HOW DOES THE LACK OF GUARANTEES INFLUENCE ORGANIZATIONAL FAILURES? EVIDENCES FROM A COMPLEX FOOD CHAIN

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Abstract

The role of formal and informal institutions in organizational economics is traditionally analyzed in terms of efficient governance mechanisms that minimize transaction costs. Based on a different perspective, the present paper focuses on organizational failures and the problem of lack of guarantees in sequential transactions. In particular, the paper examines a bundle of guarantees that supports a particular transaction and its relation with inefficiencies in the economic exchange. A model relating property rights, guarantees and institutions is proposed for the understanding of organizational failures. The model is then applied to contractual failures in the Brazilian Beef Chain. The authors perform a multiple logistic regression model regarding producers' perception of the lack of guarantees. The analysis suggests the existence of a *guarantee vacuum* within transactions between cattle producers and the beef industry. The paper concludes by pointing out the consequences of the analysis for the examination of complex transactions.

Key Words - coordination failures, guarantees, complex transactions, beef chain

INTRODUCTION

In recent years, the meat industry in Brazil has undergone profound changes. Firstly, national meatpackers have initiated a process of internationalization along with initial public offers (IPO) and diversification of activities – e.g., the purchase of chicken

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and pig slaughter units besides leather processing initiatives. Secondly, the National Beef Chain has come under strong market concentration. Finally, the national livestock sector assumes a business profile, generating gains for the whole beef chain. (NEVES, SAAB, 2008). As a consequence, the Brazilian Beef Exporter Chain has achieved a growing market share.

Although its international success, the Brazilian meat industry has being characterized by an old trend of lack of trust between cattle producers and the meatpacking sector. Fraud and bankruptcy are said to be a routine for the industry. The situation has intensified in late 2008 when the global economic crisis hit the Brazilian export beef industry, encouraging strategic repositioning of the meatpacking industry and the consequent change in the pattern of business relationships between the meatpacking industry and the cattle producing sector. More importantly, a number of large meatpacking firms went bankrupted because they could not honor the payment to producers for the slaughtered animals. In February 2009, the problem became critical when one of the largest national beef exporters went bankrupted. Besides this company, at least five other major Brazilian companies experienced this same situation

As a general fact, organizational failures and the problem of lack of guarantees in the Brazilian beef industry can adversely affect the future performance of the industry, reducing the success of the international expansion. Based on Barzel (1982, 1997), this research examines a bundle of guarantees that supports a particular transaction and its relation with inefficiencies in the economic exchange. The aim of the paper is to investigate the reasons for a recurrent coordination problem in the Brazilian beef chain regarding its institutional dimension. The research is focused on (i) analyzing the role of formal and informal institutions in minimizing conflicts in the scope of complex food chains; (ii) investigating the lack of guarantees and its determinants as a relevant cause of organizational failures.

The paper is organized into five sections, besides the introduction and the closing comments. In section 1, a model relating property rights, guarantees and institutions is proposed for the understanding of organizational failures. The model is then applied to contractual failures in the Brazilian beef chain. Section 2 discusses the empirical methodology and hypotheses. Section 3 describes the transaction patterns in the Brazilian beef chain. Section 4 provides a descriptive analysis of the type of disputes that reach the Brazilian courts and section 5 presents a multiple logistic regression model regarding producers' perception of the lack of guarantees

SECTION 1: THEORETICAL APPROCAH

The understanding of the nature of the conflict in the economic exchange is developed in this research on the grounds of institutional failure in guaranteeing property rights. For this, it is considered Yoram Barzel's contributions which link the concept of guaranties to transaction costs. For the author, transaction costs are defined as the resources used to establish and maintain property rights, including the costs involved with the protection and the capture of such rights. In other words, transaction costs are the costs of ensuring property rights and the choice of institutional arrangements is directly related to the need to provide protection to the exchanged rights. Based on Williamson (1985), Barzel's contributions should be examined from the standpoint of efficiency considering either the incentives related to property rights as transaction costs to which the measurement dimension is a relevant aspect.

Institutional environment and property rights

Institutional environment is the starting point to Property Rights theory. For North (1991), institutions have the goal of establishing and protecting rights, the latter being understood as the rules of a society, setting limits to human interactions through formal (laws, property rights, regulations) and informal rules (traditions, taboos and customs). Moreover, institutions provide incentives to human relationships with the role of organizing the economic environment, reducing uncertainty and, together with other economic instruments, defining a set of possible choices and so creating a favorable environment for the process of making decision.

From property rights lenses, the analysis of economic efficiency could be done based on two basic approaches: i) one which is strictly related to economic argument and; ii) other one which also includes social and political arguments. In accordance to economic approach, Demsetz (1967) argues that the transaction value is not due to the product or to the service itself, but to the value of the set of the rights that are transacted. The delimitation and the guarantee of property rights are fundamental to promote economic efficiency, because the failures in protecting the rights generate externalities opening room for value capture in the exchange process. For the author, the property rights generate incentives to internalize externalities. Since the externalities, positive or negative, are related to economic inefficiency, the greater the delineation and the security of property

rights more efficient is the exchange. Moreover, the incentive for the definition of property rights increases as the resources become more valuable.

Under the logic of social and political aspects, Eggerstsson (1990) argues that the traditional approach based on Demsetz' contribution is a naïve one. From Demsetz's perspective (1967) the structuring of a legal property right system is strongly rooted in economic arguments and the "internalization of externalities" is a result of a comparative analysis of marginal gains and costs of the property rights allocation. According to Eggerstsson (1990), under this approach, the state has a passive role and it establishes rules under the pressure of economic agents. It is clear for the author the role of government in generating economic efficiency. In face of high transaction costs, the state maximizes the wealth when it allocates and ensures the rights of ownership directly to individuals or through the redefinition of a legal framework. By setting specific regulations, standards and norms transaction costs are reduced and as a consequence the wealth increases. In addition, there are situations when even at the presence of valued assets, joint ownership and free access are maintained, which would not be explained only considering the economic argument. Among others, the costs of exclusion, the cost of internal governance in the case of shared rights besides issues related to equity and justice must be included in the analysis model.

In sum, the institutional analysis is not trivial. Williamson (2000) proposes four stages for the investigation of institutional environment, considering that they are all interrelated and interdependent. At the first level there are informal institutions characterized by the social, cultural and religious relations. The formal institutional environment, represented by the rules and laws, including property rights and political rights, is the second level whose purpose is to shape the economic environment in order to reduce costs. The third and fourth stages involve, respectively, the governance structures (contracts and other coordination mechanisms) and the microeconomic environment in which resources are allocated through prices, quantities and incentives. Each stage is characterized by its duration which is defined as the time required for the occurrence of changes in the economic and organizations pattern.

Economic rights and legal rights

Barzel (1997) focus on the importance of protecting and guaranteeing property rights and to improve the theoretical discussion he proposes that property rights should be legal and/or economic. The distinction between legal and economic rights is based on

identifying who is in charge of guaranteeing them. The state is assigned as the responsible to ensure the rights prescribed by law, herein called legal rights and economic rights falls to the firm and other institutional arrangements. Based on Barzel (2001), economic rights are those that reflect the ability to obtain benefits of a good or a service[2]. Legal rights are those that the state recognizes as belonging to an individual or to a group of individuals[3]. Considering the exchange of goods or services, the value of economic right is the value discounted the protection and the capture costs.

The legal rights contribute to the definition of economic rights, but are not necessary and even sufficient for their existence. Barzel (2001) illustrates this proposition arguing that stolen goods may not represent legal rights to those who possess them, but they reflect economic rights. Likewise, there are situations in which legal rights reinforce the economic rights and in others that both complement the delimitation of property rights on a particular product or service. Therefore, economic rights and legal rights are not exclusive. For the author, the rights that individuals have on an asset are a function of the effort played by individuals for its protection, the attempt to capture part of it by others and the protection offered by the state. The central issue is that the definition and the guarantee of rights have a cost, so the rights are not perfectly delineated. It is thus clear that the author associates property rights guarantee and transaction costs.

Assuming that perfect guarantee of property rights is not possible, except with prohibitive costs, there are failures in the search of the delineation of rights. Thus, transaction costs are positive and some value in every transaction is always at the public domain. The reason why some asset attributes are kept in public domain is that the measurement and protection of such attributes are costly or the marginal gains resulting from their ownership are lower than the marginal costs involved. Also according to Barzel (1997), the concept of ownership is ambiguous since the assets are multidimensional and they show variability. The author illustrates this by examining the price of a gallon of gasoline. Beyond the price of the gasoline itself, other attributes such as the rate of octane fuel, product quality (regular or premium), associated services and the waiting time in queue to be served at the petrol station are part of the traded assets and are priced as well. However, each attribute has an associated right and some are protected by the state - legal

[2] "*Economic rights reflect the ability (in expected terms) to benefit from a good (or service)*" (BARZEL, 2001)

[3] *" Legal rights are the rights that the state recognizes as those of a particular individual or a set of individuals*" (BARZEL, 2001)

rights - some by their own agents - the economic - and part is in the public domain, available for capture by one of the agents involved in the transaction.

The rights allocated at the public domain are likely to be captured and the agents invest in this value appropriation. Thus, the opportunity to capture occurs when part of the rights is in the public domain and it is not guaranteed by the State and economically it is not yet efficiently protected by any agent. Considering this point, individuals invest in maximizing their rights and not their utility as claimed by neoclassical theory. The conflict emerged from the search for capturing and protecting rights results in value dissipation. From the understanding of value dissipation as a loss of efficiency, it is possible to affirm that the dispute could create a fruitful environment to the occurrence of organizational failures and to market power exercise. Barzel (1997) argues that there is no condition for the emergence of disputes in situations that rights are clearly defined or when the attributes are fully allocated in the public domain - polar situations. The problem is in intermediary levels of property rights delineation and especially when there are changes in the value of an attribute along an economic relationship or, in better terms, during contract time.

Considering Barzel's (1997) and Coase's reasoning (1960) the efficient solution does not depend on to whom the right should be allocated, but the condition of the trade off between the parties. Whereas transaction costs are positive and, consequently, the complete delineation of property rights is always imperfect, Barzel (1997) argues that contracts are always incomplete and part of the rights will always be traded in the public domain. So, it is understood that the author proposes a theoretical model that allows the understanding of organizational forms diversity as long as it helps to identify the genesis of organizational failures.

The role of formal and informal institutions in guaranteeing property rights

The informational aspect and specifically the measuring cost of attributes are crucial to the understanding of the efficiency in allocating property rights. According to Barzel (1997)[4], the difficulty in defining rights is related to the multidimensional nature of attributes and their variability, which in sum open room for value capture. The author defends that the analysis of attributes variability and the identification of the guarantees

[4] According to Barzel (1997), assets should be considered as a set of attributes, which characterizes the transaction in a multidimensional concept. So, each dimension is related to the necessity of property rights delineation and guarantee. For instance, considering a fruit as the transected asset, it has several dimensions whose rights have to be delineated and protected like the weight, shape, color, variety, taste, health condition *i.e.* a set of attributes which adds complexity to the transaction itself.

involved are relevant elements to investigate the achievement of efficient organizational structures to handle the transaction. Considering that efficiency is related to the minimization of value dissipation, the guarantees assume a leading role to address the variability and thus to ensure efficiency in the exchange process.

In the absence of variability or in situations that the attributes are measurable at low cost there is no need to provide assurance to the transaction and the market is the most efficient form of governance. Coase (1960) proposes that in the absence of transaction costs, the resources are efficiently allocated to those to who attach greater value to them, regardless to who is assigned responsibility for their use. In a world where transaction costs are zero the state's presence is innocuous because from economic reasoning the rights are allocated efficiently. However, transaction costs are always positive. The presence of transaction costs, from Barzel's perspective, is related to the presence of assets' variability. Thus, the economic problem is the allocation of variability and the guarantees offered in order to minimize the variability impact on the value creation.

According to Barzel (1997), the allocation of variability determines whether or not the rights are well defined. Furthermore, more efficient organizational forms are those that allocate the variability with the agent that most contribute to their occurrence, in other words, who is responsible for issuing the necessary guarantees in order to achieve low cost transaction. Therefore, the type of guarantees offered by the agents configures the institutional arrangements to be adopted. If the guarantee is represented by the coercive power of the State, formal contracts are the mechanism that should be adopted and the market is the most efficient governance mode; otherwise, if the guarantee is based on reputation, relational contracts emerge as hybrid institutional arrangements to handle the transaction. Finally, when the asset variability is granted by the firm's equity capital, the most efficient solution is to internalize the transaction within the firm (Barzel, 2002).

