q_t^2$	-1.03×10^{-11} *		3.45×10^{-7}
<i>Cleaning</i>	-1.735032 *	-0.326322 ***	
<i>Pouches</i>	-1.679897 *	-0.295244 ***	
<i>Maintenance</i>	-1.751398 *	-0.371777 ***	
<i>Cleaning</i>	-1.620244 *	-0.205529 ***	
<i>Vehicle</i>	-1.775949 **	-0.375075 ***	
Regression Statistics			
R^2 adjusted	0.5883	0.578	0.5102
JB	43.48 (0.000)	62.69 (0.000)	3.42 (0.180)
Andreson-Darling	1.15 (0.004)	0.846 (0.029)	0.55 (0.152)
Levene	1.109 (0.339)	1.311 (0.280)	1.79 (0.149)

Source: Prepared by the authors

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%. Values in parentheses are the p-values of the tests.

All models presented in Table 2 are robust and indicate the transfer of fixed to variable costs, reinforcing the relevance of the results. However, Model 6, which incorporates the dummies additively, is the most robust of them. These regressions are relevant to confirm the 'U' shape of the average cost function and, therefore, confirm the model proposed in equation (9).

To test the second hypothesis formulated, that the process of converting fixed costs into variable costs is not integral, costs should reduce over time, elasticities over time were estimated marking the outsourcing processes, as represented in Figure 3.

Figure 3 contains the fixed and variable costs relative to the maximum absolute value of the rates in the period (measured on the ordinate axis) in relation to the different outsourcing processes that took place at X University, in the period of analysis, which runs from 1995/1 to 2017/2 (identified on the abscissa axis as number of semesters). Thus, as there was no outsourcing until the 14th semester of the analysis period, there is a slight change in variable costs in this period. The first outsourcing takes place in the 15th semester, when the outsourcing of the food sector takes place and there is an increase in variable costs and a reduction in fixed costs. It is noteworthy that the effects are of equal magnitude, but in opposite directions. This indicates that the first outsourcing resulted, in terms of elasticity, only in a trade-off between fixed and variable costs.

In the outsourcing that follows, there is a small reduction in the impact on variable costs initially and that this increases as the outsourcing processes expand, maintaining the effect on fixed costs. So, it is not only evident that outsourcing converts fixed costs into variable ones, but also reduces the impact of variable costs in relation to fixed costs. The findings regarding elasticities clearly indicate cost gains in outsourcing processes and are in line with those obtained by Giosa (1999), Bacic and Souza (1997), Kakabadse and Kakabadse (2000), Wolf (2001) and Porter (2004).

One can speculate, as reasons for these movements, the fact that when the outsourcing process starts in the organization, some transaction and learning costs are incurred with the

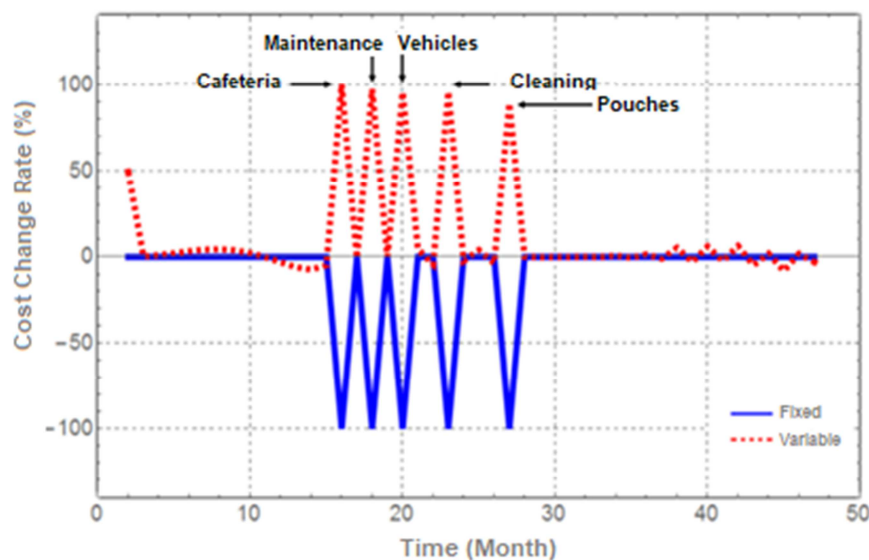


Figure 3: Elasticity of fixed and variable costs in relation to outsourcing processes measured over time

Source: Prepared by the authors.

hiring and management of outsourced workers. As a result, for the new outsourcing processes, there are learning gains and the institution's structure, focused on the management of outsourced workers, can remain relatively stable in the inclusion of new outsourced workers. Another element to mention is that outsourced workers can simply expand the services they provide, resulting in more effective services given the relationship between the agents involved and the lesser need for controls compared to new partners.

