Contracts and incentives in Quality Beef Chain: analyzing organizational failures

Grupo de Pesquisa: Economia e Gestão no Agronegócio

Resumo
Coordenação é um fator determinante para a competitividade do agronegócio. No entanto, o Sistema Agroindustrial da Carne Bovina é tradicionalmente relacionado a uma baixa taxa de contratação formal quando comparado a outros sistemas produtivos. Esta pesquisa busca identificar as razões desse fenômeno (Por que isso acontece? As estruturas de incentivos são suficientes para promover a cooperação entre produção e indústria frigorífica? Qual o papel das instituições e das estruturas de incentivos?). Especificamente, esse artigo objetiva investigar as falhas de coordenação nos “Programas de Qualidade” coordenados pela indústria frigorífica. O tema é tratado com base em dois construtos teóricos: i) Teoria do Agente Principal; ii) Economia dos Custos de Transação. Propõe-se um modelo de estrutura de incentivos para a produção de carne bovina de qualidade considerando os investimentos específicos realizados pelos produtores rurais e indústria frigorífica. Além dos investimentos específicos, analisa-se o papel desempenhado pelas instituições em prol da redução das falhas organizacionais. Apresenta-se um modelo matemático e um modelo estratégico para o qual se aplica teoria dos jogos como ferramenta de análise. Qualidade é tratada a partir de uma abordagem multidimensional, desde que diferentes atributos são considerados. O modelo teórico é posteriormente validado em um múltiplo estudo de caso que estuda dois “Programas de Qualidade”. Os resultados apontam que a complexidade de se desenhar estruturas de incentivos eficientes tornam a sustentação dos referidos “Programas de Qualidade” uma tarefa árdua. O papel das instituições, representado pelos contratos formais e pela coordenação horizontal, é um aspecto relevante a se considerar quando da prevenção das falhas organizacionais.

Palavras-chaves: carne bovina, estruturas de incentivos, falhas organizacionais

Abstract
Coordination mechanisms are basic factors for agrisystems competitiveness. However, the Brazilian beef chain is traditionally associated to less formal contractual relations when compared to other chains. This research seeks to identify the reasons for this phenomenon. (Why is that so? Are incentives structures enough to promote cooperation between production and industry? What is the role of institutions and incentive structures?)
Specifically, the paper aims to investigate the coordination failures within Beef Quality Programs coordinated by meat packers. The issue is treated considering two theoretical frameworks: i) The Principal-Agent theory and ii) The Transaction Costs Economics (TCE). We propose a model of incentive structures for the production of quality beef which considers specific investments made by cattle raisers and the meatpacking industry. Besides specific investments it is also analyzed the role institutions play in order to reduce organizational failures. It is presented a mathematical and a strategic model to which game theory is applied. The quality is addressed from a multidimensional approach, since different product attributes are considered. The theoretical model is then validated with a multiple case study with two “Quality Beef Programs”. The survey results suggest that the complexity of drawing efficient incentive structures makes the maintenance of quality programs for meat an arduous task. The institutional role represented by formal contracts and horizontal coordination is a relevant aspect to consider in preventing organizational failures.

Key Words: bovine meat, incentive structures, organizational failures

1. Introduction

Coordination mechanisms are determinant factors for agrisystems competitiveness. Coordination implies, among other things, conciliating divergent interests in favor of common goals. Transaction Costs Economics (TCE) and Incentives Theory (IT) delimit the problem, respectively, under the lenses of assets specificity and incentives structures, motivated by the search for efficiency. Among different forms of coordination forms, contracts emerge as a governance mode.

In agrisystem coordination literature contracts assume an important role (MENARD, 1996, ZYLBERSZTAJN, FARINA, 1999, MENARD; KLEIN, 2004; MARTINEZ; ZERING, 2004; ZYLBERSZTAJN, 2005). Different contract structures are observed in each production activities. In the United States, 47% of the animal production occurs under contract form, and the production of bovine meat is the one that presents the lesser indices1 (MACDONALD, KORB, 2006). In Brazil2, Zylbersztajn (2005) points out that contracts cover a growing share of agricultural activities. However, considering the animal production, such as in USA, beef production is less aligned with contractual

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1 The contracts of poultry and egg production represent 88.2% of the value produced in the United States, while pork and beef represent, respectively, 57.3% and 28.9%. Considering Brazil, large part of poultry and pork production are coordinated by the processing industry under contracts.

2 Examples of the relevant role of contracts in the Brazilian agribusiness are found in the market of land rent and food production. Anticipated purchase of soy for the crush industry (ALMEIDA, 2008), the citrus contracting production (CHADAD, 2007) and sugar and alcohol production (PEDROSO, 2008), beyond the commercial transactions in the sector of animal protein production, especially those in the poultry and hog (ZYLBERSZTAJN, 2005) signal for the importance of the hybrid forms of governance for the coordination of Brazilian agrisystems.
governance mode. Why is that so? Are the incentives structures enough to promote cooperation between production and industry? What is the role of institutions and incentive structures? Specifically, this paper aims to identify the reasons for low adoption of formal contracts examining contractual arrangements in beef Quality Programs developed by Brazilians meat industries.

