Networks, Relational Contracts and the Theory of the Firm: Beyond Williamson

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Abstract
This paper analyses the role of relational contracts in the formation of networks and the conditions that make these contracts feasible. Relational contracts help circumvent difficulties in formal contracting and allow parties to utilize their detailed knowledge of their situation while adapting to new information as it becomes available (MacNeil, 1978). However, these contracts cannot be enforced by a third party and must be self-enforcing, which means that the value of the future relationship must be sufficiently large so that neither party wishes to renege (Dixit, 2004).

However, what causes certain contracts to breakdown while others go well? According to Baker *et al* (2002) integration affects the parties' temptation to renege a relational contract. Thus, in a given environment, a desirable relational contract might be feasible under integration but not under non-integration - and this will be particularly true when we face alternative asset prices that vary too much.

Empirical research was conducted to assess the determinants of companies' decisions between contracting law services in the market and employing an internal legal department. That could be explained by the variation on assets value (in the case, the value of legal services), the total amount of the pay-offs and the institutional environment.

Keywords

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Relational Contracts, Vertical Integration, Theory of the Firm.

1 Introduction

Firms either can conduct their operations through the market or can operate in a high degree of vertical integration. In the first case, firms avoid what we call *holdup* problems (Klein, Crawford and Alchian, 1978). These occur when it comes time to work out the terms of the deal left open at the outset. When this happens, the other side might demand terms of trade that are onerous but not so onerous that the first part would willingly forfeit the value of those transaction-specific assets by taking its business elsewhere. If all of the assets belong to one firm, there is no problem at all, which explains the second choice, the vertical integration (Williamson, 1985).

However, this rationale does not explain why some companies operate through networks, arrangements in which parties remain economically separate entities but have long-term relationships. Toyota and others Japanese automobile companies are typical examples of this arrangement (Holmstöm, Roberts, 1998). According to the authors,

> The pattern of relations between Japanese manufacturing firms and their suppliers offers a prominent instance where the make-buy dichotomy and related theorizing have been less than satisfactory…These practices [in Japanese automobile industry] feature long-term, close relations with a limited number of independent suppliers that seem to mix elements of market and hierarchy. Apparently, these long-term relations substitute for ownership in protecting specific assets.

The portion of new contracts awarded to these suppliers is greater or lower depending on supplier performance from previous contracts, which is the essence of relational contracts behind the Japanese model. Relational contracts help circumvent difficulties in formal contracting no matter whether these difficulties come from holdup problems or from another source. A relational contract allows parties to utilize their detailed knowledge of their particular situation to adapt to new information as it becomes available (MacNeil, 1978). However, as is shown, they cannot be enforced by a third party and must be self-enforcing, which means that the value of the future relationship must be sufficiently large so that neither party wishes to renege (Dixit, 2004). However, what causes certain contracts to breakdown while others go well?

Baker *et al* (2002) examine the problem in the light of relational contracts and property rights theory. According to those authors, integration affects the parties' temptation to renege a relational contract. Thus, in a given environment, a desirable relational contract might be feasible under integration but not under non-integration, which will be particularly true when facing wide variances in alternative prices of an asset. These assets are not restricted to physical ones, and can even be a legal title to a certain product or discretion that an outsourced worker has about how to allocate his time doing his job (Hart, 1992).

Departing from these hypotheses and with grounds on the incentive literature, a model was constructed and empirical research was conducted. The companies' decisions between contracting law services in the market or employing an internal legal department, or even the adoption of a hybrid form, could be explained by the variation on assets value (in the case, the value of legal services, expressed by a greater competition degree - Bertrand, 2004). In addition, the total amount of the pay-offs and the institutional environment, particularly the time used to reach a decision and the variability of the expected result (Hart, 1995; Dixit, 2004) comes into the decision-making process. The results of the empirical research confirm these assumptions and point some interesting lines of research in the relational contracts field.

2 The BGM[2] Model

The BGM model deals with a situation in which a supplier (from now on called the *upstream* party) produce a product that can be used by another company, the *downstream* party, in its production process. The upstream party needs a specific asset to produce this product. If the upstream party owns the asset, the transaction is non-integrated, which means that the upstream party is an independent contractor. If it is the other way around, if the downstream party owns the asset, the transaction is integrated and the upstream party is considered an employee. The product produced by the upstream party can be used in the downstream production process or can be sold in the market.

The market value of the product produced has an important role in the bargain between these two parties. The greater the alternative (market) values of the product, the better the bargaining position of upstream party. As a result, this party will invest in improving its outside opportunities to sell in order to strengthen its bargaining position and raise the final price[3].

The upstream party can influence the value of the product both for the downstream party use and for market use. For example, we could have an automobile part that is more specifically tailored to a certain automobile company or that could be for general use in several types of vehicles. The investments made by the upstream party to make this automobile part more specific or general will result in a greater value either for the downstream party or for the market. Therefore, the efforts to improve the value of the product differ according to who will use the product. This effort is neither observable nor is its outcome contractible. The only way to incentivise the effort to increase the value for the

[2] Baker, Gibbons and Murphy, 2002.