Finally, as the parameter of the cubic variable in Model 1 is significant and mathematically irrelevant, very close to zero, it is identified that the occupation of the scale did not exceed its technical capacity. The segment that the data validates is the part with decreasing returns of the cost function, indicating as secondary information that there were cost gains due to the scale of X University, and these results are in accordance with the findings of Arima, Tonini and Capezzutti (2002).

5 Final Considerations

The objective of this research was to evaluate the impacts of outsourcing processes on fixed and variable costs, assuming that the outsourcing process would result in (i) transfer of fixed costs to variable costs and (ii) that this process would reduce costs long-term. For that, an econometric model with the inclusion of dummies that capture the effects of outsourcing on fixed and variable costs was proposed to test

the hypotheses and meet the objective. A differential of this model is the inclusion of additive dummies, to assess the possibility of cumulative gains.

The objective was achieved and the hypotheses confirmed, as the proposed methodological process allowed us to identify that the outsourcing processes that took place at X University resulted in the transfer of fixed costs into variable one. In addition, it was possible to verify that, new outsourcing processes resulted in a greater effect in the drop in fixed costs than in the increase in variable costs, so, there was not just a transfer, but a reduction in total costs because fixed costs have been reduced more than variable costs have increased.

These findings are in line with the results of researchers who worked with the hypotheses that outsourcing converts fixed costs into variable ones, both theoretically and empirically, and that they also generate cost savings. What is added in this research in relation to what has been shown in the literature is the modeling to assess these effects and quantify the impacts in terms of magnitudes and elasticities.

Another relevant finding is that the impacts on fixed and variable costs are different for new outsourcing processes. Therefore, with each new outsourcing, the fall in fixed costs is more intense than the increase in variable costs, indicating several possibilities for explaining these elements, including learning gains, reduced transaction costs and lesser impacts on the processes of the management structure of these new contracts in the organization. These elements indicate the possibility of future studies to identify which ones are in fact exerting influence to obtain this result.

Finally, the fact that additive dummies were included to capture learning gains in the model generated the best result among the different estimation possibilities, which reveals an important methodology to be incorporated in future studies. Thus, it appears that this study makes a relevant contribution to future research.

References

- Alves, S. M. P., Coelho, M. C. R., Borges, L. H., Cruz, C. A. M., Massaroni, & L. Maciel, P. M. A. M. (2015). A flexibilização das relações de trabalho na saúde: a realidade de um Hospital Universitário Federal. *Ciência & Saúde Coletiva*, 20(10), 3043-3050. <https://doi.org/10.1590/1413-812320152010.11592014>
- Arima, C. H., Tonini, A. C., & Capezutti, D. (2002, outubro). Decisão sobre terceirização em função da aplicação de custeio ABC. *Anais do Congresso Brasileiro de Custos*, São Paulo, SP, Brasil, 9. Recuperado em 20 de julho de 2018, de <https://anaiscbc.emnuvens.com.br/anais/article/viewFile/2714/2714>
- Atkinson, A.A., Banker, R.D., Kaplan, R.S., & Young, S.M. (2000). *Contabilidade gerencial*. Tradução André Olímpio Mosselman Du Chenoy Castro. São Paulo: Atlas.
- Bacic, M. J., & Souza, M. C. A. F. (1997, novembro). Por que os programas de terceirização falham? *Anais do Congresso Brasileiro de Gestão Estratégica de Custos*, Belo Horizonte, MG, Brasil, 4. Recuperado em 20 de julho de 2018, de <https://anaiscbc.emnuvens.com.br/anais/article/view/3353>
- Bacic, M. J., & Souza, M. C. A. F. (2002). Algumas reflexões quanto às decisões de terceirização considerando o custeio variável e o contexto relacional e estratégico. In: *Anais do Congresso Brasileiro de Custos*, 9. São Paulo, São Paulo, Brasil. Recuperado em 06 de março de 2019, de <https://anaiscbc.emnuvens.com.br/anais/article/view/2763>
- Barbosa, A. M. S. (2010). A naturalização da identidade social precarizada na indústria do alumínio primário paraense. *Sociologias*, 12(23), 268-303. <https://doi.org/10.1590/S1517-45222010000100010>.
- Besanko, D., Ranove, D.D., Shanley, M., & Schaefer, S. (2006). *A economia da estratégia*. 3. ed. São Paulo: Artmed.
- Brasil, H. G. (1993). A empresa e a estratégia da terceirização. *Revista de Administração de Empresas*, 33(2), 611-618. <https://doi.org/10.1590/S0034-75901993000200002>
- Brown, M. B., & Forsythe, A. B. (1974). Robust tests for equality of variances. *Journal of the American Statistical Association*, 69(346), 364-367. <https://doi.org/10.2307/2285659>
- Bryce, D. J., & Useem, M. (1998). The impact of corporate outsourcing on company value. *European Management Journal*, 16(6), 635-643. [https://doi.org/10.1016/S0263-2373\(98\)00040-1](https://doi.org/10.1016/S0263-2373(98)00040-1)
- Cohen, S., & Rousset, J. (2013) *Strategic supply chain management: the five core disciplines for top performance* (2a ed.) New York: McGraw-Hill.
- Costa, F. (2003). Outsourcing estratégico: uma nova perspectiva. *Revista de Administração Pública*, 37(1),