The Brazilian beef chain is characterized by its complexity and diversity. The demand for quality products with traceability is related to healthy, social and environment concerns. For that an efficient coordination between industry and production should be accomplished. This new context imposes challenges to this sector. The processing industries, mainly those oriented to the international market, develop Quality Programs that, in last instance, represent a private initiative for carcasses classification and standardization. These programs aim to incentive the production of standardized animals in order to attend industrial processes optimization and consumer demand for quality. Compensations are given to cattle growers as a form of incentives in order to have animal carcasses with some attributes related to beef quality.

The difficulty in creating mechanisms of incentives to induce cooperation stands out the quandary faced by the Brazilian beef chain. What should seem obvious - to adopt coordinated systems that add value to the product and represent profits for the whole sector - presents difficulty in handling relations under the scope of production and industry. Both agents discredit the effectiveness of those called Quality Programs, although they affirm that the cooperation is the way to achieve competitiveness. This paradox points to the relevance of the subject, which is to analyze coordination imperfections. Traditionally, the literature focuses the efficiency model with little attention for the understanding of organizational failures.

Regarding the literature gap, this research has the objective to study the pattern of contracts in Brazilian Quality Beef Programs considering the imperfections in institutional arrangements mechanisms. The main research questions are: i) Is the incentive structure to promote cooperation enough? ii) Which are the risks involved? iii) What is the role of institutions?

2. Theoretical framework

The subject of vertical coordination will be treated considering two theoretical frameworks: i) The Principal-Agent theory and ii) The Transaction Costs Economics (TCE). The incentive idea is present in both approaches. In the first one, the incentive is structured by means of ex ante contracts where risk and prizes are placed in order to provide the necessary incentives for the transaction. For TCE the contracts are incomplete and also involve ex post negotiation, since the agents are not fully rational. The investment in specific assets creates the possibility of quasi rents capture, as the agents have an opportunistic behavior. For that approach, the governance modes provide the necessary incentives for the economic transaction.

The problem of principal-agent arises when one party (the principal) delegates to another (agent) a task. In condition of informational asymmetry, since the principal does not have access to all information gathered by the agent, it is difficult to assess and measure his or her performance. Risk and uncertainty are therefore inserted into the
exchange, contributing to the agency cost. Based on the assumptions of rationality and self-interest, both principal and agent, seek to maximize their utility, but since goals may be different, a situation of conflict can be characterized. Contracts arise, then, as a way of creating incentives and providing mechanisms for monitoring, in order to maximize the value generated to the principal.

Based on Jensen and Meckling (1976), the agency cost is the sum of: i) monitoring costs; ii) the bonding costs - premiums paid to the agent as an incentive and; iii) the residual loss. The authors emphasize that agency costs apply also in cooperative relationships, provided that a relationship of principal-agent is established.

The existence of informational asymmetry, according to Besanko et al. (2006), was associated with two main elements: hidden information and hidden action. The idea of hidden information is related to the concept of adverse selection as presented by Akerlof (1970). In the presence of informational asymmetry (the seller knows better the quality of the product in comparison to the buyer), the phenomenon of adverse selection leads the buyer to consider and pay only for the average quality of the product. Uncertainty about the quality generates, then, a perverse effect: producers of higher quality goods have no incentive to transact their products and, ultimately, only products of inferior quality will be traded in the market.

The assumption of hidden action, also called moral hazard, is presented by Eisenhardt (1989) as the lack of the agent’s effort to apply himself to the execution of the task in accordance with the principal’s interest. Due to the difficulty in observing and / or measuring the agent’s action or even because of the monitoring cost there is room for cheating. The author highlights that the share of risk is a relevant aspect to be considered in a principal-agent relationship, especially when the agents have different attitudes in face of risk. The evaluation of agent’s profile, if risk seeking, risk neutral or risk averse, is crucial for cooperative relationships, particularly when the parties have different goals. The identification of the level of necessary incentives to align the agent's performance with principal’s interest is important to build a cooperative relationship. The problem is to identify a model that adequately addresses the variables involved in this equation: fixed wages, premium prizes, cost and risk.

The classical principal-agent model looks for the optimal allocation of risk and prize (incentive) of production considering a system of efficient compensation. Holmstrom and Milgrom (1991) affirm that this model generates limited results as it does not allow to delineate more complex organizational problems, for instance, the tasks with different dimensions, the multitasks. This concept is related to the different tasks that the agent had to execute to reach the desired result established by the principal. According to the authors, when it has multiple tasks to execute, the incentive not only serves to place the risk and to motivate the effort as also to direct the action of the agent to one determined dimension of the task. In other words, depending on the incentive the marginal benefit of an activity is increased at the expenses of the benefit of the other. Thus, the expected results could be perverse and it depends on how the general incentive is proposed. In synthesis, the agent when placing efforts among different tasks tends to make greater effort in that dimension which generates greater rewards. The multitask model applies to situations which involves different tasks for the same agents and also to some task with different dimensions.
Gibbons (1998) highlights another limitation of the classical model of principal-agent concerning the assumption that the result \( y \) is easily measured and that performance is only stimulated through monetary measures. Relational contracts emergence when reputational factors are present and subjective incentives measures should be considered within the model.

In summary, incentives and cooperation are related variables. However, in order to effectively promote the cooperation among agents the relation between the incentive applied and the task performed must be understood. The theory suggests that the incentive is not separated from risk analysis which in turn depends on the behavior of agents facing an event of uncertainty. The possibility of verifying the results and the multidimensional task character are also variables that must be considered in the construction of a cooperation model.