Applying the same reasoning, Barzel (1997) argues that the firm should be understood as a set of guarantees. This concept derives from the assumption that every transaction is subject to some variability and the function of an *agreement*[5] is to allocate the risk of variability in an efficient way, *i.e.* with the part that most contribute to their existence. It creates the figure of the *residual claimant*. However, to become a *residual claimant* the agent should have sufficient resources to offset the risks and losses that may occur depending on the variability of the asset. It turns out that in many situations the agent

[5] Based on Barzel (2001), the term *contract* should be applied only to the relations that occur in the market, in which legal rights are properly protected by the coercive power of the State

does not have enough wealth to provide the necessary guarantees. This could result in delivering products of inferior quality in order to reduce total costs. The identification of third parties which gives security could be another solution to the lack of residuals claimants' wealth. The last solution could be to internalize the transaction within the firm (Barzel, 2001). Thus, the firm has come as a solution to the needs of guarantees and when safeguarding the transaction with its equity, the firm has the opportunity to appropriate the transaction residuals.

In the same way that firms emerge to solve the problem of guarantees for the variability, hybrid institutional arrangements (relational contracts) also require guarantees solutions. The investment in reputation and brand building appears as an alternative to the problem of variability and the consequent need for safeguards. Both mechanisms are designed to minimize the measurement costs. The product standardization helps to reduce transaction costs, allowing the buyer to purchase the goods without getting involved in searching costs (Barzel, 1982, 2001). When standards are created, the information becomes public and available at zero cost (Barzel, 2003). Therefore, it is expected that self-regulation gives room to third parties.

In short, considering transactions which involve the exchange of legal rights, formal institutions (judiciary) provide the necessary safeguards to protect the transacted value. However, in the presence of weak institutional environment and less efficient in protecting the rights or attributes whose value is difficult to measure, there is the need for equity capital (firm) and / or reputational capital (relational contracts) to provide guarantees to transactions. Moreover, as the attributes have a multidimensional aspect, part of the transaction can be guaranteed by the State (legal rights) and part guaranteed by the firm or the institutional arrangement established by the parties (relational contracts). In other words, part of the transaction can be guaranteed by formal institutions while the other part is provided by informal institutions whose enforcement is given by third-parties and / or reputational mechanisms.

Guarantees and organizational failures

Based on Barzel's contributions presented above, it is understood that organizational failures derive from value dissipation along the transaction process. This value dissipation arises from the failure to provide guarantees to the transaction. If this is true, the study of organizational failures implies analyzing the type of guarantees offered by agents and / or by the institutional environment and their connection with the

institutional arrangement adopted to coordinate the transaction. The guarantee model which associates the dimensions of the transaction, attributes variability and institutions of governance is shown in Figure 1.

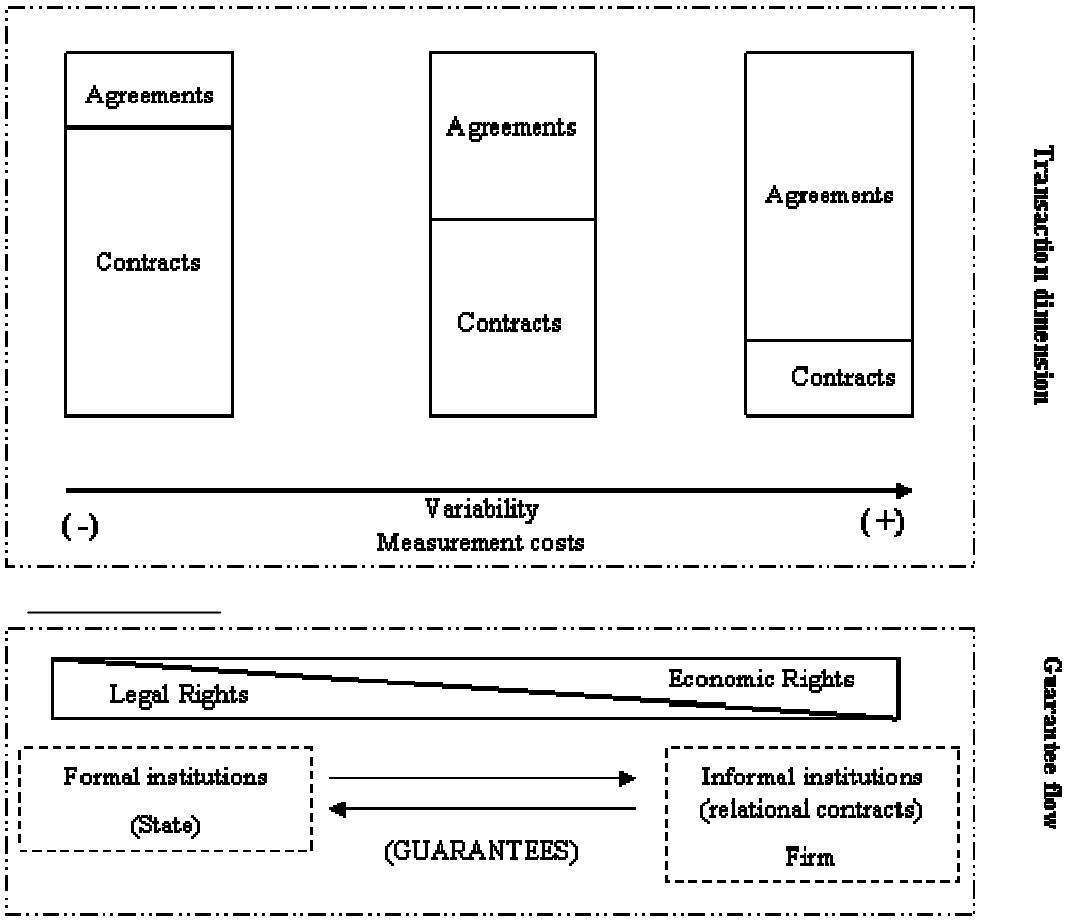

Figure 1. – The guarantee model
Source: Adapted from Zylbersztajn (2005) and Zylberstajn e Caleman (2009)

Considering the guarantees allocation, the theory advocates that who contributes to attribute variability should provide the necessary guarantees. There are situations, however, that the agent responsible for the attribute variability does not offer the necessary guarantees and the reason for that could be related to the lack of capital or the agent's opportunistic behavior. At this point there are two possibilities: i) the attributes are easily measured and the state through its coercive power may establish responsibilities with a clear definition of rights (the legal right / formal institution) and; ii) the attributes are not easily measurable and as consequence three possible solutions arise: a) reputational capital related to informal institutions which establish conduct rules and product standards (economic law / informal institutions), b) equity capital related to the need of internalizing

the transaction within the firm (economic law/hierarchy) and c) third parties capital (insurers) - third parties ensure the transaction (economic law / informal institutions).

Thus, the transaction efficiency is related to the type of institutional arrangement adopted by the agents and the guarantees offered to reduce the value dissipation. It could be claimed that to analyze transactions efficiency or its counterpart, the transactions inefficiency, the researcher should investigate the *guarantee chain* of the transaction. The *guarantee chain* model is illustrated in Figure 2

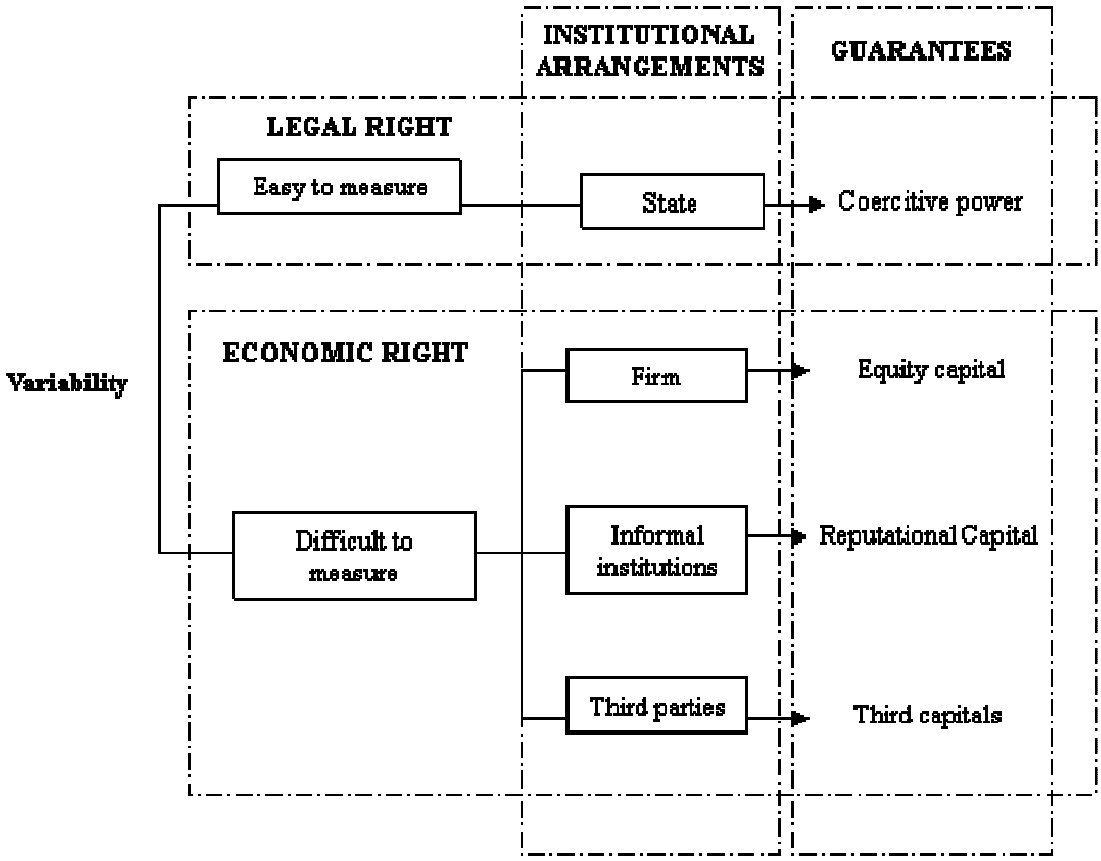

Figure 2 – The *guarantee chain*: institutional arrangements and sources of guarantees
Source: elaborated by the authors

Based on figure 2, one can infer that organizational failures stem from the inefficient allocation of guarantees in face of attributes variability. Since the transaction architecture, in other words, the institutional arrangement depends on who provides the necessary guarantees in order to assure that the transaction occurs at low cost, if the guarantees are not enough, there is room for failure occurrence. The increase in attributes value in the public domain and higher measurement costs are factors that increase the risk in capturing the transaction value, what contributes to the existence of flaws.

Assumption 1: *Organizational failures result from the inefficient allocation of guarantees in face of attributes variability*

The guarantees depend on the type of rights that are transacted - economic and / or legal rights - which are complementary and not mutually exclusive. So, in any transaction, part of the guarantees is offered by formal institutions and partly by informal institutions. In every transaction there is a *guarantee chain* which depends on the attributes, their variability and measurability. The analysis of the *guarantee chain* is fundamental to the study of organizational failures.

Assumption 2: *The lack of guarantees is a determinant factor to failure occurrence.*

SECTION 2: HYPHOTESES AND METHODOLOGY

The analysis of the *guarantee chain* is applied to the transaction between producers and the meatpacking industry in a Brazilian Beef Chain. The asset is an animal for slaughter. This is a transaction which governance is exercised by the market. The asset is a commodity and price is the reference to the exchange process.

The price reflects a set of product's attributes. The animal price[6] involves many dimensions (margins) like the weight, the age, the animal gender and the race, beyond the issues of sanity and distance from the farm to the slaughterhouse. The price also reflects the risk of the transaction. In situations of a lack of animal supply, which represents a risk of excess capacity for the industrial plant, it is common to observe an increase in the animal price. Likewise, slaughterhouses that face adverse financial situations usually acquire the animals at higher prices than those performed by the market. Thus, the price has a dimension of risk to producers. Moreover, the risk to what this research is concerned is related to the risk of selling the animals to the slaughterhouses and to not receive for this sale. Herein this risk is called the *risk of not being paid*. It is based on this dimension, in its variability and in the pattern of the guarantees allocation that this research is developed.

As pointed out before, the analysis of efficiency about the allocation of guarantees involves the need of identifying to whom lays the responsibility for the attributes

[6] In most Brazilian states the animal price for slaughtering is established by a measure of weight called "*arroba*" (@) which is equivalent to 15 kg.

variability and the choice of the institutional arrangements to handle the economic exchange. In this research, the meatpacking industries are the agents to whom the responsibility for the *risk of not being paid* should be charged. Therefore, it is up to the abattoirs to offer the necessary guarantees in order to have low transaction costs, *i.e*., to achieve greater economic efficiency. The predominant mode of governance is the market.