99-132. Recuperado em 10 de março de 2019, de <http://bibliotecadigital.fgv.br/ojs/index.php/rap/article/view/6478>.

Davenport, T. H. (2005) The coming commoditization of processes. *Harvard Business Review*, 83(6), 100-108. Recuperado em 22 de julho de 2018, de <https://hbr.org/2005/06/the-coming-commoditization-of-processes>

Departamento Intersindical de Estatística e Estudos Socioeconômicos [DIEESE] (2017). O processo de terceirização e seus efeitos sobre os trabalhadores no Brasil. Recuperado em 20 de julho de 2018, <https://www.dieese.org.br/relatoriotecnico/2007/terceirizacao.pdf>

Domberger, S., & Fernandez, P. (1999). Public-private partnerships for service delivery. *Business Strategy Review*, 10(4), 29-39. <https://doi.org/10.1111/1467-8616.00117>

Druck, G., & Franco, Tânia. (2008). A Terceirização no Brasil: velho e novo fenômeno. *Laboreal*, 4(2). <https://doi.org/10.4000/laboreal.11413>

Ferruzzi, M. A., Spers, E. E., Sacomano, M. Neto, & Ponchio, M. C. (2011). Reasons for outsourcing services in medium and large companies. *Brazilian Business Review*, 8(4), 44-66. <https://doi.org/10.15728/bbr.2011.8.4.3>

Fleury, P. F. (2003). *Supply chain management: conceitos, oportunidades e desafios da implementação*. Ilos, Rio de Janeiro: UFRJ. Recuperado em 22 de julho de 2018, de <https://www.ilos.com.br/web/supply-chain-management-conceitos-oportunidades-e-desafios-da-implementacao/>

Fonseca Correia, E. M. (2014). O desenvolvimento do outsourcing, seus fundamentos, riscos e benefícios. *Lusíada. Economia e Empresa*, (11), 161-180. Recuperado em 18 de março de 2019, de <http://revistas.lis.ulusiada.pt/index.php/lee/article/view/899>

Giosa, L. A. (1999). *Terceirização: uma abordagem estratégica* (5a ed.). São Paulo: Pioneira.

Girardi, D. M. (1999). A importância da terceirização nas organizações. *Revista de Ciências da Comunicação*, 1(1), 23-31. Recuperado em 22 de julho de 2018, de <https://periodicos.ufsc.br/index.php/adm/article/view/7998/7383>

Gujarati, D. N., & Porter, D. C. (2012). *Econometria básica* (5a ed.) Porto Alegre: AMGH Editora LTDA.

Hehn, H. F. (1999). *Peopleware: como trabalhar o fator humano na implementação de sistemas integrados de informação (ERP)* (1ª ed.). São Paulo: Gente.

Hill, R. C., Griffiths, W. E., & Judge, G. G. (2003). *Econometria* (2a ed.). Tradução Alfredo Alves de Farias. São Paulo: Saraiva.

Horngren, C.T., Foster, G., & Datar, K.M. (2000). *Contabilidade de custos*. Rio de Janeiro: LTC.