The TCE analyzes the contractual world from the bounded rationality and opportunism presuppositions. The structure that minimizes the transaction costs must also consider the transactions attributes: frequency\(^3\), asset specificity\(^4\) and uncertainty\(^5\). Williamson (1985) argues that asset specificity is the key variable to identify the more efficient form of governance. An asset is considered specific to a transaction as alternative allocations imply loss of value. The possibility of contractual breaches is higher as more specific the involved assets are, since the specificity almost results in the existence of rents that can be captured in the transaction (WILLIAMSON, 1985; KLEIN et al., 1978). Williamson (1996) points out that the governance mechanism must be understood as incentive structures. Furthermore, it also represents an alternative to mitigate conflicts and guarantee mutual profits. For the TCE, \textit{ex ante} incentives are not enough for the promotion of cooperation, contrasting to what the Principal-Agent Theory defends. Moreover, it also has to consider the necessity of \textit{ex post} adaptations and the fact that the incentives are not essentially pecuniary. The governance structure itself is an incentive for the emergence of a cooperative environment.

The behavioral assumptions assumed by TCE are bounded rationality and opportunism. The idea of bounded rationality departs from Simon’s concept (1991) that agents are intentionally rational but they are so in a limited way. Since the agents are limited in their cognitive abilities, contracts are necessarily incomplete (AZEVEDO, 1996; HART, 1991; WILLIAMSON, 1991). The opportunistic behavior implies the possibility of

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\(^3\) Williamson (1985) classifies frequency as recurrent and occasional and he identifies the efficient mode of governance relating it to asset specificity. The frequency is related to transaction regularity and, if recurrent it involves the construction of reputation.

\(^4\) According to Williamson (1996), asset specificity should be classified in: i) local specificity; ii) physical specificity; iii) human specificity; iv) time specificity; v) dedicated assets and vi) brand.

\(^5\) The uncertainty is linked both to information availability and to the probability of occurrence of a given event. In presence of uncertainty it is required specific governance form in order to adapt to environment turbulence (WILLIAMSON, 1985).
an ex post contract breaching, opening room for moral hazard and hold-up events. Hence, there is the necessity of creating contracts safeguards ex ante.

According to Williamson (1996), the existence of incomplete contracts accounts for a significant part of economic problems. Based on the assumptions of bounded rationality and opportunistic behavior, the presence of contractual safeguards becomes an important factor in understanding how to proceed with the trade in a long-term perspective. Zylbersztajn and Zuurbier (1999) argue that the challenge is to design complete and comprehensive contracts to cover the contingencies which arise from opportunistic behavior and business environment uncertainties. Moreover, the possibility of cooperative action as a solution for contracts failures would be only possible if not considering opportunism as a premise, which for the authors is a naïve perception.

In addition to behavioral assumptions, the identification of governance structures which minimize transaction costs should also consider the transaction attributes such as frequency, asset specificity and uncertainty. The alignment model proposed by Williamson (1985, 1996) creates a continuum whose extremes are market relation and vertical integration and the shifting parameter is the asset specificity. From this perspective, hybrid forms of governance, located at an intermediate position between the extremes mentioned above, emerge as efforts of coordination to align towards the minimization of transaction costs. Among different hybrid forms of governance there are contracts. The contracts, explicit or implicit, are understood as forms of governance that provide incentives for the transactions. Given their incompleteness, it is necessary to offer safeguards in order to prevent from environment uncertainty and to avoid hold-up events caused by opportunistic behavior.

For TCE, the operation of the legal system and the contract’s guarantee involve positive transaction costs (Williamson, 2000). Since the courts are not the only alternative for resolving disputes, firms and institutional arrangements emerge as solutions to conflicts. The institutional environment is exogenous to the model. However, changes in laws and regulations can promote equilibrium solutions displacement.

3. General hypotheses
In this research, coordination failures in strictly coordinated beef quality subsystems are investigated from the following assumptions: i) Hypothesis 1: The failure in coordinating quality beef subsystems is related to failures in the transmission of monetary incentives along the chain; ii) Hypothesis 2: The institutions (formal and informal ones) are non pecuniary structures of incentives which promote cooperation and reduce failures on the transmission of incentives along the quality subsystem.

4. Methodological approach
The methodology involves the development of a theoretical model (mathematical and a strategic model) which is afterwards applied to a multi-case study. The theoretical model provides a simplified analysis of the relation between the production and the industry for the transaction of quality products. The strategic model, through the application of game theory, identifies the agents’ behavior in the face of informational asymmetry. Both modeling are developed considering two modes of coordination: i)
subsystem 1: vertical coordination between producers and industries involved in the production of young steers and; ii) subsystem 2: horizontal and vertical coordination in which cattle raisers are organized in an association in order to transact a credence good – organic beef – with a meat packer. The theoretical models are based on the study of dynamic governance within complex agrisystems network proposed by Zylbersztajn and Farina (2005).

The qualitative approach is developed with three beef exporters companies with relevant market share in the Brazilian beef exportations. The data is collected through semi-structured interviews conducted with the managers of these Quality Programs. Two cases investigate the companies “Alpha” and "Beta", under the assumptions of subsystem1. The company herein called “Sigma” is an example for subsystem 2. Considering the investments in specific assets made by cattle raisers and the industry, the proposed theoretical model attempts to delineate the necessary incentive structure for producing quality beef. For that, it is considered the multidimensional character of quality, since that different attributes of the animal are exchanged.