Research hypotheses

(i) In the Brazilian Beef Chain, organizational failures result of an inefficient guarantees allocation along the transaction between producers and the slaughterhouse - the risk of not being paid for the animal sold to slaughter;

(ii) The lack of guarantees in the transaction is a determinant factor to the occurrence of organizational failures;

(iii) Failures of formal and informal institutional in providing guarantees contribute to organizational failures in a Brazilian beef chain;

(iv) Formal institutions (judiciary) are not effective in guaranteeing the right of being paid for the animals sold to slaughter.

Methodology

The accomplishment of the research encompasses a qualitative and a quantitative approach. The qualitative approach implies semi-structured interviews with leaders of the beef sector (production and meatpacking industry). The interviews were conducted with an exploratory goal in order to identify the main issues related to the research problem and to gather evidence to compose a structured questionnaire to be applied in the next step of the research. In parallel, a survey of lawsuits judged on 1st and 2nd degree by the Court of Mato Grosso do Sul[7] in the period from November, 2002 to April, 2009 was developed with the purpose to identify the conflict pattern that comes to court regarding cattle producers and meatpacking companies.

The quantitative approach is performed through structured questionnaires applied among cattle raisers in Mato Grosso do Sul. The purpose is to investigate producers' behavior and risk perception. The risk perception of not being paid for the sale of animals to slaughter is analyzed regarding the producers profile and the guarantees' and

[7] Mato Grosso do Sul is a state located at Midwest of Brazil which shows great importance to the Brazilian beef production and exportation.

transaction's patterns. It also aims to understand the role of formal (legal) and informal institutions (producers associations) to support the lack of guarantees of the transaction.

The data analysis encompasses a multiple logistic regressions in two steps. Initially, it is developed an ordered logit regression for the analysis of factors related to risk perception. Subsequently, it is proposed a recursive bivariate probit model to investigate the direct influence of collective actions in the perception of risk. The data were analyzed with the Stata10 support. The reasoning for applying a recursive bivariate probit model derives from the importance of analyzing the direct influence of collective actions (participation in producers' associations) in the risk perception, since this phenomenon has theoretical background. Besides this, there is the necessity in testing the independence of the residuals of both regressions (risk perception and participation in producers' association).

SECTION 3: TRANSACTION PATTERNS AND GUARANTEES IN THE BRAZILIAN BEEF CHAIN

This research analyzes the transaction carried out between cattle raisers and the meatpacking industry in the spot market. This analysis does not consider the transactions under the scope of quality contracts in which specific investments are made. The description is related to the transaction pattern and its guarantee chain.

Transaction pattern

The animal for slaughter is a multidimensional asset. In addition to gender (male or female), weight and age, a set of other attributes must be considered. Quality, health and traceability concerns are also traded at the time of sale. Fresh meat, blood, offal and leather are products and byproducts of the slaughtering process.

In the majority of Brazilian states, the animal price to be paid to producers is established for each 15 kilograms of the animal – so called *arroba.* The price is related to animals' dead weight, so the amount to be paid for cattle raisers depends on the carcass[8] measurement after slaughtering the animal. The final yield varies a lot as it also depends on

[8] The carcass yield represents the percentage of carcass (meat and bone meal) obtained from the slaughter of the animal. Based on the carcass yield the amount of money to be paid to producers is defined. The producer is not paid by the offal, hides and other byproducts of slaughter. Some industries offer a premium for quality leather, but it is not a standard procedure for all meatpacking companies. The average carcass yield is 52% for male animal.

the animal breeding, feeding conditions, age and also the meatpacking employee's ability on carcass cleaning. Considering spot market, the producer remuneration is based on the final weight of the animal carcass (meat and bones) depending on the quality of the slaughtering process, the carcass classification and the reference price accorded by the parties at the begging of the agreement. Other slaughter byproducts such as offal, blood and leather do not constitute producer's revenue. In general, there is much uncertainty about the final amount because at the moment that the producer sells the animal at the farm he does not know in advance what will be the carcass yield.

Therefore, the slaughter animal presents a set of margins - age, weight, gender, health conditions, traceability, fat covering, offal, and leather, among others - and some of them are not contracted at the moment of the agreement. There are a number of margins within the transaction that as long as they are not contracted they fall into public domain, subject to capture by economic agents, in this case the meatpacking industry. There is room for several types of conflict in this transaction like carcass measurement, carcass classification (quality attributes that are not rewarded), discounts rates depending on the animal's non-compliance, byproducts that are not paid, for instance, the leather, etc.... Beyond all these problems, considering the spot market, the conflict that is usually reported is the non-payment for the animals sold to the industries, whether because business failure, bankruptcy proceedings or even uncertainty about whom to assign responsibility for the company's assets. This research, in particular, investigates the guarantees related to the event of not being paid the amount owed by the meatpacking industry.

In general, cattle for slaughter are trade through direct sales or through brokers. Considering direct sales, the producer comes in contact with the meatpacking employees to get information on prices and to negotiate the amount of animals to be slaughtered, the price and payment terms. Prices and payment terms are set by the industry based on market orientation. The industry slaughtering scale is an important variable to price variability. In general, the payment term is *at sight* or within 30 days. Actually, the spot prices are paid with a lag of 2 to 3 days of slaughtering and it incorporates a discount rate of 3% to 5%, depending on previous negotiation. After the agreement, the animal is loaded on the farm. The transport of the animals is usually performed by the meatpacking's own truck or by private contractors hired by the company. The meatpacking company is in charge of the shipping costs.

The meatpacking industry could also purchase through outsourced commissioned. In some situations these professionals not only mediate the purchase of livestock as they also accompany the shipment and the animal slaughter. There are four types of intermediation:

i) The broker is a buyer's representative with exclusive relationship with the meatpacking industry. The commission is paid by the company;

ii) The broker is an independent professional representing different meatpacking companies. The producer trusts the broker as they have a long term relationship; the broker informs market prices and slaughtering scale and he could even supervise the animal slaughtering process. The commission is paid by the producer (in this case, the intermediation occurs without guaranteeing the transaction);

iii) Intermediation with guarantee: the broker effectively ensures part of the transaction, which may be related to guaranteeing the carcass yield or be related to guaranteeing the whole transaction by means of advancing the final payment. In the case of only guaranteeing carcass yield, the broker assumes the risk of better or worse carcass performance when comparing the animal weight at farm and at the slaughterhouse's balance. The carcass performance at farm is based on a reference table of carcass classification. The broker commission depends on a positive difference between both balances. The broker receives the difference in case the carcass yield at slaughterhouse is higher than at farm. Otherwise (the carcass yield at farm is higher) the producer pay nothing to the broker and the latter must assume the loss. In the case of guaranteeing the whole transaction, the broker advances the payment to cattle raisers based on the animal weighting at farm and he sells the animal to the slaughterhouse. The broker's remuneration results from the difference achieved on buying and selling the animals. This type of intermediation is usually performed by specialized brokers companies and the producer keeps the animal property right (the invoice is made in behalf of producer). Because this modality involves assuming the total risk of the transaction it is not very usual.

iv) M*archand*: the broker is a meat dealer. He buys the animals from the cattle ranchers, slaughters them in an outsourced manufacturing plant and sells the meat to retail

The guarantee chain

The animals are loaded on a truck after the price, the payment term and the delivery date are accorded with the slaughterhouse. In some situations, the broker or the person in charge of the negotiation accompany the weighting and the shipment at the farm. The invoice and the license to animal transport are the formal documents issued before slaughtering. Even in case the price agreement is based on cash payment, the payment will only occur after the animal is slaughtered and the carcass yield is defined.

Considering term sales, the payment occurs in average 30 days after the animal slaughter and the carcass verification. To guarantee the payment, the slaughterhouse issues a Rural Promissory Note (RPN) on behalf the cattle raiser. The RPN provides a collateral security, which is usually signed and guaranteed by an employee of the company's commercial department without legal liability. The RPN being issued and in accordance with the timetable, the company makes the payment in the designated current account. In case you need to advance the amount of money, the producer may discount the RPN in the accredited bank.

There are two types of RPN discount: i) RPN guaranteed by law decree 167/1967 and ii) NPR discounted in the parallel, *i.e*. without the support of the decree law that deals with rural credit. The discount under Decree Law is on the bank's responsibility because the appeal is granted on a credit line that the slaughterhouse has with the bank. Thus, the bank assumes the operation risk. In another form of discount, the bank enables a triangle operation to discount the RPN. It is a personal credit transaction which responsibility rests with the producer and not with the RPN issuer - the meatpacking industry. This method is called *discount in parallel* and in this operation the risk is assumed by the producer.

It is observed that there are no formal guarantees for the amounts due by the industry since the animal delivery at farm until at sight payment or at the RPN receipt. Moreover, producers deliver the animal without even a guarantee of the effective weight of the animals since that the weights carried at the farm are just a reference that will be further validated in the balance of the slaughterhouse. The accurate information about the animals' yield and the amount owed by the slaughterhouse will happen only after the slaughter and the carcass evaluation. It is only at this stage of the entire process that he receives a formal document, the Rural Promissory Note, which qualifies him as a creditor

of the company. We identify, therefore, an important gap regarding the *guarantee chain* in the Brazilian Beef Chain.

SECTION 4: DISPUTES PATTERN THAT REACH THE COURTS

The survey and the analysis of lawsuits that reach the courts was conducted in trials held on 1st and 2nd instance in the Court of the State of Mato Grosso do Sul during the period from November, 2002 to April, 2009. The survey was based on information collected in the Court website.

Table 1 presents the results. It is confirmed that the main conflict in the transaction between cattle raisers and slaughterhouses is the lack of guarantees on the payment of the animals sold to slaughter. Moreover, the predominant reason for that is the bankruptcy of some meatpacking industries or in some cases the evidence of future occurrence. Another conflict is the debt payment made to third parties which has not been formally accredited as a creditor, like cattle auctions and cattle brokers. In most cases, the debt legal representation is made by Rural Promissory Note.

Table 1 – Conflict pattern and evolution – (2002 to 2009)

The conflict pattern	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**T**
Non payment of RPN - discussion about the document validity (object / format) and the guarantor liability	1		1	1		1	2		**6**
Non payment of RPN – request for the attachment of a property as collateral for payment	3	1							**4**
Non payment of RPN – payment to a 3rd person who is not accredited by the creditor / farmer		1	2	3		2	3	1	**12**
Non payment of RPN – request of blocking beef stock		1							**1**
Non payment of RPN – request for property confiscation		3				1	1	3	**8**
Non payment of RPN – company under bankruptcy				1		1	1		**3**
Producers request slaughterhouses bankruptcy		4							**4**
Non-delivery of animals according to specifications agreed between the parties					1				**1**
Discount on contracted price on the grounds of lack of animal quality		1	1						**2**
TOTAL	**4**	**11**	**4**	**5**	**1**	**5**	**7**	**4**	**41**

Source: Elaborated by the authors based on the website of the Court of Mato Grosso do Sul/Brazil

The highest number of court trials is observed in 2003 (eleven lawsuits) followed by 2008 with seven sentenced lawsuits. During the researched period, there are a total of 41 trials at the Court of Mato Grosso do Sul.

Based on this survey, it is identified that 29% of lawsuits are related to non-payment of RPN on the grounds that the payment was carried out with a 3rd person who was not entitled as creditor. Regardless the specific reason of the non-payment of RPN, it represents 83% of the conflicts that reach the Court. Therefore, the lack of guarantees seems to be the conflict pattern in the beef chain of the State of Mato Grosso do Sul. Considering that the transaction pattern in beef chain is the same in almost whole country, the conflict is of great relevance for the efficiency of the Brazilian beef sector.

The non payment is largely due to bankruptcy almost always related to a fraudulent initiative. According to a lawsuit filed by the State of Mato Grosso do Sul[9] and the District Attorney it is exemplified a complex relationship among different slaughterhouses whose legal owners are not *de facto* owners featuring a practice known as *ghost owners*. Therefore, it becomes difficult to apply penalties to the company and in case of bankruptcy the creditors are prevented from receiving the debts. There is an important relationship between the number of lawsuits in court and the occurrence of bankruptcy.

SECTION 5: PRODUCERS' BEHAVIOR AND PERCEPTION RISK: EMPIRICAL DATA

The survey among cattle raisers encompasses 107 questionnaires applied during March, 2010. This is a non-probability sample, since part of it is characterized as a self-generated sample[10] (52.34% of questionnaires) and partly as a random sample (47.66%). The random sample is composed by farmers drawn from the list of producers of the State Bureau of Animal and Plant health Protection of Mato Grosso do Sul (IAGRO/MS). This list contained the name of farmers that sold animals for slaughter during January and February, 2010. The interviews were conducted with the farmers in charge of making decisions about the animal trade. The questionnaires were conducted preferably by telephone (67.29%), and some face to face interviews (27.10%). Others were conducted via e-mail (5.61%).