Imhoff, M. M., & Mortari, A. P. (2005). Terceirização, vantagens e desvantagens para as empresas. *Revista Eletrônica de Contabilidade*, 3(2), 82-94. <https://doi.org/10.5902/198109466219>

Kakabadse, N, & Kakabadse, A. (2000). Outsourcing: a paradigm shift. *Journal of Management Development*, 19(8), 670-728. <https://doi.org/10.1108/02621710010377508>

Konishi, S. (2014). *Introduction to Multivariate Analysis: Linear and Nonlinear Modeling* (1a ed.). Tokyo, Japan: CRC Press. <https://doi.org/10.1201/b17077>

Kremic, T., Tukul, O. I., & Rom, W. O. (2006). Outsourcing decision support: a survey of benefits, risks, and decision factors. *Supply Chain Management*, 11(6), 467-482. <https://doi.org/10.1108/13598540610703864>

Kumar, S., & Kopitzke, K. K. (2008). A practitioner's decision model for the total cost of outsourcing and application to China, Mexico, and the United States. *Journal of Business Logistics*, 29(2), 107-139. <https://doi.org/10.1002/j.2158-1592.2008.tb00089.x>

Leiblein, M. J., & Miller, D. J. (2003). An empirical examination of transaction and firmlevel influences on the vertical boundaries of the firm. *Strategic Management Journal*, 24(9), 839-859. <https://doi.org/10.1002/smj.340>

- Levene, H. (1960). Robust tests for the equality of variance. In: OLKIN, 1a ed. *Contributions to probability and statistics*. Palo Alto: Stanford University Press, p.278-292. <https://doi.org/10.2307/2285659>
- Liu, Y., & Tyagi, R. K. (2017). Outsourcing to convert fixed cost into variable costs: a Competitive Analysis. *International Journal of Research in Marketing*, 34(1), 252-264. <https://doi.org/10.1016/j.ijresmar.2016.08.002>
- Marcelino, P. (2007). Afinal, o que é terceirização? Busca de ferramentas de análise de ação política. *Pegada*, 8(2), 55-70. <https://doi.org/10.33026/peg.v8i2.1640>
- Marquez-Ramos, L., & Martinez-Zarzoso, I. (2014). Trade in intermediate goods and Euro-Med production networks. *Middle East Development Journal*, 6(2), 215-231. <https://doi.org/10.1080/17938120.2014.961327>
- Martins, E. (2003). *Contabilidade de custos* (9a ed.). São Paulo: Atlas.
- Martins, G. A. (2008). Estudo de caso: uma reflexão sobre a aplicabilidade em pesquisas no Brasil. *Revista de Contabilidade e Organizações*, 2(2), 8-18. <https://doi.org/10.11606/rco.v2i2.34702>
- Mas-Colell, A., Whinston, M. D., & Green, J. R. (1995). *Microeconomic theory* (Vol. 1), New York: Oxford university press.
- Mittelhammer, R. C., Judge, G. G., & Miller, D. J. (2000). *Econometric foundations* (1a ed.) Cambridge: Cambridge University Press.
- Montgomery, D. C. (2005). *Design and analysis of experiments* (6a ed.) Arizona: John Wiley & Sons.
- Mozzini, S. H. R. (2011). *Fatores de decisão de terceirização em tecnologia da informação*. Dissertação de Mestrado em Administração, Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, RS, Brasil. Recuperado em 22 de julho de 2018, de <https://lume.ufrgs.br/bitstream/handle/10183/37185/000820269.pdf?sequence=1&isAllowed=y>
- Oliveira, G. C. D. N., Silva, D. D., Costabile, L. T., & Barros, E. (2013). Insucesso na terceirização da armazenagem e transporte de carga frágil para operador logístico: um estudo de caso. *GEPROS. Gestão da Produção, Operações e Sistemas*, 8(2), abr-jun., 95-114. <https://doi.org/10.15675/gepros.v8i2.620>
- Pepper, B. (1996). Trends in outsourcing. *Information Security Technical Report*, 1(3), 8-10. [https://doi.org/10.1016/S1363-4127\(97\)83013-0](https://doi.org/10.1016/S1363-4127(97)83013-0)
- Pereira, L. D. A. (2004). Gestão da força de trabalho em saúde na década de 90. *Physis: Revista Saúde Coletiva*, 14(2), 363-382. <https://doi.org/10.1590/S0103-73312004000200010>
- Pindyck, Robert S. & Rubnfield Daniel L. (2015). *Microeconomia* (8a ed.). São Paulo: Pearson.
- Porter, M. (2004). *Estratégia competitiva: técnicas para análise de indústria e concorrência* (9a ed.). Rio de Janeiro: Campus.
- Prado, E. P. V. (2009). Terceirização de serviço de TIC: uma avaliação sob o ponto de vista do fornecedor. *REAd: Revista Eletrônica de Administração*, 15(3), 1-26. Recuperado em 20 de julho de 2018, de <https://seer.ufrgs.br/read/article/view/39024/25104>
- Prado, E. P. V., & Takaoka, H. (2002). Os fatores que motivam a adoção da terceirização da tecnologia de informação: uma análise do setor industrial de São Paulo. *Revista de Administração Contemporânea*, 6(3), 129-147. <https://doi.org/10.1590/S1415-65552002000300008>
- Prado, E. P. V., & Takaoka, H. (2006). A terceirização da tecnologia de informação e o perfil das organizações. *Revista de Administração*, 41(3), 245-256. <https://www.redalyc.org/pdf/2234/223417413003.pdf>
- Rezende, A. C. (2008) *Terceirização das atividades logísticas* (1ª ed.). São Paulo: Instituto IMAM.
- Ross, W. T., Dalsace, F., & Anderson, E. (2005). Should you set up your own sales force or should you outsource it? Pitfalls in the standard analysis. *Business Horizons, Harvard*, 48(1), 23-36.