5. Theoretical model

The central assumption is the efficient allocation of scarce resources between alternative and competitive ends. The developed model estimates the interaction of two individuals, the supplier (cattle raiser) and the purchaser (processor industry). The economic analysis is developed from the model of rational choice where some presuppositions are considered: i) the individual is autonomous, rational and self-interested; ii) the individual maximizes his or her utilities; iii) the information is asymmetric which results in the possibility of moral hazard and adverse selection.

The model illustrates the exchange between the producers and the beef industry focusing on quality products. Quality is understood as a set of attributes defined by the processing industry. The challenge is to build an incentive structure in order to induce the supplier to care about the specifications established by the industry. Cattle raisers agree to undertake specific investments in quality production since that premium prices are paid in order to remunerate the costs and the risk involved in the activity. The industry also carries out specific investments which imply costs. In the presence of specific assets, quasi rents are created opening room for value capture. Institutional arrangements failure is evidenced. The delivery of quality to the final consumer depends on the quality of the processed raw material (animal). The industry financial return depends on the optimization of its processes which implies less variability in the pattern of the animal supplied. Agent (supplier/ cattle raiser) and Principal (meat processor) search to maximize their utilities. The incentive for quality supply is a prize for the attributes demanded by the industry which is a percentage above the market price. In sum, three models are developed: i) production; ii) beef industry and iii) interaction between production and industry (equilibrium status).

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6 A quantitative approach will be the next step of this research. The success/failure of a coordinated subsystem regarding the incentive transmission along a productive chain will be analyzed applying a Monte Carlo simulation.
Subsequently, a model of strategic behavior of the two agents is developed, adding a dynamic component to the transaction – the existence of a contract versus the absence of a contract and the payment versus no payment of a bonus for the quality by the industry.

The model requires the interaction of two agents, an agricultural producer (P) and an industry (I). The transacted product (the animal) has a level of quality where (M) represents a set of attributes defined by the industry.

Producers are willing to make specific investments \((e_p)\) in quality production since the incentives generated by the industry pay the costs \((c_ep)\) and the risk \((w)\) which arises from the production of quality attributes. In the case of specific investments, quasi-rents are created, opening room for capture. The industry also makes specific investments \((i)\) for the processing of superior quality products which involves costs \((c_i)\).

The delivery of a superior quality product to final consumer depends on the quality of the raw and the processed material. The industry's profitability also depends on the optimization of its production processes which require a low level of product variability in terms of the animal delivered by the supplier.

Both agent (supplier of raw material/animal) and principal (industry), seek to maximize their utilities. The incentive for the production of quality animals means paying a bonus \((b)\) for the attributes that attend the specifications defined by the industry. The bonus is paid as a percentage over the market price \((p)\), then \(b = \alpha \cdot p\), where \(\alpha \in [0,1]\) and \(p\) is the market price.

**Mathematical model: Subsystem 1 (vertical coordination)**

In this subsystem, farmers individually negotiate with the industry that coordinates a Quality Program. In general, the quality is assessed by the industry based on a set of product attributes, and the bonus is calculated from a classification table which assigns percentages of different awards depending on the category in which the animal is considered. The final quality depends not only of specific investments made by the production side, but also it depends on the investments made by industry and by the others agents involved with the distribution to final consumption.

\[UP = p + b_{ep}(p) - c_{ep} \quad (1)\]

The quality required by the industry will be achieved if the producer marginal benefit is at least equal to their marginal cost. In other words: \(b_{ep} = c_{ep} \quad (2)\). As the producer is risk averse, the risk prize \((w)\) of producing a high quality animal should also be considered in the model as the investments made in order to achieve it could be captured as a quasi-rent. Thus: \(UP = p + b_{ep}(p) - c_{ep} - w \quad (1')\) and \(b_{ep}(p) = c_{ep} + w \quad (2')\)

However, quality has various dimensions. A quality product is measured from a set of attributes and each attribute means, in turn, that specific investments are made by the supplier. The multidimensional character of quality gives more complexity to the structure of incentives, as follows: \(UP = p + \{b_{ep,1}(p) + b_{ep,2}(p) + b_{ep,3}(p) + \ldots + b_{ep,n}(p)\} - c_{ep} - w\)
(3) and $b_{ep,i}(p) + b_{ep,2}(p) + b_{ep,3}(p) + ... + b_{ep,n}(p) = c_{ep} + w$ (4) Where $b_{ep,i}$ para $i \in \{1, ..., n\}$ represents the prize paid for the dimension $i$.

b) Processing Industry

Considering the processing industry ($I$) and the processed product price as $p_c$, its utility function is defined as $UI = p_c + b_{ei}(p_c) - c_{ei} - p - b_{ep}(p)$ (5) where $b_{ep}(p) = \sum_{i} b_{ei}(p)$. The industrial optimization processes require low variability in the supplied product (animal). Assuming that some variability does exist, its cost of production can be broken down into some related costs: i) the specific investment ($c_{ei}$); ii) the acquisition of raw material ($p$) and; iii) the prize for the risk of failure in the supply of homogenous quality ($c_v$): $UI = p_c + b_{ei}(p_c) - c_{ei} - p - b_{ep}(p) - c_v$ (6). Assuming that the processor is risk neutral to the generated quasi-rents created along the industrial processing, the utility maximization occurs when the marginal benefit is equal to the cost of production and transaction: $b_{ei}(p_c) = c_{ei} + b_{ep}(p) + c_v$ (7)