This research starts from some assumptions:

[9] For more details see lawsuits 2007.006092-8/0001.00 April, 16th, 2007 and 2003.012226-5 May, 4th, 2004 in the website of the Court - www.tjms.jus.br

[10] According to Mattar (2001) a self-generated sample is one in which the sample composition starts from some indications of potential interviewees and grows successively from new directions. This is a non-probability sample which use is indicated when no one knows the exact size of the population to be sampled or under conditions where it is not possible to achieve a complete listing of the elements of this population.

i) The farmers' risk perception is related to the lack of guarantees in the animals sale for slaughter;

ii) Regarding the sale of animals for slaughter, the producers' low or medium confidence in the courts is related to the unclear delineation of property rights and to the weak enforcement offered by the Justice which in turn is related to producers' high risk perception;

iii) The development of collective action results in greater bargaining power and guarantees to the transaction, which in turn represents a lower risk perception to producers;

iv) The history of conflict between cattle raisers and the meatpacking industry results in high perceived risk of the transaction.

Considering these points, the survey was conducted based on four main hypotheses regarding the transaction risk perception:

i) ***Hypothesis 1*** (the role of formal institutions): the risk perception is minimized when the delineation of property rights is clear and guaranteed by formal institutions (legal mechanisms);

ii) ***Hypothesis 2*** (the role of informal institutions): the risk perception is minimized in the presence of collective action (informal institutions);

iii) ***Hypothesis 3*** (transaction pattern): the risk perception is minimized when the transaction is frequent, it involves longer relationships and the farm is close to the industrial plant (frequency, reputation and locational specificity);

iv) ***Hypothesis 4*** (conflict pattern): the risk perception is potentiated in the presence of past conflicts (*path dependence*)

The data: a descriptive analysis

Regarding the non payment of the animals sold to slaughter (coordination failures), the study of the phenomenon of lack of guarantees is based on: i) producers' profile, ii) conflict pattern, and iii) transaction and guarantees pattern. Tables 2 to 4 characterize the results.

Considering producers profile (Table 2), more than half of the interviewed group of ranchers have a high degree of education, more than 20 years in the cattle production

activity, strong income dependence on this economic activity and intermediary technological level (slaughtered steers between 20 and 36 months of age, the use of feed supplementation in the dry season and the use of artificial insemination for breeding animals).

Table 2 – Producers' profile

	Qt	%		Qt	%
Time in cattle production activity			**Education**		
1 a 10 years	11	10.28	Fundamental degree	17	16.19
11 a 20 years	26	24.30	High School	15	14.29
21 a 30 years	40	37.38	College (or more)	73	69.52
>30 years	30	28.04			
Tradition			**Slaughter/year**		
1rst generation	22	20.56	< 500	35	33.98
2nd generation	37	34.58	501 to 2000	46	44.68
3 rd generation	22	20.56	2001 to 5000	14	13.59
4 rd generation (or more)	26	24.30	> 5000	8	7.77
% income / cattle production			**Production Technology**		
until 50%	17	16.04	Pasture	48	45.28
51% to 99%	24	22.64	Supplementation (dry season)	35	33.96
100%	65	61.32	Feed lot	22	20.75
Slaughter age			**Artificial insemination**		
Until 20 months	1	0.94	Yes	53	50
20 to 36 months	78	73.58	No	53	50
> 36 months	27	25.47			

Source: Research survey

The lack of guarantees in the transaction is a determining factor for risk perception, as evidenced in Table 3. More than half of the interviewed producers reported problems of not being paid for the animals sold to slaughterhouses, and of these, nearly half reported that the problem occurred more than once and half farmers reported that it happened in the last five years. It is noteworthy that among those respondents who reported problems of non payment less than half turned to justice as a way to review their rights and less than 20% of them said that the judicial mechanisms were effective to solve the problem. Overall, 63% of respondents say they have low confidence in justice. Among the main reasons cited for the low confidence and in order of importance there are: i) the justice slowness; ii) the current legislation does not prioritize the payment of cattle suppliers; iii) the low effectiveness of the justice results; iv) the existence of legal but not *de facto* shareholders; and v) the attorneys' fees.

The participation in producers' associations is reported by more than 80% of the respondents and marketing alliances have the highest rate of importance[11]. At the second level of importance are the rural unions (rural unions, federations and national confederation).

Table 3 – Conflict and guarantees' pattern

	Qt	%		Qt	%
Risk perception			**Non payment historical?**		
High	29	27.10	Yes	64	59.81
Average	40	37.38	No	43	40.19
Low	38	35.51			
Number of times / non payment			**Last non payment**		
Once	35	54.69	< 5 years	31	48.44
2 times	11	17.19	5 to 10 years	14	21.88
3 times	12	18.75	> 10 years	19	29.69
> 3 times	6	9.38			
Judicial mechanisms?			**Is the judicial mechanism effective?**		
Yes	30	46.88	Yes	5	15.63
No	34	53.13	No	27	84.38
Collective action?			**Level of confidence in justice**		
Yes	90	84.11	High	12	11.21
No	17	15.89	Average	27	25.23
			Low	68	63.55

Source: Research survey

It is noteworthy that the survey coincided with a major shift in the pattern of the transaction. Until then, the payment period was traditionally 30 days after the slaughtering and animal carcass evaluation. With the bankruptcy of several companies in 2009, it started a marketing campaign to only sell at sight. In order to ensure animal supply, the slaughterhouses began to pay with 2-3 days after the slaughtering, which was considered as a *at sight* payment. This represented an improvement in the producers' risk perception[12]. Probably because of this shift in the transaction pattern more than 80% of respondents answered *at sight* as the transaction term which would not be reasonable to expect a few months before the questionnaires application. The usual term was 30 days with the possibility of discounting the Rural Promissory Notes (RPN).

As indicated in Table 4, the acquisition of cattle is held by the employees of slaughterhouses (46.73%) and through brokers (41.12%). The intermediation through brokers is based on the necessity of reducing information asymmetry (price, scale, carcass yield guarantee) and on trust relationships. In terms of transaction frequency, nearly 80%

[11] 63% of the farmers who participate in marketing alliances consider that this action is of high importance in contrast to 29% of farmers who participate in Rural Unions and 24% in Producer's associations.
[12] This is the researcher's point of view which is based on impressions collected when applying the questionnaires.

of respondents reported selling more than 4 times per year and this decision, based on the interviewed farmers, is predominantly related to the need for risk management, liquidity (financial restrictions) and trade aspects (higher prices).

Table 4 – Transaction and guarantees' pattern

	Qt	%		Qt	%
With whom to trade?			**Transaction frequency**		
Slaughterhouse owner	3	2.80	1 to 2 times/year	6	5.61
Slaughterhouse employee	50	46.73	3 to 4 times/year	16	14.95
Brokers	44	41.12	> 4 times/year	85	79.44
Producers' association	9	8.41			
Payment form			**Relationship length (producer and abattoir)**		
Anticipated	5	4.67	< 5 years	31	29.81
at sight (2 to 3 days)	89	83.18	5 to 10 years	48	46.15
On term (30 days)	13	12.15	> 10 years	25	24.04
Average distance to industrial plant					
Until 300 Km	82	78.10			
> 300 Km	23	21.90			

Source: Research survey

The data: econometric evidences

The econometric analysis previously involved a set of variables that were developed to better investigate the farmers' risk perception. As presented in Tables 2 to 4, the variables are related to farmers' profile and to the patterns of the transaction and the guarantees. All the variables and their descriptions are presented in Appendix 1.

The theoretical argument for the phenomenon of risk perception (the lack of guarantees) was the first criterion to choose variables to compose the econometric model. Subsequently, it was proceeded an analysis of the correlation matrix of those variables with risk perception. The correlation indices and the levels of significance are presented in Appendix 2.

The variables that show correlation at 1%, 5% or 10% of significance are: i) to have tradition in ranching (3rd generation); ii) the activity (cattle raising) has a high degree of share in the rural income generation; iii) to accomplish the animals fattening; iv) to adopt artificial insemination; v) to come up with an historical of not being paid for the animals sold to abattoirs; vi) to have several events of not being paid; vii) to have had problems of not being paid and to have gone to Court; viii) to participate in producers' associations / unions. Besides those, it is identified that the variables related to the transaction pattern (the distance from the farm to the slaughterhouse, the time relationship with the industry, the transaction frequency and the payment deadline) and the guarantee pattern offered by formal institutions (trust in justice) should compose the analysis model since they are

related to the research hypotheses and they have theoretical argument to explain the phenomenon.

It suggests that the higher the *tradition in ranching* and the greater *the participation of livestock in the generation of rural income*, the greater the perceived risk of the transaction as the bankruptcy of slaughterhouses is a recurrent event in the studied region, with the consequent non-payment of the animals supplied. Likewise, it is expected that the greater the *technological support* and the greater the specialization at final stages of the production process (*activities of fattening*) more positively related they are to risk perception, since technology implies greater investment in the productive process and activities of fattening need close relationship with the meatpacking industry.

Based on the argument of path dependence, *the historical of not being paid*, *the number of events occurred* and *to have had problems and to have claimed to justice* should be variables positively related to transaction risk perception. Moreover, positively related to risk perception, there are *the distance between farm and industrial plant* (the larger the distance the greater the risk as it is assumed that informational asymmetry is also greater) and the *transaction frequency* (high frequency would be related to high risk perception since this transaction pattern is clearly related to the need for risk management, besides technical and commercial reasons, as the interviewers explained). On the other hand, the *long term relationship with the abattoir* is expected to be negatively related to risk perception (trust building is inverse to risk perception) and also the option of *at sight payment*, since the risk of not being paid is minimized when compared to the usual practice of 30 days term.

Considering the guarantees offered by institutions, it is expected that the greater the *confidence in the justice* the lower the risk perception (for that, it assumes the enforcement of judicial mechanisms) the same way as average confidence in the justice is related to higher perception risk. Furthermore, considering *collective action* as way to minimize informational asymmetry and to promote greater bargaining power, belonging to a producers' association or producers' union would result in lower perceived risk of the transaction.

Table 5 shows the variables included in the econometric model, their relationship with the research hypotheses and the expected sign to explain the phenomenon of lack of guarantees (risk perception).

Table 5 – Econometric variables description and research hypotheses

Classification	General hypotheses/	Variable Description	Detailed hypothesis	Variable type	Sign
Producers' profile	Control Variables	Activity tradition (third generation =1).	To have tradition in cattle raising leads to higher perceived risk of the transaction.	Dummy	+
		Cattle raising share (%) in the rural income generation.	To have high share (%) of cattle raising activity in rural income implies a high risk perception.	Continuous	+
		Production stage: animals' fattening.	To be specialized in animal fattening results in high perception of risk.	Dummy	+
		Production technology: artificial insemination.	To use artificial insemination for animals breeding results in higher risk perception.	Dummy	+
Guarantee pattern	H1 - The role of formal institutions	High level of confidence in the Justice	H1a – to have high level of confidence in Justice results in lower perceived risk of the transaction.	Dummy	-
		Average level of confidence in the Justice.	H1b – to have average confidence in Justice implies high perceived risk of the transaction.	Dummy	+
	H2 - The role of informal institutions	To belong to producers' association/union	H2 – to belong to a producer's association (to have collective actions) is related to have high risk perception.	Dummy	+
Transaction pattern	H3 - Transaction pattern	Time relationship (years) with slaughterhouses that currently trade (the greater value in case of more than one answer)	H3a - Longest relationship with the meatpacking industry results in lower risk perception.	Continuous	-
		Distance from farm (in km) to slaughterhouses that currently trade (the greater value in case of more than one answer)	H3b – Greater distance between farms and slaughterhouses leads to higher perceived risk of the transaction.	Continuous	+
		High transaction frequency (> 4 sale/year)	H3c - High transaction frequency represents a higher risk perception.	Dummy	+
		at sight payment (3 days in average)	H3d – To sell animals with at sight payment involves a lower risk perception of the transaction.	Dummy	-
Conflict pattern	H4 - Conflict pattern	Risk perception (high/average/ low)	Dependable variable	Dummy	
		The occurrence of the event of "not being paid" the cattle sold to slaughterhouses	H4a – to have had problems of not being paid for the animal sold to the abattoir means to have high risk perception	Dummy	+
		Number of times of the events ("not being paid") occurrence	H4b - Increased number of events of not being paid results in high-risk perception.	Discrete	+
		To have problem of not being paid for the animal sold to abattoir and to have gone to Court.	H4c – to have had problems of not being paid and to have gone to Justice implies high perceived risk of the transaction.	Dummy	+