<https://doi.org/10.1016/j.bushor.2004.10.005>

Santos, B. A. D., Diehl, C. A., & Andrioli, R. F. (2013). Impacto da externalização de serviços secundários em uma instituição de ensino superior. *Contextus - Revista Contemporânea de Economia e Gestão*, 11(1), 7-24. <https://doi.org/10.19094/contextus.v11i1.32154>

Slack, N., Brandon-Jones, A., & Johnston, R. (2018). *Administração da produção* (8a ed.). São Paulo: Atlas.

Severo Filho, João. (2006). *Administração de logística integrada: materiais, PCP e marketing* (2.ed.). Rio de Janeiro. E-papers.

Stal, E., & Morganti, F. (2011). Multinacionais brasileiras em tecnologia de informação: produção de software e terceirização de serviços. *RAI Revista de Administração e Inovação*, 8(4), 182-205. <https://doi.org/10.5773/rai.v8i4.893>

Souza, M. A., & Diehl, C. A. (2009). *Gestão de custos: uma abordagem integrada entre contabilidade, engenharia e administração* (1a. ed.). São Paulo: Atlas.

Stock, J. H., & Watson, M. W. (2004), *Econometria* (1a, ed.), São Paulo: Pearson.

Tenreiro, C. (2013). Combinando testes de Mardia e BHEP na avaliação duma hipótese multivariada de normalidade. *Revista Estudo Geral*, Coimbra, 15-21. Recuperado em 20 de julho de 2018, de <http://hdl.handle.net/10316/43976>

Valença, M. C. de A., & Barbosa, A. C. Q. (2002). A terceirização e seus impactos: um estudo em grandes organizações de Minas Gerais. *Revista de Administração Contemporânea*, 6(1), 163-185. <https://doi.org/10.1590/S1415-65552002000100010>

Valois, Ú., & Almeida, A. T. (2009). Support model for multicriteria decision to outsource productive activities based on SMARTS method. *Produção*, 19(2), 249-260. <https://doi.org/10.1590/S0103-65132009000200003>

Varian, H. R. (2015). *Microeconomia: uma abordagem moderna* (9a ed.), Rio de Janeiro: Campus.

Vendruscolo, M. I., & Alves, T. W. (2009). Estudo da economia de escala do setor de telecomunicações móveis do Brasil pós-privatizações. *Revista Contabilidade & Finanças*, 20(49), 63-78. <https://doi.org/10.1590/S1519-70772009000100005>

Vining, A., & Globberman, S. (1999). A conceptual framework for understanding the outsourcing decision. *European Management Journal*, 17(6), 645-754. [https://doi.org/10.1016/S0263-2373\(99\)00055-9](https://doi.org/10.1016/S0263-2373(99)00055-9)

Wolff, G. (2001). *Integração vertical e terceirização: uma abordagem crítica focada nas questões estratégicas para a competitividade da manufatura*. Dissertação de Mestrado em Engenharia Mecânica, Universidade Federal de Santa Catarina (UFSC), Florianópolis, SC, Brasil. Recuperado em 20 de julho de 2018, de <https://repositorio.ufsc.br/xmlui/bitstream/handle/123456789/79832/182587.pdf?sequence=1&isAllowed=y>

Yang, Q., & Zhao, X. (2016). Are logistics outsourcing partners more integrated in a more volatile environment? *International Journal of Production Economics*, 171, 211-220. <https://doi.org/10.1016/j.ijpe.2015.09.036>

Yin, R. K. (2015). *Estudo de Caso: Planejamento e métodos*, Porto Alegre: Bookman.

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