c) Production and industry equilibrium

The balance between production and industry in multidimensional incentive contracts is achieved when the marginal benefits of the agent are at least equal to the marginal benefits of the principal, as presented as $[b_{ep,1}(p) + b_{ep,2}(p) + b_{ep,3}(p) + ... + b_{ep,n}(p)] = b_{ei}(p_c)$ (8). From the restriction posed above, incentives contracts between production and industry must be designed in a way that allows the balance between the different incentives for each dimension of quality. In addition, returns associated with specific investments and the risk must be considered. Regarding the risk, for suppliers it is exemplified by the risk of quasi rent capture generated in the production of a quality animal and for the industry it is the variability in the processed product. Thus: $b_{ep}(p) = c_{ep} + w - c_{ei} - c_v$, where $b_{ep}(p) = \sum_{i} b_{ep}(p)$.

In general, the benefit that the industry will receive when selling a high quality beef to consumers should at least pay the benefits the industry paid to suppliers. Similarly, the contract must ensure that the risk of product variability represents part of the cost of the supplier.

**Mathematical model: Subsystem 2 (vertical and horizontal coordination)**

In subsystem 2, a credence good is part of the transaction and its production implies greater investment in specific assets made by both agents when compared to subsystem 1. Moreover, as it is a credence good (organic beef), there is a need of third party to certify the quality. The bonus for quality is established between the parties (production and industry) and it represents a percentage above the market price. But, as it is a product that

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7 The final consumer’s utility when applied to the model generates the possibility of quasi rent capture along the industrial process. This variable should then be considered when a more robust analysis be built.
demands more specific investments, the percentage of bonus is greater than those applied for subsystem 1. Besides, in the presence of horizontal coordination, producers bear the costs of governance \((c_g)\) of this institutional arrangement. Like in subsystem 1, the final quality depends not only on the specific investments made in production, but also it depends on the investments made by industry and the others agents involved in the distribution to final consumption.

\[ a) \quad \text{Production} \]

In this subsystem, the producer’s utility \((U_P^*)\) is given by the sum of the market price \((p)\) plus the % bonus achieved by product differentiation \((b^*)\) minus the costs of specific investments \((c^*_{ei})\). Regarding the necessity of a horizontal coordination, besides the cost of specific investments, there are also positive costs of governance \((c_g)\) which should be added to the model: 

\[ U_P^* = p + b^*_{ep} (p) - c^*_{ep} - c_g \]  

(10)

where \(b^*_{ep} (p) = \sum_i^n b^*_{ep_i} (p)\) as, \(b^*_{ep} > b_{ep}\) e \(c^*_{ep} > c_{ep}\) where, \(b^*_{ep_i}\) to \(i \in \{1, \ldots, n\}\) which represents the bonus paid for the dimension \(i\).

It is assumed that \(b^*_{ep} > b_{ep}\) e \(c^*_{ep} > c_{ep}\), i.e., the premium received by the producer in a program of organic meat is higher than that obtained in a program of quality meat. On the other hand, the specialized investments made by the producers are also larger, because in addition to the investments made to obtain a young animal (subsystem 1), the producer must also adapt their production to the rules established for organic production.

Like in subsystem 1, the investment in quality will only be made by the producer if the marginal benefit is at least equal to its marginal cost. Moreover, as the supplier is risk adverse, the risk of quasi-rent capturer must also be accounted for. Thus, 

\[ U_P^* = p + b^*_{ep} (p) - c^*_{ep} - c_g - w \]  

(11) and 

\[ b^*_{ep} (p) = \sum_i^n b^*_{ep_i} (p) \] 

(12).

\[ b) \quad \text{Processing Industry} \]

Similarly to that presented in subsystem 1, the industry’s utility function is given by: 

\[ U_I^* = p^c + b^*_{ei} (p^c) - c^*_{ei} - p - b^*_{ep} (p) - c_g \]  

(13) where, \(b^*_{ep} (p) = \sum_i^n b^*_{ep} (p)\) e \(c^*_{ei} > c_{ei}\). Its utility maximization occurs when its marginal benefit rewards its marginal costs, i.e. the bonus paid to suppliers and the costs of the transaction. Thus, 

\[ b^*_{ei} (p^c) = c^*_{ei} + b^*_{ep} (p) + c^*_{ei} \]  

(14).

\[ d) \quad \text{Production and industry equilibrium} \]

Compared to subsystem 1, the inclusion of governance costs differentiates the condition of equilibrium in subsystem 2. Thus, based on equations (12) and (14), the balance equation in subsystem 2 is presented in (15) and (16): 

\[ b^*_{ep} (p) = b^*_{ei} (p^c) \] 

(15)

being, \(b^*_{ep} (p) = \sum_i^n b^*_{ep_i} (p)\) or \(b^*_{ep} (p) = c^*_{ep} + c_g + w - c^*_{ei} - c_e\). (16).

As presented, the incentive structure in subsystem 2 should be designed in such a way that the costs of governance are added to the costs of specific investments and to that of risk capture. Comparing the equilibrium of subsystems 1 and 2 and the equilibrium
equations (9) and (16), it follows that the premium paid to the producer in subsystem 2 must be greater or at least equal to the cost of governance involved in the transaction plus the specific investment and the risk of quasi rent capture costs. Thus:

$$b_{ep}^* (p) - b_{ep} (p) = c_g$$ (17).