Source: Research survey

As already mentioned at the methodology item, the data analysis is accomplished in two steps: i) First step - an econometric analysis for investigating factors related to risk perception applying ordered logit regression; ii) Second step - a recursive bivariate probit model to investigate the direct influence of collective actions in the risk perception.

a) Ordered logit regression

The dependent variable is ordinal or ranked in the estimation using ordered probit or ordered logit regressions. Therefore, in ordered logit or probit the exogenous variable is not dichotomous, *i.e.*, it does not assume values of ***0*** or ***1***. In this research, the dependent

variable (y_i = risk perception) takes three values: ***0*** in case of perceived low risk, ***1*** for average risk perception and ***2*** for high-risk perception. Just as in a binary model, we assume a latent variable y_i^* to characterize a certain degree of risk perception which depends linearly on a set of explanatory variables x_i , *i.e.*, $y_i^* = x_i'\beta + e_i$ which e_i indicates a random error *i.i.d*[13]. The observed value y_i is then determined based on y_i^* and on the limit points γ_1 and γ_2 for which the rule below applies:

$$y_i = \begin{cases} 0 \text{ se } y_i^* \le \gamma_1 \\ 1 \text{ se } \gamma_1 < y_i^* \le \gamma_2 \\ 2 \text{ se } \gamma_2 < y_i^* \end{cases} \qquad (1)$$

Thus, the probability of observing each value of y_i is determined by the expressions below where $F(.)$ represents the cumulative distribution's function of e_i .

$$\begin{aligned} &\Pr(y_i = 0 / x_i, \beta, \gamma) = F(\gamma_1 - x_i'\beta) \\ &\Pr(y_i = 1 / x_i, \beta, \gamma) = F(\gamma_2 - x_i'\beta) - F(\gamma_1 - x_i'\beta) \\ &\Pr(y_i = 2 / x_i, \beta, \gamma) = 1 - F(\gamma_2 - x_i'\beta) \end{aligned} \qquad (2)$$

For the three probabilities, the marginal effects associated with changes in the regressors are determined by the relations:

$$\begin{aligned} &\frac{\partial \Pr(y_i = 0 / x)}{\partial x} = f(\gamma_1 - x_i'\beta).(-\beta) \\ &\frac{\partial \Pr(y_i = 1 / x)}{\partial x} = [f(\gamma_1 - x_i'\beta) - f(\gamma_2 - x_i'\beta)].\beta \\ &\frac{\partial \Pr(y_i = 2 / x)}{\partial x} = f(\gamma_2 - x_i'\beta).\beta, \end{aligned} \qquad (3)$$

$$f(.) = \text{probability density function}$$

[13] For further details see Greene (2003).

As mentioned before, the independent variables in the analyzed model are related to: i) the producers' profile (tradition in the cattle raising activity, livestock share in the rural income generation, the production stage of animals' fattening for slaughter and the use of artificial insemination); ii) the conflict pattern (occurrence of *not being paid* event, the amount of times there was lack of payment for the cattle sold to the abattoir, the use of judicial mechanisms in case of not being paid), iii) the guarantees and transaction pattern (the participation in producer's associations; high and medium confidence in the justice, the distance to the meatpacking industry, the length of the relationship with the meatpacking industry, the transaction frequency and the form of payment - at sight). Table 6 presents the results.

Table 6 – The transaction risk perception (Ordered logit)

Dependable variable	*Risk perception (0 = low; 1 = average; 2 = high)*
Method:	*Ordered logit*
N° observations	*103*
	(A)
(standard error in parenthesis)	
Risk perception	**Coef.**
3rd Generation	1.395
	(0.5532)**
Cattle raising share	-1.218
	(0.8688)
Animal fattening activity	1.546
	(0.8988)***
With historical of not being paid	0.639
	(0.5946)
Artificial insemination use	-0.689
	(0.4452)
Number of events of *not being paid*	0.020
	(0.1969)
Problems of *not being paid* and have gone to Court	1.101
	(0.6077)***
High confidence in Justice	-0.374
	(0.7120)
Average confidence in Justice	0.924
	(0.5101)***
To belong to producer's association	1.631
	(0.6726)**
Time relationship	0.001
	(0.0291)
Distance to slaughterhouse	0.00005
	(0.0015)
High frequency of transaction	0.154
	(0.5225)
At sight payment	-0.153
	(0.6470)

Log likelihood	-90.684758
LR chi2	43.12
Prob > chi2	0.0001
Pseudo R2	0.1921
* significance 1%; ** significance 5%; *** significance 10%;	

Source: Research survey

Based on Table 6, the regression fits the data well ($\chi 2 = 43.12$ $p < 0.0001$) and some individual parameters are statistically significant at the 0.05 and 0.10 level. The regression neither shows multicollinearity between the explanatory variables or heteroskedasticity among residues[14]

The explanatory variables with a significance level at 0.05 are: i) to be the 3rd generation of ranchers and; ii) to belong to producers' associations. The variables that are significant at 0.10 level are: i) to have animals' fattening activity; ii) to have average confidence in Justice and; iii) to have had problems of not being paid and to have gone to Court. As it was expected, all variable with significance show a positive relationship with the dependent variable (risk perception). The be a member of producers' association should be related to the necessity of facing the lack of guarantees of the transaction - collective actions reduce information asymmetry and increase the producers bargaining power – and this could explain the positive relationship of this variable with high risk perception.

Thus, beyond producers' profile (tradition and the activity of animals fattening), the formal and informal institutions (average confidence in Justice; participation in producers' association) and path dependence (past conflict) are related to high perceived risk in the transaction.

The analysis of coefficients of an ordered logit model is a bit more complicated than the interpretation of the coefficients of a binary model since the middle category, herein the average risk perception, is not easy to interpret. In traditional linear regression models, the coefficients express the marginal effect on the dependent variable and in logistic models there is a probability analysis of the effect of the dependent variable given the probability of the other variables being constant. To analyze the results, it is interesting to examine the odds ratio (OR) whose values are given in Appendix 3.

Based on the odds ratio and given the likelihood of the other variables be constant, the probability of the rancher to have high risk perception compared to the sum of

[14] Variation Inflation Factor test for multicollinearity (VIF <10) and Breusch-Pagan / Cook-Weisberg test for heteroskedasticity - Appendix 3.

probabilities of low and average risk perception, is increased in 410% or 4.10 times if he belongs to a producer 's association. Likewise, if he has average confidence in Justice, it implies an average increase of 1.51 times in the high risk perception of the transaction, compared with the sum of probabilities of medium and low risk perception.

Those variables related to the transaction pattern have no significance at 0.05 or 0.10 level. It is assumed that this is due to the low specificity of the transacted attribute (commodity) and to the low reputation of the meatpacking industry. So, the high frequency of transaction could not be related to meatpacking reputation and trust building, but to the farmer's need in managing risk, since the animal commercialization is done in various periods in order to no enlarge the potential loss. Likewise, the length of relationship with industry does not allow trust building between agents, being the historical of conflict an important factor to be considered on the path dependence behavior of ranchers.

b) The recursive bivariate probit regression

The recursive bivariate probit regression is applied to the estimation of coefficients of two regressions whose exogenous variables are dichotomous, one explanatory variable in the first equation becomes the dependent variable in the second equation and there are independent variables in common. Thus:

$$\begin{aligned} Equation1 &: Y_1 = Y_2, X_1, X_2 \\ Equation2 &: Y_2 = X_1, X_2, X_3 \end{aligned} \quad (4)$$

Based on theoretical arguments, there is interest in investigating the direct influence of collective actions in the risk perception, for which the recursive bivariate probit method shows to be appropriate. It is estimated the first equation in which the risk perception is associated to the existence of collective actions (participation in producers' associations/ unions) and it is estimated a second equation where collective actions become the dependent variable.

Therefore, simultaneously, it is investigated the explanatory variables for the phenomenon of risk perception, given that collective actions has a strong influence on risk perception. The recursive bivariate probit model is adopted because there is the necessity

of avoiding estimation errors in case that both regressions are dependent[15]. The idea is that the two decisions are interrelated.

The adoption of the bivariate model, by assuming the possibility of non-independence of the residues, allows a more efficient estimation of parameters. In dealing with a situation where in the second equation the exogenous variable is the endogenous variable of the first, there is a need for a recursive bivariate model. According to Maddala, 1983 and Greene, 2003, the recursive bivariate probit regression is formulated so that

$$\begin{aligned} y_1^* &= x_1\beta_1 + y_2\gamma + \varepsilon_1, \ldots . y_1 = 1 \ldots . . se . . y_1^* > 0, 0 otherwise \\ y_2^* &= x_2\beta_2 + \varepsilon_2, \ldots \ldots \ldots . . y_2 = 1 \ldots . se . . y_2^* > 0, 0 otherwise \end{aligned} \qquad (5)$$

y_1 is a binary dependent variable that matters to the first equation; y_2 is a binary dependent variable in the second equation which is included in the first equation as an endogenous variable and x_1 and x_2 are regressors of both equations. A typical bivariate probit model does not include the $y_2\gamma$ in the first equation. It is assumed that the stochastic disturbances of the two equations are independent with standard normal distribution and whose joint density function with correlation coefficient ρ is presented below.

$$\phi(\varepsilon_1, \varepsilon_2, \rho) = \frac{1}{2\pi\sqrt{1-\rho^2}} \exp\left[\frac{-1}{2(1-\rho^2)}(\varepsilon_1^{\,2} + \varepsilon_2^{\,2} - 2\rho\varepsilon_1\varepsilon_2)\right] \qquad (6)$$

The results of the bivariate probit regressions are presented in Table 7. The explanatory variables entered in the first equation of the bivariate probit regression are those that are part of the ordered logit regression[16].

[15] In general, an independent approach to two regression models assumes that the residuals are independent and both exhibit normal distribution N (0, 1). However, if the residues of the two equations are related, both have one common share (ηi) and one part that is unique to each equation (ε_{1i}, ε_{2i}). Thus: $\mu_{1i} = \eta_i + \varepsilon_{1i}$ and $\mu_{2i} = \eta_i + \varepsilon_{2i}$. It is assumed that the three types of errors are normally distributed. If this is true, μ_i s are normal but they are also dependent. That is, each μ_i now depends in part on the value η_i and this, in turn means that μ_{1i} and μ_{2i} are related to each other.

[16] Some variables which compose the ordered logit regression and that showed no significance were excluded in the bivariate probit regression in order to have a better refined model.

Table 7 – Transaction risk perception *versus* collective actions (Recursive bivariate probit model)

Dependent variable	***Risk perception (0 = low; 1 = high)***
Method:	*Recursive bivariate probit*
N^{o} observations	**100**
Log likelihood	*-81.47433*
Wald chi2	*84.17*
Prob > chi2	*0.0000*
(standard error in parenthesis)	
Percepção Risco	**Coef.**
3rd Generation	0.790
	(0.3547)**
Animal fattening activity	8.138
	(1.45e+07)
Problems of *not being paid* and have gone to Court	0.493
	(0.3231)
Average confidence in the Justice	0.878
	(0.3491)**
To belong to producer's association	2.345
	(0.3376)*
Time relationship	-0.001
	(0.019)
Distance to slaughterhouse	0.0003
	(0.010)
At sight payment	0.669
	(0.4199)
Cons	-2.356
	(0.6301)
Dependent variable	***Participation on producers' association (0 = No; 1 = Yes)***
Participation on producers' association	**Coef.**
3rd Generation	0.608
	(0.4403)
Animals slaughtered per year	0.0003
	(0.0002)***
Animal fattening activity	0.158
	(0.7139)
With historical of *not being paid*	0.686
	(0.3483)**
Problems of not being paid and have gone to Court	0.4939
	(0.5354)
High confidence in the Justice	-1.614
	(0.4898)*
Average confidence in the Justice	-0.6731
	(0.3943)***
Cons	0.5431
	(0.3475)
/athrho	-13.41342
Rho	-1
chi2(1)	2.84113
Prob > chi2	0.0919
* significance 1%; ** Significance 5%; *** Significance 10%; Likelihood-ratio test of rho=0	

Source: Research survey

The analysis of Table 7 shows that the data fits well ($\chi 2 = 84.17$, $p < 0.0000$) and the dependent variables (risk perception and participation in producers' associations) are perfectly related, but in an inverse way (rho[17] = -1). The LR test for rho = 0 ($\chi 2 = 2.84113$, $p < 0.0919$) suggests that the residuals are correlated with 0.10 level of significance. The residues correlation confirms the necessity of a bivariate recursive method for estimating the parameters.