**Strategic model**

The strategic model aims to capture the dynamic aspects of agent’s interaction and the uncertainty surrounding the bonus incentive transmission along the chain. The mathematical model presented so far assumes that the industry would be willing to pay for quality. The strategic model has two possibilities: i) the producer may or may not choose to contract with industry and; ii) the industry may or may not pay bonuses to the producer. The modeling strategy will be developed through a game between the agents, considering the producer (P) and industry (I).

The payoff matrix represents the possible outcomes of the simultaneous interaction of independent agents, depending on the incentive structure chosen by the agents. It is understood that the incentives transmission is efficient if the bonus received by the agents reward the specific investments made by them. Therefore, it is assumed that both agents - producers and industry - are investing in specific assets for achieving quality, but at different levels, depending on the type of subsystem analyzed. It is considered that the greater the asset specificity, the greater the possibility of capture of quasi rents and the higher the risk of "hold-up" occurrence (KLEIN et al., 1978). Moreover, there is no technological or organizational constrains for quality production. So, the incentive to quality production depends on the bonus paid by the consumer and the industry in order to remunerate the production and the transactions costs. To simplify the model, it is assumed that retailers fully transfer the bonus received from the consumer.

The producer (P) strategic option is drawing or not a formal contract with the industry in order to supply the animal. In subsystem 1, the quality achievement is related to investments in animal breeding and on animal nutrition with the purpose of having precocity. But, with the animal precocity there is a positive externality related to the reduction in the animal cycle of production, consequently, with its production cost. In other words, even if the animal doesn’t receive any premium price (bonus), indirectly the producer receives some benefit from producing young steers. The choice of subsystem 2 involves the production of quality through credence good (organic beef) for which specific investments are significant higher for both agents: the investment made by the industry in brand to market the differentiated product, the certification process and the adoption of an organic production system by producers (time of rural property conversion, third parties certification and so on). Thus, there is a gradation in the specific investments made by producers and industry, being higher in subsystem 2.

The choice of contracting implies positive governance costs $c_{gc}$. In general, this should be less than the benefit received by the subsystem 1, i.e. $c_{gc} < b_{ep}$, since the cost of contracting is the same for both subsystems and $b_{ep}^* (p) > b_{ep} (p)$. Thus, if $c_{gc} < b_{ep}$ it is also true that $c_{gc} < b_{ep}^* (p)$. Otherwise, given the rationality of agents, the act of
contracting would not benefit at all. Moreover, as the contract is an incentive structure (WILLIAMSON, 1986), it is assumed that if the producers don’t choose to contract, it is likely that they do not receive the expected full bonus, even when the industry pays some amount of premium prices. In this scenario (no contract / paid bonus) the bonus is called $b'_{ep}$ (subsystem 1) and $b''_{ep}(p)$ (subsystem 2) and for subsystem 1 $b'_{ep} < b_{ep}$ and for subsystem 2, $b''_{ep} < b^*_{ep} - c_{eg}$.

The industry choice is the payment or not of the bonus for the quality delivered by the producer. To pay the bonus means that the industry rewards the specific investments made by producers and the risks of quasi rent capture involved. The bonus percentage, however, varies depending on the subsystem, either for producers or industry. The premium paid to the producer of the subsystem 2 must be greater than that paid in subsystem 1, that is $b^*_{ep} > b_{ep}$, and $b^*_{ei} > b_{ei}$, since the subsystem 2 implies more specific investment. For the industry in the subsystem 2, the option of not paying a bonus for quality implies a cost called $\Delta t$, since by not paying a bonus for a highly specific product, the industry incurs the risk of the producer not honoring the transaction in $t_2$. Putting in a different way, by not paying a bonus to a highly specific asset it should be accounted as a present value, i.e. $(t_1)$ the cost of hold-up. Thus, the payoff of the industry in subsystem 2 with the option of not paying a bonus should be discounted $\Delta t$. It is assumed that $\Delta t \geq b^*_{ep}$, since the hold-up prevents future transactions occurrence without a contract between the parties. The game outcomes are presented in figures 1 and 2.

**Strategic model 1: vertical coordination (subsystem 1)**

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\begin{array}{c|c|c}
& \text{No contract} & \text{P} \\
\hline
\text{No contract} & 0 & b_{ep}(p) + b_{e}(p) \\
\text{P} & -\alpha b_{ep}(p) + b_{e}(p) & b_{ep}(p) - c_{eg} b_{e}(p) \\
\end{array}
\]

**Figure 1: Payoff matrix– model 1 (mathematical notation)**

Source: author

In Q1 - without a contract and not paying - the producer’s payoff is 0 (zero) since even the producer makes specific investments and he does not receive any bonus, he still has the benefit of having young animals (precocity). For industry, the payoff is the bonus received from the consumer plus the gain of the capture bonus not paid to the producer. In Q3 - with contract and not paying - the producer’s payoff is negative, since it bears the
governance costs of contracting. Based on the payoff matrix analysis, it is clear that the dominant strategy for the industry is *not paying* bonuses, as well as *no contract* is for producers. The Nash equilibrium occurs in Quadrant 1 (Q1) when the producer does not contract and industry does not pay bonuses. Thus, in the subsystem 1, the producer chooses not to sell animals through formal contracts and the industry does not pay the premium for the animal early even if receiving a benefit from consumers.

**Strategic model 2: horizontal and vertical coordination (subsystem 2)**

The same exercise performed for subsystem 1 is now developed for subsystem 2 in which the product is a credence good, the specific investments made by the agents are higher and there is a cost to the industry for opting in not paying a bonus to producers. The outcomes of this strategic interaction of agents are shown in figure 2.

Figure 2: Payoff matrix– model 2 (mathematical notation)
Source: author

For subsystem 2, the equilibrium occurs in Q4 - under contract and paying a bonus – being the contract adoption the producer’s choice and the payment of premium prices the industry option. In this case, the dominant strategy for the industry is paying the bonus and the Nash equilibrium occurs in Q4.

From the analyzed models (model 1 and model 2), it is identified two equilibrium conditions for the studied subsystems: subsystem 1 - vertical coordination of a quality subsystem of: producer does not contract the supply of raw materials and the industry does not pay the bonuses; subsystem 2 - horizontal and vertical coordination of a quality subsystem (credence good): formal contract of supply and bonus paid by the industry.

6. Quality Programs in the Brazilian beef chain: a multiple case study

An empirical application of the above developed models will be carried out by analyzing the Quality Programs of the two subsystems - the subsystem 1 and subsystem 2 - which differ in the product – young steer and organic beef, respectively - and the adopted
governance structures - only vertical coordination in subsystem 1 and horizontal and vertical coordination in subsystem 2. The three exporting beef processors investigated operate in Brazil whole country and they represent a large market share in Brazilian beef exportation.

In subsystem 1 it is analyzed two Quality Programs coordinated by two meat packers. Specifically; they are herein called Alpha and Beta industries. The Quality Beef Programs are basically organized with the purpose of carcasses classification and grading in which a set of products attributes are evaluated. The Brazilian cattle carcasses classification grid, established by Ministerial Decree n° 612/89, emphasizes the maturity as a criterion of quality. Besides, others criteria for animal maturity are sex, conformation, fat cover and animal weight.

In the researched industries, the quality attributes considered in their programs are: i) the animal sex (male, female and castrated male), ii) the animal maturity (number of permanent incisor teeth), iii) the carcass fat cover and iv) the carcass weight. The prize to be paid to producers is defined from a combination of the attributes cited above. To achieve the maximum bonus the animals must combine favorable attributes of weight, maturity and fat cover for each category of gender (sex). The prize is paid as a percentage above the market price.

For Alpha Company, there is also an additional premium of 1% to carcasses certified as EurepGap and for those originated from organic systems. The castrated males reach a maximum prize of 4% and 7% for females. The carcasses classified out of the established patterns are subject to penalties through discounts on the market price. It is important to emphasize that in this industry all the animals are slaughtered within the specifications of the quality program. There is no need to prior register within the program and after the slaughtering process is completed the producers receive a spreadsheet which certifies the animal performance.

The Beta Company does not consider the right of prize for female’s animals. Only males (castrated steers and young castrated steers) are accepted in the Quality Program. The requirement of homogeneity in animal lots in Beta industry differentiates both companies. The prize is paid only to carcasses from lots which have at least 70% of the animals classified in theirs categories. The homogeneity level summed to other criterions - maturity, fat covering, sex and weight – allow a prize that could reach up to 6% of bonus. In opposite to Alpha industry, at Beta the animals are slaughtered considering quality attributes only when the producers apply to the Program. The Beta’s Quality Program is

8 The maturity is measured by the number of permanent incisor teeth - 2,4,6 and 8 teeth - and a subjective evaluation of the animal shape profile shows its muscle development, which may be convex, subconvex, straight, straight straight and concave. Animals considered as convex express greater muscle development and concave animals, lower development. The cattle finishing process is a subjective evaluation of fat thickness (subcutaneous or cover) and it may be absent, low (1 to 3 mm), medium (3 to 6 mm), standard (6 to 10 mm) and excessive (greater than 10 mm).

9 O EUREPGAP – European Retailer Produce Working Group - Good Agricultural Practices – is a quality certification system, involving questions of good agricultural practice, animal welfare, social and environmental responsibility.
restricted to certain regions of the country, while in Alpha the quality classification is present in all industrial units.

It is interesting to note that under these beef quality programs there are no formal contracts drawn up between producers and processing industry. The standards required by industry and the levels of prizes are informed through booklets and brochures available at the firms website. Formal contracts occur only in cases of advanced purchase for slaughtering, not necessary considering quality attributes. Contractual clauses are related to final prices and not to quality demands for animals’ carcasses. However, in Alpha industry - in which animal classification under the Quality Program is independent of prior registration - the formal contract for advanced purchase presents the carcasses standard classification as an appendix to the contract.

Considering the attributes for carcasses classification, except for fat covering and animal conformation, all other variables are easy to measure (sex, weight and maturity). The evaluation of fat covering and animal conformation is carried out from technicians’ subjective experience. Despite the possibility of using appropriate measurement tools, for instance special rulers for checking fat covering, they are only used in case of doubt about the evaluation. According to the industry, the challenge in implementing quality programs is related to the difficulty in establishing prizes that really incentive the production of quality animals. According to them some beef cuts even those from premium carcasses do not receive differentiated prices paid by consumers. Indeed, some of the beef cuts do not receive any prize from consumers, which represent a difficulty in establishing a general percentage to pay to producers as an incentive for quality. Moreover, as the quality of beef results from a range of interdependent attributes, it is hard to create an incentive structure that encompasses all the factors demanded for the production of a premium beef in accordance with the interests of the processing industry.