Considering the risk perception, the variables that is significant at 0.01 level is to belong to a producers' association and at 0.10 level of significance there are the tradition in cattle raising (3rd generation) and average confidence in the Justice. Considering the participation in producers' association, at a level of significance of 1%, there is high confidence in the Justice. The number of slaughtered animals delivered by farmers and to have average confidence in the Justice have 10% level of significance to explain the participation in producers' association. Likewise, to have high confidence in the Justice shows 1% level of significance.

In the recursive bivariate probit model, conditional marginal effects make more sense than typical marginal effects. The effects are presented in table 8. The predicted probability that producers have high risk perception is 75.12% at the reference points, given that they belong to producer's associations (or are involved with collective actions).

Table 8 – Marginal effects after bivariate probit

Y = Pr(risk perception=1, to belong to producers' association=1) =0.7512		
Variable	**dy/dx**	**X**
3rd generation*	0.2287	0.22
Animal fattening activity *	0.3948	0.07
Problems of *not being paid* and have gone to Court *	0.1724	0.3
Average confidence in the Justice *	0.0913	0.26
To belong to producer's association*	0.7582	0.85
Time relationship	-0.0029	9.34
Distance to slaughterhouse	0.00009	227.48
At sight payment *	0.0184	0.85
Animals slaughtered per year	0.00004	1723.88
With historical of *not being paid**	0.0922	0.6
High confidence in the Justice *	-0.4050	0.12
* dy/dx is for discrete change of dummy variable from 0 to 1		

Based on Table 8, shifting the situation of having a historical of not being paid for the animals that were sold to the abattoir to a situation of not having historical of not being

[17] **rho** is a correlation parameter of the two regressions of the recursive bivariate probit model and it measures the degree of residues correlation between both equations, assuming zero for no correlation and 1 for a perfect correlation.

paid increases at 0.10 percentage points the joint probability of having high risk perception and to belong to producers' associations. Likewise, the increase of one head of animals sold for slaughter increases at 0.00004 percentage points the joint probability of high risk perception and collective actions. Furthermore, the fact of having average confidence in the Justice increases at 0.09 percentage points the joint probability of high risk perception and collective actions and to have high confidence in the Justice reduces at 0.40 percentage points the same joint probability.

It should also be noted that the perfectly negative correlation between the dependent variables (risk perception and the participation in producers' associations) might be interpreted as an option that the producer has to belong to a producers' association or to have high risk perception. Thus, collective action would be as a counterpoint to the high perceived risk or the lack of guarantees of the transaction. This interpretation supports the second general hypothesis of the research that the perceived risk of the transaction is minimized in the presence of collective action of agents (informal institutions).

It is concluded that hypothesis 3 (transaction pattern) was the unique hypothesis that was not validated by this research. The variables (transaction frequency, distance of meatpacking industries, relationship time and form of payment) were not statistically significant. The hypothesis 1 - the role of formal institutions - was validated since to have average confidence in the Justice was statistically significant to high-risk perception (hypothesis H1b). Likewise, to belong to producers' association, in other words, to develop collective actions through informal institutions, is significantly associated with high risk perception (hypothesis H2). To have historical of problems of not being paid for the animals sold to slaughter and to have appealed to justice is also significant for a greater likelihood of having high risk perception (hypothesis H4c).

FINAL CONCLUSIONS

The subject *organizational failure* is not deeply studied by Economics of Organizations and its analysis is carried out from theories that address the problem of the emergence of cooperation and not the failure itself. The observation of the real world, however, leads to the conclusion that the failures are the rule and not the exception. Assuming the difficulty of studying organizations and institutional arrangements that are not sustained over time, the research focus is always on successful cases, the survivors. In the same way, the investigation of coordination mechanisms that are related to more

efficient solutions is the mainstream in economics of organizations. This paper takes a step forward as it proposes to investigate the economic problem of coordination from a different perspective – the coordination inefficiencies.

This research is based on the institutional aspects of organizational failures. The analysis is focused on a Brazilian beef chain. As a general rule, beef is a commodity and the spot market is the predominant governance mode. The inefficiency of formal and informal institutions in providing the necessary guarantees for an efficient economic exchange is identified as an important reason for coordination failures within this agrichain.

The paper suggests the existence of a *guarantee vacuum* in the transactions between cattle producers and the meatpacking industry. The research investigates the transactions patterns of supply of cattle to slaughter and explores the idea of a *guarantee chain*. A survey with 107 cattle raisers is conducted in order to identify the main factors that are associated with producers' risk perception which in turn is assumed to be related to the lack of guarantees in the transaction.

The survey points out the risk of cattle producers not being paid for the slaughtered animal. A large number of meatpacking industries do not honor their debt because they went bankrupted or because they faced financial difficulties. The analysis validates the hypothesis of the role of formal and informal institutions in preventing organizational failures. To have average confidence in Justice is significantly related to producer's high risk perception. In the same way, to have collective actions (to participate in producers' association) is also related to high risk perception. It appears that the perception of risk could be considered as a reason to develop collective action. In other words, informal institutions play a relevant role to face the lack of guarantees in the transaction. In the same way, the risk perception is potentiated because formal institutions (Justice) don't promote a better delineation of property rights and the legal rules are not enforced properly.

Moreover, the historical of having conflicts with the meatpacking industry and to have gone to Court is also significantly related to high risk perception validating the hypothesis of path dependence. Based on the results, the transaction pattern (location specificity, frequency, time relationship and payment term) are not significantly related to risk perception. Perhaps this is due to the commodity aspect of the asset and to the historical of conflicts that is recurrent in this transaction – high frequency is related to risk management and longer relationship is not associated with trust building as usual.

As a final comment it is important to stress that this research should be understood as a first attempt to investigate organizational failures in a complex food chain. In contrast to part of the institutional literature, the present research is based on an *inefficient perspective* instead of an efficient perspective. It proposes that the institutional analysis should consider the structure of transaction guarantees when accessing organizational failures. Moreover, this research contributes in shedding lights to the economic problem of organizational failures and in proposing a model to its understanding. Specifically, it investigates a complex food chain but the proposed *guarantee model* could also be applied to other complex organizations. The central idea is concerned with the attributes dimension, the existence of variability, the rights pattern (legal/economics) and the related guarantees offered in behalf of value creating. The association of this model to failures (value dissipation) could be considered as a step forward in the study of organizational failures.

As a future research agenda it is suggested an in depth investigation of the role of formal and informal institutions in organizational failures by inserting new questions in the survey and creating new proxies other than risk perception in order to exam the lack of guarantees in a broader perspective. Beyond this point, it should also be interesting to investigate the individuals' cognitive restriction regarding economic inefficiencies and failures. This variable was not examined in this research.

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APPENDIXES

Appendix 1 – Variables description

Variable	Description	Variable type
N_PROPR	Number of rural properties	discrete
TEMPATIV	Time in the rural activity (year)	continuous
TRAD_QUA	Tradition (forth generation =1)	dummy
TRAD_TER	Tradition (third generation =1)	dummy
TRAD_SEG	Tradition (second generation =1)	dummy
SEG_GRAU	Education (high school =1)	dummy
TER_GRAU	Education (Graduate =1)	dummy
ABAT	Number of animals slaughtered per year	discrete
PART_PEC	Cattle raising share (%) in the rural income	continuous
ATIV_CC	Full cycle production system	Dummy
ATIV_RE	Breeding and fattening production system	Dummy
ATIV_ENG	Animal fattening production system	Dummy
TEC_CONF	Technology of production (most f the herd is finished in feedlots)	Dummy
TEC_SUPL	Technology of production (most f the herd is finished with supplementation in dry seasons)	Dummy
IDAD_SP	Age of animal slaughter (< 20 months)	Dummy
IDAD_PR	Age of animal slaughter (20 to 36 months)	Dummy
INSEM_S	Technology of production: artificial insemination (yes/no)	dummy
PERCRISC	Transaction risk perception (high/average/low)	Dummy
PROBL	The occurrence of non receipt of the cattle sold to slaughterhouses	Dummy
PROB_VEZ	Number of times of occurrence of not being paid for the animals	discrete
PROB_TEM	Time of occurrence of the last issue of *not being paid*	continuous
PROB_JUD	The use of judicial mechanisms in case of non-receipt	Dummy
PROBJ_OK	Solving the problem in case of use of legal mechanisms	Dummy
CONFJUSA	High confidence in the Justice	Dummy
CONFJUSM	Average confidence in the Justice	Dummy
PART_ASSOC	To belong to producers' association	Dummy
ASSOC_A	Collective actions considered as the great importance	Dummy
ASSOC_M	Collective actions considered as the average importance	Dummy
FRIGTEMP	Time of relationship (years) with slaughterhouses with which producer currently trade (the higher value in case of more than one answer)	continuous
FRIGDIST	Distance from the farm (Km) to the slaughterhouse with which the producer currently trade (the higher value in case of more than one answer)	continuous
FREQ_A	High transaction frequency (> 4 sales/year)	Dummy
FREQ_M	Average transaction frequency (3 a 4 sales/year)	Dummy
NEG_AP	Negotiation of the animals through an association of farmers	Dummy
NEG_EI	Negotiation of the animals through brokers offices	Dummy
NEG_I	Negotiation of the animals through brokers (individuals)	Dummy
NEG_C	Negotiation of the animals through slaughterhouses employees	Dummy
PRAZO	At sight payment (3 days delay)	Dummy
NPR	The discount of Rural Promissory Notes in order to anticipate the payment	Dummy

Source: The research survey

Appendix 2: Correlation matrix

	percrisc	n_propr	tempativ	trad_qua	trad_ter	trad_seg	seg_grau
percrisc	1.0000						
n_propr	-0.1400	1.0000					
	0.1505						
tempativ	0.1015	0.1508	1.0000				
	0.2984	0.1211					
trad_qua	-0.0779	0.0432	-0.0252	1.0000			
	0.4251	0.6589	0.7965				
trad_ter	0.2601	-0.1157	0.0754	-0.2882	1.0000		
	0.0068	0.2353	0.4400	0.0026			
trad_seg	0.0028	-0.0170	-0.0018	-0.4119	-0.3699	1.0000	
	0.9772	0.8624	0.9850	0.0000	0.0001		
seg_grau	0.0432	-0.0358	0.2331	-0.1660	-0.0056	0.1026	1.0000
	0.6589	0.7145	0.0157	0.0875	0.9543	0.2929	
ter_grau	0.0036	0.0367	-0.2281	0.2931	-0.0005	-0.0525	-0.5917
	0.9708	0.7076	0.0181	0.0022	0.9962	0.5915	0.0000
abat	0.0391	0.4580	0.2655	-0.0472	0.0557	0.0353	0.2535

	0.6946	0.0000	0.0067	0.6359	0.5760	0.7237	0.0098
part_pec	-0.2243	-0.1021	0.1199	-0.1551	0.0594	0.0199	0.0068
	0.0208	0.2979	0.2209	0.1125	0.5451	0.8395	0.9449
ativ_cc	-0.1013	0.1361	0.0341	0.0345	-0.1761	0.0602	-0.1683
	0.2994	0.1621	0.7271	0.7244	0.0696	0.5376	0.0832
ativ_re	-0.0369	0.0624	0.1216	0.0492	0.0979	-0.0624	0.0038
	0.7060	0.5231	0.2121	0.6146	0.3155	0.5230	0.9690
ativ_eng	0.2204	-0.1389	-0.1788	-0.0618	0.0524	0.1255	0.0020
	0.0225	0.1537	0.0654	0.5273	0.5916	0.1977	0.9834
tec_conf	-0.0044	0.2005	0.1156	0.1431	-0.0299	0.0677	0.0610
	0.9642	0.0384	0.2358	0.1414	0.7595	0.4884	0.5325
tec_supl	-0.0496	-0.0820	-0.0447	-0.0345	0.1761	0.0229	-0.1166
	0.6121	0.4009	0.6476	0.7244	0.0696	0.8146	0.2317
idad_sp	0.0104	-0.0794	0.2039	-0.0550	0.1909	-0.0706	-0.0392
	0.9155	0.4160	0.0352	0.5735	0.0489	0.4698	0.6884
idad_pr	0.0150	0.0387	-0.0309	-0.0958	-0.0019	0.0897	0.1251
	0.8782	0.6923	0.7521	0.3265	0.9841	0.3584	0.1992
probl	0.3242	0.0709	0.1460	0.2422	-0.0547	-0.0453	-0.1083
	0.0007	0.4681	0.1336	0.0120	0.5760	0.6430	0.2670
insem_s	-0.1792	0.0460	0.1657	0.0489	-0.0415	-0.0129	0.0307
	0.0648	0.6381	0.0881	0.6171	0.6713	0.8954	0.7536
prob_vez	0.2406	0.1181	0.2292	0.2197	-0.1039	0.0066	0.0723
	0.0126	0.2258	0.0176	0.0230	0.2868	0.9465	0.4595
prob_tem	0.1491	-0.0168	0.0864	-0.0172	0.0369	0.0907	-0.1883
	0.1255	0.8637	0.3764	0.8604	0.7061	0.3529	0.0521
prob_jud	0.3047	0.1723	0.4006	0.1800	0.1973	-0.1913	-0.0723
	0.0014	0.0759	0.0000	0.0636	0.0417	0.0484	0.4596
probj_ok	0.0237	0.1519	0.1515	0.0811	-0.0031	0.0252	-0.0894
	0.8088	0.1182	0.1194	0.4066	0.9749	0.7964	0.3598
confjusa	-0.1126	0.0536	0.1569	0.0749	-0.0342	-0.0093	0.0271
	0.2483	0.5838	0.1064	0.4434	0.7262	0.9242	0.7817
confjusm	0.1441	-0.2104	-0.1607	-0.1285	-0.0826	0.2110	-0.0487
	0.1385	0.0296	0.0982	0.1873	0.3977	0.0292	0.6187
part_assoc	0.2785	0.1457	0.1798	0.0078	0.0946	-0.0065	0.1019
	0.0037	0.1342	0.0638	0.9365	0.3325	0.9468	0.2965
assoc_a	-0.0150	0.1194	0.0281	0.0958	0.2100	-0.1339	-0.1251
	0.8782	0.2204	0.7740	0.3265	0.0299	0.1693	0.1992
assoc_m	0.0090	0.0378	0.0678	0.0223	-0.0056	0.1026	-0.0855
	0.9271	0.6988	0.4878	0.8197	0.9543	0.2929	0.3812
frigtemp	-0.0059	0.1152	0.2910	0.0931	-0.0420	-0.0189	0.2749
	0.9528	0.2444	0.0027	0.3471	0.6724	0.8487	0.0047
frigdist	0.1288	0.1155	0.0161	0.0237	0.0194	-0.0350	0.0404
	0.1902	0.2406	0.8707	0.8101	0.8443	0.7231	0.6822
freq_a	-0.0544	0.2422	0.0388	0.2882	-0.0845	-0.1649	-0.1942
	0.5780	0.0120	0.6916	0.0026	0.3869	0.0895	0.0450
freq_m	0.0781	-0.1638	-0.0767	-0.2376	0.0461	0.1359	-0.0183
	0.4237	0.0919	0.4325	0.0137	0.6376	0.1626	0.8513
neg_ap	-0.0960	0.0054	-0.0718	-0.0932	0.0958	0.0629	-0.1224
	0.3254	0.9561	0.4621	0.3398	0.3264	0.5201	0.2093
neg_ei	-0.1057	0.0881	-0.0612	0.0789	-0.1154	-0.0807	-0.1876
	0.2784	0.3667	0.5313	0.4194	0.2367	0.4084	0.0530

neg_i	0.0871	-0.0137	-0.0926	0.1506	0.1016	-0.1228	-0.0957
	0.3724	0.8887	0.3430	0.1214	0.2976	0.2076	0.3267
neg_c	0.0763	-0.0104	0.1706	-0.1376	-0.1057	0.1855	0.3232
	0.4346	0.9152	0.0790	0.1577	0.2786	0.0557	0.0007
prazo	-0.0798	0.0774	0.0482	0.0218	-0.0803	0.1168	0.0377
	0.4137	0.4279	0.6217	0.8238	0.4109	0.2307	0.7001
npr	0.0802	0.0741	0.0928	0.3211	-0.0783	-0.0779	-0.1233
	0.4117	0.4482	0.3419	0.0007	0.4229	0.4252	0.2057

	ter_grau	abat	part_pec	ativ_cc	ativ_re	ativ_eng	tec_conf
ter_grau	1.0000						
abat	-0.2010	1.0000					
	0.0417						
part_pec	-0.0740	-0.0412	1.0000				
	0.4509	0.6794					
ativ_cc	0.0663	-0.0810	-0.0104	1.0000			
	0.4974	0.4158	0.9157				
ativ_re	0.0845	0.1135	-0.0258	-0.6940	1.0000		
	0.3866	0.2536	0.7932	0.0000			
ativ_eng	-0.0630	0.0797	-0.1100	-0.3716	-0.1307	1.0000	
	0.5193	0.4234	0.2616	0.0001	0.1795		
tec_conf	0.0989	0.3916	0.0176	0.0686	0.0397	-0.0411	1.0000
	0.3110	0.0000	0.8582	0.4826	0.6846	0.6744	
tec_supl	0.1886	-0.1296	-0.0725	-0.2046	0.1959	0.2116	-0.3623
	0.0517	0.1918	0.4604	0.0345	0.0431	0.0287	0.0001
idad_sp	0.0663	-0.0416	0.0628	-0.1364	0.1966	-0.0257	0.1909
	0.4975	0.6767	0.5226	0.1612	0.0424	0.7927	0.0489
idad_pr	-0.1000	0.0912	0.0724	0.0553	0.0366	-0.0087	0.2062
	0.3053	0.3594	0.4606	0.5715	0.7081	0.9288	0.0331
probl	0.1775	0.1244	-0.1856	0.1022	0.0211	-0.0144	0.1340
	0.0673	0.2106	0.0568	0.2950	0.8293	0.8829	0.1688
insem_s	0.0338	0.0341	0.0585	0.5076	-0.4425	-0.2621	0.1898
	0.7299	0.7326	0.5515	0.0000	0.0000	0.0064	0.0503
prob_vez	-0.0131	0.1550	-0.0987	0.0902	-0.0192	0.0527	0.1439
	0.8932	0.1180	0.3142	0.3555	0.8446	0.5895	0.1392
prob_tem	0.2532	-0.0657	-0.0475	0.0599	-0.0260	0.0436	0.1112
	0.0085	0.5100	0.6288	0.5397	0.7903	0.6558	0.2544
prob_jud	0.1132	0.2484	-0.0314	0.0482	0.1106	-0.0810	0.1973
	0.2458	0.0114	0.7495	0.6224	0.2565	0.4069	0.0417
probj_ok	0.1511	0.1438	0.0097	-0.0298	0.1136	-0.0586	0.2161
	0.1203	0.1473	0.9217	0.7608	0.2441	0.5490	0.0254
confjusa	-0.0119	0.0212	0.1703	0.0023	0.1227	-0.0940	0.1856
	0.9033	0.8315	0.0809	0.9809	0.2082	0.3354	0.0556
confjusm	0.1192	-0.1843	-0.1305	0.0038	-0.0162	0.1073	-0.1358
	0.2214	0.0623	0.1823	0.9688	0.8684	0.2711	0.1630
part_assoc	0.0878	0.1776	-0.0341	0.0693	-0.0427	0.0116	0.1579
	0.3688	0.0726	0.7285	0.4783	0.6622	0.9056	0.1044
assoc_a	0.2355	0.1473	-0.0242	-0.0998	0.1751	0.0938	0.3141
	0.0146	0.1377	0.8058	0.3064	0.0712	0.3367	0.0010
assoc_m	-0.0135	-0.0174	-0.1502	0.0027	0.0716	0.0020	-0.1388
	0.8902	0.8615	0.1244	0.9783	0.4638	0.9834	0.1539

frigtemp	-0.0298	0.3049	0.0486	0.0904	0.0133	-0.2174	0.3184
	0.7639	0.0020	0.6259	0.3613	0.8938	0.0266	0.0010
frigdist	0.1729	0.1681	-0.1307	-0.0854	0.0966	0.0099	0.0073
	0.0777	0.0929	0.1859	0.3865	0.3271	0.9204	0.9414
freq_a	0.1495	0.1757	-0.1446	0.1272	0.0767	-0.0524	0.1444
	0.1244	0.0758	0.1390	0.1918	0.4322	0.5916	0.1379
freq_m	0.0047	-0.1336	0.1421	0.0213	-0.0752	-0.0050	-0.1485
	0.9614	0.1784	0.1461	0.8280	0.4412	0.9596	0.1269
neg_ap	0.2068	-0.0132	0.0741	0.0733	0.0198	-0.0802	0.2624
	0.0326	0.8944	0.4501	0.4533	0.8395	0.4117	0.0063
neg_ei	-0.0506	-0.0861	-0.1110	0.1756	-0.1065	-0.1229	-0.1759
	0.6050	0.3872	0.2572	0.0704	0.2751	0.2071	0.0700
neg_i	0.0448	-0.0759	-0.1803	-0.0275	0.0052	0.1219	-0.1716
	0.6470	0.4460	0.0643	0.7784	0.9576	0.2111	0.0772
neg_c	-0.1252	0.1701	0.1544	-0.0467	0.0088	0.0552	0.1261
	0.1988	0.0859	0.1141	0.6330	0.9282	0.5721	0.1958
prazo	0.0150	-0.0033	0.1661	0.0499	-0.0923	0.1190	0.0433
	0.8778	0.9739	0.0887	0.6097	0.3444	0.2222	0.6576
npr	0.2218	0.0249	0.0313	-0.0595	-0.0097	0.1209	0.1531
	0.0217	0.8026	0.7504	0.5423	0.9212	0.2150	0.1155

	tec_supl	idad_sp	idad_pr	probl	insem_s	prob_vez	prob_tem
tec_supl	1.0000						
idad_sp	-0.0692	1.0000					
	0.4790						
idad_pr	-0.0553	-0.1593	1.0000				
	0.5715	0.1012					
probl	0.0189	0.0796	-0.0709	1.0000			
	0.8472	0.4150	0.4678				
insem_s	-0.1516	0.0980	-0.0688	-0.1030	1.0000		
	0.1191	0.3151	0.4815	0.2912			
prob_vez	-0.0195	0.0590	-0.0550	0.6732	0.0010	1.0000	
	0.8416	0.5459	0.5734	0.0000	0.9919		
prob_tem	0.1139	-0.0333	-0.1253	0.5578	-0.0233	0.2225	1.0000
	0.2426	0.7338	0.1984	0.0000	0.8120	0.0213	
prob_jud	-0.0482	0.1556	-0.0875	0.5116	0.0891	0.5428	0.2998
	0.6224	0.1095	0.3702	0.0000	0.3616	0.0000	0.0017
probj_ok	0.0298	-0.0215	-0.0642	0.1815	-0.0422	0.1029	0.1562
	0.7608	0.8260	0.5109	0.0614	0.6659	0.2916	0.1081
confjusa	-0.0650	0.2733	0.0168	0.0497	0.0626	0.0255	0.0235
	0.5058	0.0044	0.8635	0.6113	0.5221	0.7942	0.8102
confjusm	0.0417	-0.0564	-0.1298	0.0812	0.0269	-0.0159	0.0366
	0.6697	0.5637	0.1825	0.4057	0.7829	0.8705	0.7084
part_assoc	0.1472	0.0422	0.0226	0.2174	0.1238	0.2108	0.1132
	0.1304	0.6659	0.8175	0.0245	0.2040	0.0293	0.2458
assoc_a	0.0553	0.1593	0.0880	0.0281	0.0267	0.0250	0.0009
	0.5715	0.1012	0.3675	0.7742	0.7847	0.7983	0.9926
assoc_m	0.2252	-0.0392	-0.2988	0.0564	-0.0231	0.0146	0.0278
	0.0197	0.6884	0.0018	0.5636	0.8129	0.8817	0.7760
frigtemp	-0.1276	-0.0156	0.0946	0.1276	0.0877	0.0436	0.0633