In subsystem 2, the production and the marketing of organic beef are conducted through a partnership between farmers and a large Brazilian meat packer which has expressive international market share. This industry invested in the development of an organic label and it exports and markets this organic brand with large national and international retailers. Herein, this industry is called Sigma. Organic animals are produced in farms which are certified by independent companies specialized in auditing processes of organic food production. The certifying company is accredited by international institutions. Similarly, the process of animals slaughtering and beef processing is subject to certification by the same auditing firm. The farmers are organized into a producer’s association which negotiates the terms of supply contract. In general, the contract establishes the relationship duration between the parties - currently set as three years - the bonus to be paid to cattle raisers (5% to 10% above the market price based on the ESALQ\textsuperscript{10} index) and criteria for carcasses classification (weight, age and fat cover). Usually, the bonuses received by organic animals are higher than those paid to young steers (subsystem 1) and the meatpacking standard of carcasses classification in subsystem 2 is less restrictive than those applied to subsystem 1, specifically regarding fat cover and

\textsuperscript{10} ESALQ (Escola Superior de Agricultura Luiz de Queiroz) is an agronomic Brazilian University whose economic research department analyses on bovine market prices is a national reference for trade.
animal maturity (number of permanent incisors teeth). So, in subsystem 1 both parties have a long-term relationship and they establish formal contracts in opposition to what was observed in subsystem 1. However, the contract is not collective and each producer has to signal its own document but the producer’s association negotiates the general contract clauses for all cattle raisers. With this horizontal coordination, the producer’s bargaining power increases.

7. Final conclusions

Quality is a demand of national and international consumers. Health, traceability and organoleptic characteristics - color, taste and texture - are related to the perception of quality. Beyond technological issues, organizational aspects are crucial in granting quality and coordination aspects assume an important role. Quality Programs coordinated by the beef industry represent an initiative to achieve more efficient organizational forms. However, when assessing the duration of these programs it becomes clear that the task is not a trivial one. Designing an appropriate structure of incentives is the challenge posed to these programs. This paper is based on the Theory of Incentives and Transaction Cost Economics and it shows that quality production is a multidimensional task involving a set of specific investments and each one represent a possibility of capturing quasi-rents. All the risks involved should also be considered as an important variable in the theoretical model.

Considering quality as a multidimensional concept and the necessity of specific investments for its production, it’s identified imperfect institutional arrangements in Quality Beef Programs. The complexity of drawing efficient structures of incentives makes difficult the maintenance of these programs. The problem is that some beef cuts even those derived from awarded carcasses are not rewarded in a linear form by the consumer market. Some cuts don’t receive any differentiated price and this compromises the establishment of a prize to be paid to producers. Moreover, the quality results of a set of interdependent attributes which confers complexity to create compensation structure that incentivizes the production in a balanced form in accordance to the processing industry interest. The producers, for their turn, question the effectiveness of these programs since the final quality of the meat also depends on a set of factors related with the industrial processing and the conditions of storage and transport. They also consider the compensation model as confuse and complex one, realizing that it is all about an exercise of market power. The legal institutions have a preponderant role to play, in special, allowing that both parts propose clear standards for carcass standardization and classification.

All these uncertainties create a risk perception, hindering the establishment of formal contracts and maintaining a distrustful relationship between production and industry. Therefore, investments in producing animals with quality attributes are not properly encouraged by the industry and those who accept to do it are in risk of value capture. Given this, the institutions have a role to play in order to help establishing an efficient incentive structure, besides guaranteeing the requirements of health for livestock and the industrial processing with also satisfactory conditions throughout the cold chain.

The role of institutions for the promotion of cooperation and, concerning this research, the role of institutions for preventing inefficient incentive transmission along the
chain is confirmed when the outcomes in subsystem 2 is analyzed. Because organic products are related to environmental and healthy aspects and not to intrinsic beef attributes like, for instance, tenderness, consumers pay awards for all beef cuts and not for just those from the rear of the animal, considered as “prime cuts”. On the other hand, the greater asset specificity involved and, therefore, the greater risk of quasi rents capture, the organic system requires more effective coordination which is reflected on the need of drawing contracts for supplying animals to the industry. Thus, it is clear the role of governance structure as an incentive mechanism for transaction efficiency. Besides that, to minimize the risks of incentive transmission failure along the chain it is important to stress the need of a broad discussion about standard classification criterion. It is also relevant to be aware of the need of achieving satisfactory quality requirements on livestock health, industrial processing, cold chain and storage conditions.

This conclusion makes sense when the agents downstream do not have a benevolent behavior. On other words, opportunism is part of the model applied on this research. Otherwise, even if consumers are aware of environmental and healthy issues and they do pay a bonus for all types of beef cuts and not only for those prime cuts, the industry could exercise its market power and do not reward the producers. The industry could argue that de animal was not classified as a quality one. According to informational asymmetry, the industry could state that after slaughtering the animal some attributes like, for instance, fat covering are not acceptable and the animal doesn’t deserve to receive a bonus for this classification criterion. Thus, the problem of failures in incentive transmission along the chain is maintained, even in the presence of high percentage of bonus paid by retailers and consumers. Considering all these aspects, quality becomes a feasible goal only at low transaction and production costs and to achieve those institutional issues must be inserted in the analytical model.

References