	0.1969	0.8751	0.3394	0.1967	0.3763	0.6602	0.5231
frigdist	-0.0599	0.0524	0.0302	0.1621	-0.0405	0.1429	-0.0369
	0.5439	0.5957	0.7599	0.0985	0.6818	0.1459	0.7084
freq_a	0.1176	-0.1909	0.1060	0.1018	0.0877	0.1700	0.0003
	0.2279	0.0489	0.2772	0.2966	0.3688	0.0800	0.9979
freq_m	-0.0767	-0.0407	-0.0981	-0.0305	-0.1009	-0.1197	0.0890
	0.4322	0.6770	0.3149	0.7554	0.3010	0.2194	0.3620
neg_ap	-0.0733	-0.0294	0.1090	-0.1637	0.1039	-0.1286	0.0158
	0.4533	0.7634	0.2636	0.0921	0.2871	0.1868	0.8720
neg_ei	0.0314	-0.0451	-0.2669	-0.0182	0.0777	-0.0846	-0.0816
	0.7478	0.6444	0.0055	0.8525	0.4262	0.3863	0.4034
neg_i	0.1678	-0.0536	0.0882	0.0472	-0.1936	0.0357	-0.0211
	0.0841	0.5833	0.3661	0.6296	0.0457	0.7151	0.8295
neg_c	-0.1119	-0.0910	0.1075	0.0418	0.0462	0.1141	0.0751
	0.2512	0.3514	0.2703	0.6692	0.6364	0.2420	0.4420
prazo	0.0030	-0.2160	0.0068	-0.0119	0.0458	0.0123	0.0104
	0.9758	0.0255	0.9443	0.9031	0.6397	0.8996	0.9153
npr	0.0991	0.0999	-0.1223	0.1868	0.1961	0.2301	0.1538
	0.3097	0.3060	0.2096	0.0541	0.0430	0.0171	0.1137

	prob_jud	probj_ok	confjusa	confjusm	part_a~c	assoc_a	assoc_m
prob_jud	1.0000						
probj_ok	0.2561	1.0000					
	0.0077						
confjusa	0.1738	0.2020	1.0000				
	0.0734	0.0370					
confjusm	-0.1231	-0.1286	-0.2065	1.0000			
	0.2065	0.1867	0.0329				
part_assoc	0.2144	-0.0249	-0.1696	-0.1007	1.0000		
	0.0266	0.7990	0.0807	0.3022			
assoc_a	0.0875	-0.1350	-0.0168	-0.0638	0.2650	1.0000	
	0.3702	0.1656	0.8635	0.5139	0.0058		
assoc_m	0.0476	0.1657	-0.0582	0.1373	0.1755	-0.2462	1.0000
	0.6263	0.0881	0.5515	0.1586	0.0706	0.0106	
frigtemp	0.1158	0.0684	0.0657	-0.1216	0.1237	0.0839	0.0244
	0.2418	0.4903	0.5077	0.2188	0.2109	0.3971	0.8059
frigdist	0.1029	-0.0925	-0.0442	0.1283	0.2060	0.0926	0.0695
	0.2964	0.3480	0.6544	0.1921	0.0350	0.3477	0.4810
freq_a	0.0601	0.1126	0.0342	-0.1304	-0.0313	-0.0540	0.0056
	0.5383	0.2480	0.7262	0.1808	0.7487	0.5809	0.9543
freq_m	-0.0284	-0.0928	-0.0660	0.1788	0.1105	0.0981	0.0571
	0.7719	0.3416	0.4996	0.0654	0.2570	0.3149	0.5588
neg_ap	-0.1142	-0.0671	-0.0010	-0.1761	0.1317	0.4970	-0.1224
	0.2415	0.4923	0.9919	0.0697	0.1763	0.0000	0.2093
neg_ei	-0.0723	0.0130	-0.0876	0.1242	0.0013	-0.1733	0.3055
	0.4595	0.8943	0.3694	0.2025	0.9898	0.0743	0.0014
neg_i	-0.0005	-0.0176	0.0137	0.0860	-0.3038	0.0111	-0.1593
	0.9963	0.8572	0.8883	0.3784	0.0015	0.9093	0.1011
neg_c	0.1243	0.0589	0.0233	-0.0266	0.2021	-0.1918	-0.0005
	0.2020	0.5468	0.8117	0.7856	0.0368	0.0478	0.9959

```
       prazo |  -0.1086  -0.0188  -0.0777  -0.0839   0.0779   0.0494   0.0377
             |   0.2653   0.8475   0.4263   0.3904   0.4250   0.6135   0.7001
             |
         npr |   0.2257   0.1391   0.0100   0.0809   0.1668  -0.0039   0.0921
             |   0.0194   0.1530   0.9188   0.4076   0.0859   0.9679   0.3453
             |

             | frigtemp frigdist   freq_a   freq_m   neg_ap   neg_ei    neg_i
-------------+------------------------------------------------------------------
    frigtemp |   1.0000
             |
             |
    frigdist |   0.1652   1.0000
             |   0.0937
             |
      freq_a |   0.0532  -0.1469   1.0000
             |   0.5920   0.1348
             |
      freq_m |  -0.0095   0.2000  -0.8242   1.0000
             |   0.9239   0.0408   0.0000
             |
      neg_ap |  -0.1046  -0.0909  -0.0958   0.1562   1.0000
             |   0.2908   0.3565   0.3264   0.1082
             |
      neg_ei |  -0.1053  -0.0750  -0.0662   0.1481  -0.1408   1.0000
             |   0.2873   0.4470   0.4983   0.1280   0.1480
             |
       neg_i |  -0.0812   0.0631   0.1170  -0.1696  -0.1673  -0.2566   1.0000
             |   0.4125   0.5226   0.2302   0.0807   0.0849   0.0076
             |
       neg_c |   0.2149   0.0369   0.0130  -0.0250  -0.2838  -0.4352  -0.5171
             |   0.0285   0.7083   0.8943   0.7980   0.0031   0.0000   0.0000
             |
       prazo |  -0.0232  -0.0334   0.0803  -0.0216   0.1363   0.0128  -0.1650
             |   0.8155   0.7353   0.4109   0.8252   0.1616   0.8956   0.0895
             |
         npr |   0.1038   0.1233   0.0783  -0.0931  -0.1599   0.0375   0.0818
             |   0.2944   0.2103   0.4229   0.3401   0.0999   0.7014   0.4024
             |

             |    neg_c    prazo      npr
-------------+---------------------------
       neg_c |   1.0000
             |
             |
       prazo |   0.1708   1.0000
             |   0.0785
             |
         npr |  -0.0487   0.0374   1.0000
             |   0.6185   0.7023
             |
```

Appendix 3: Ordered Logit

```
Ordered logistic regression                     Number of obs   =        103
                                                LR chi2(14)     =      43.12
                                                Prob > chi2     =     0.0001
Log likelihood = -90.684758                     Pseudo R2       =     0.1921

------------------------------------------------------------------------------
    percrisc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    trad_ter |   1.395687     .55327     2.52   0.012     .3112973    2.480076
    part_pec |  -1.218703   .8688798    -1.40   0.161    -2.921676    .4842704
    ativ_eng |   1.546459   .8988221     1.72   0.085    -.2151995    3.308118
       probl |   .6398104   .5946041     1.08   0.282    -.5255922    1.805213
     insem_s |  -.6894361   .4452426    -1.55   0.122    -1.562096    .1832234
    prob_vez |   .0204356   .1969296     0.10   0.917    -.3655393    .4064105
    prob_jud |   1.014949   .6077336     1.67   0.095    -.1761867    2.206085
    confjusa |  -.3742297   .7120642    -0.53   0.599     -1.76985     1.02139
    confjusm |   .9241624   .5101496     1.81   0.070    -.0757124    1.924037
  part_assoc |   1.631166    .672663     2.42   0.015     .3127703    2.949561
    frigtemp |   .0011051   .0291181     0.04   0.970    -.0559654    .0581755
    frigdist |     .00005   .0015943     0.03   0.975    -.0030748    .0031748
      freq_a |   .0154638   .5225339     0.03   0.976    -1.008684    1.039611
```

```
       prazo |  -.1539198   .6470212    -0.24   0.812    -1.422058    1.114218
-------------+----------------------------------------------------------------
       /cut1 |    .396404   1.291604                     -2.135094    2.927902
       /cut2 |   2.554892   1.312823                     -.0181933    5.127977
------------------------------------------------------------------------------

Ordered logistic regression                       Number of obs   =        103
                                                  LR chi2(14)     =      43.12
                                                  Prob > chi2     =     0.0001
Log likelihood = -90.684758                       Pseudo R2       =     0.1921

------------------------------------------------------------------------------
    percrisc | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    trad_ter |   4.037746   2.233964     2.52   0.012     1.365195    11.94217
    part_pec |   .2956134   .2568525    -1.40   0.161     .0538434     1.62299
    ativ_eng |   4.694818   4.219807     1.72   0.085     .8063806    27.33365
       probl |   1.896121   1.127442     1.08   0.282     .5912052    6.081267
     insem_s |    .501859    .223449    -1.55   0.122     .2096962    1.201083
    prob_vez |   1.020646   .2009954     0.10   0.917     .6938224    1.501419
    prob_jud |   2.759223   1.676873     1.67   0.095     .8384614    9.080099
    confjusa |   .6878189   .4897712    -0.53   0.599     .1703586    2.777053
    confjusm |   2.519757   1.285453     1.81   0.070     .9270828    6.848552
  part_assoc |   5.109827   3.437192     2.42   0.015     1.367207    19.09756
    frigtemp |   1.001106   .0291503     0.04   0.970     .9455718    1.059901
    frigdist |    1.00005   .0015944     0.03   0.975       .99693     1.00318
      freq_a |   1.015584   .5306771     0.03   0.976     .3646987    2.828118
       prazo |   .8573408   .5547176    -0.24   0.812     .2412171    3.047186
-------------+----------------------------------------------------------------
       /cut1 |    .396404   1.291604                     -2.135094    2.927902
       /cut2 |   2.554892   1.312823                     -.0181933    5.127977
------------------------------------------------------------------------------
```

VIF (variation inflation factor)

```
    Variable |       VIF       1/VIF
-------------+----------------------
    prob_vez |      2.25    0.444803
       probl |      2.16    0.461993
    prob_jud |      1.91    0.523333
    confjusm |      1.23    0.811025
    confjusa |      1.23    0.812512
  part_assoc |      1.23    0.815809
    ativ_eng |      1.21    0.827212
    part_pec |      1.20    0.835226
     insem_s |      1.19    0.839336
    trad_ter |      1.18    0.850615
    frigdist |      1.17    0.856946
      freq_a |      1.16    0.863581
       prazo |      1.14    0.876356
    frigtemp |      1.13    0.883529
-------------+----------------------
    Mean VIF |      1.38
```

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of percrisc

chi2(1) = 0.52

Prob > chi2 = 0.4724

Appendix 4: Recursive Bivariate Probit

```
Seemingly unrelated bivariate probit              Number of obs   =        100
                                                  Wald chi2(15)   =      84.17
Log likelihood =  -81.47433                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

```
percrisc     |
    trad_ter |   .7903975    .354744     2.23   0.026     .0951122    1.485683
    ativ_eng |   8.138198   1.45e+07     0.00   1.000    -2.84e+07    2.84e+07
    prob_jud |   .4930249     .32318     1.53   0.127    -.1403962    1.126446
    confjusm |   .8780283   .3491193     2.51   0.012     .1937671     1.56229
  part_assoc |   2.345289   .3376762     6.95   0.000     1.683456    3.007122
    frigtemp |  -.0010717   .0195624    -0.05   0.956    -.0394134    .0372699
    frigdist |   .0003356   .0010747     0.31   0.755    -.0017707    .0024418
       prazo |   .0669222   .4199178     0.16   0.873    -.7561017     .889946
       _cons |  -2.356193   .6301358    -3.74   0.000    -3.591237    -1.12115
-------------+----------------------------------------------------------------
part_assoc   |
    trad_ter |   .6082873   .4403532     1.38   0.167    -.2547891    1.471364
        abat |   .0003945   .0002396     1.65   0.100    -.0000752    .0008642
    ativ_eng |   .1580033   .7139461     0.22   0.825    -1.241305    1.557312
       probl |   .6866844   .3483834     1.97   0.049     .0038654    1.369503
    prob_jud |   .4939912   .5354414     0.92   0.356    -.5554547    1.543437
    confjusa |  -1.614582   .4898832    -3.30   0.001    -2.574736   -.6544287
    confjusm |  -.6731482    .394337    -1.71   0.088    -1.446035    .0997381
       _cons |   .5431807   .3475762     1.56   0.118    -.1380561    1.224417
-------------+----------------------------------------------------------------
     /athrho |  -13.41342    839.425    -0.02   0.987    -1658.656    1631.829
-------------+----------------------------------------------------------------
         rho |         -1   7.50e-09                           -1           1
------------------------------------------------------------------------------
Likelihood-ratio test of rho=0:     chi2(1) =  2.84113    Prob > chi2 = 0.0919


Marginal effects after biprobit
      y  = Pr(percrisc=1,part_assoc=1) (predict)
         =  .75120919
------------------------------------------------------------------------------
                       variable |          dy/dx                X
--------------------------------+---------------------------------------------
                       trad_ter*|        .2287492               .22
                       ativ_eng*|        .3948495               .07
                       prob_jud*|        .1724622                .3
                       confjusm*|        .0913591               .26
                      part_assoc*|        .7582317               .85
                       frigtemp |       -.0002902             9.34
                       frigdist |        .0000909            227.48
                          prazo*|        .0184941               .85
                           abat |        .0000466           1723.88
                          probl*|         .092269                .6
                       confjusa*|       -.4050614               .12
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```