[3] In some cases the over investment in raising the alternative price would be sub optimal, and some studies point that a third-party control would be desirable in these situations (Holmström, Tirole, 1991; Holmström, Milgrom, 1991, Rajan, Zingales, 1998).

downstream party, instead of increasing the market value, is to take resources to a relational contract. The downstream party, in this case, would pay a bonus if the supplier produces a high-value product, and as this arrangement is based on non-contractible results, the incentives must be self-enforcing (BGM, 2002, page 41)[4].

If the market value of the product rises to such a level that would be profitable for upstream party to not delivery the product, even if he takes into account the value of future business, the relational contract would break down. If, on reverse, the market value of the product drops to a price that makes it profitable for downstream party to renege the payment of the bonus, regardless of the profits of future business, the contract would also break down. The result is that wide variances in alternative prices of an asset can be harmful for establishing relational contracts, and under these conditions, the feasible arrangement would be the integration.

Asset ownership is also important for the maintenance of a relational contract. Under non-integration, the downstream party can use the product without buying only if he pays the bonus. If he reneges the bonus, he must pay at least its alternative (market) price to use the product in his production process. However, if the firm is organized in an integrated fashion, the downstream party already owns the product, so it is not necessary to buy it.

The breakdown of relational contracts is not easily observable. The information about payment of bonuses does not have a public registry, and it is usually confidential. Some relational contracts imply promises of future business or, in the case of relational employment, the concession of amenities, which are hard to verify. The same can be said about alternative (market) prices for a product or for a service. Marianne Bertrand (2004), when investigating relational employment contracts, relates the variation in competition to wages and indirectly to relational employment contracts, an approach that will be useful in the empirical test conducted here.

3 Empirical Test

The conditions for testing the hypotheses of BMG (2002) and Dixit (2004) are the existence of a market with different levels of variation in prices of a certain product, and the existence of different forms of asset ownership necessary for producing this product. This asset is not necessary a physical one, and could be an immaterial one, such as a list of potential clients, or the discretion of a worker in

[4] Dixit (2004) examines also the feasibility of relational contracts with resource to a more easily understandable model. Instead of consider the alternative price of the product; he proposes the use of a formal contract as a fallback in the case of the breakdown in a relational contract. The resource to the courts to enforce a formal contract, instead of the relational contract, works as a punishment phase in a repeated game.

deciding about the allotment of his time and others. The latter case would be that presented by Bertrand (2004), and this approach was adopted in our empirical test, which tested the market for legal services in Brazil.

Table 1. Variation in the number of lawyers in Brazilian States

	Absolute Number		**Lawyers/1,000 ha**		**% Variation**	
Brazilian State	**1996**	**2004**	**1996**	**2004**	**1996**	**2004**
Acre	1,080	1,106	2.16	1.75	-0.40	-18.74
Alagoas	5,040	3,399	1.89	1.14	-0.75	-39.75
Amazonas	2,970	2,283	1.21	0.73	-0.48	-39.74
Amapá	270	588	0.67	1.07	0.40	59.90
Bahia	12,600	10,552	0.99	0.77	-0.22	-22.21
Ceará	11,970	7,391	1.73	0.93	-0.80	-46.43
Distrito Federal	12,240	10,764	6.52	4.72	-1.80	-27.67
Espírito Santo	7,830	5,234	2.74	1.56	-1.18	-43.10
Goiás	12,240	10,815	2.64	1.96	-0.67	-25.57
Maranhão	3,150	3,201	0.59	0.53	-0.06	-10.63
Minas Gerais	44,370	41,128	2.62	2.17	-0.46	-17.50
Mato Grosso do Sul	5,400	5,412	2.75	2.43	-0.32	-11.73
Mato Grosso	6,120	3,942	2.68	1.43	-1.24	-46.40
Pará	7,020	6,132	1.24	0.90	-0.35	-27.95
Paraíba	5,040	4,205	1.51	1.18	-0.33	-22.10
Pernambuco	15,750	11,375	2.11	1.37	-0.74	-35.21
Piauí	2,520	2,095	0.93	0.70	-0.23	-24.72
Paraná	24,480	23,735	2.68	2.34	-0.34	-12.54
Rio de Janeiro	78,300	78,876	5.78	5.19	-0.59	-10.18
Rio Grande do Norte	3,150	3,474	1.21	1.17	-0.04	-3.41
Rondônia	945	1,547	0.75	0.99	0.24	31.58
Roraima	270	344	1.06	0.90	-0.16	-15.09
Rio Grande do Sul	41,310	32,875	4.23	3.06	-1.17	-27.57
Santa Catarina	10,710	11,228	2.16	1.94	-0.22	-9.98
Sergipe	3,780	1,824	2.28	0.94	-1.34	-58.67
São Paulo	130,500	151,927	3.76	3.81	0.06	1.59
Tocantins	945	1,244	0.87	0.99	0.11	12.68
NORTH	13,500	13,244	1.16	0.92	-0.24	-20.8
CENTER-WEST	36,000	30,933	3.34	2.42	-0.92	-27.54
SOUTH-EAST	261,000	277,165	3.83	3.58	-0.25	-6.58
NORTH-EAST	63,000	47,516	1.39	0.94	-0.45	-32.2
SOUTH	76,500	67,838	3.21	2.55	-0.66	-20.55
TOTAL	**450,000**	**436,696**	**2.82**	**2.40**	**-0.41**	**-14.68**

Source: Brazilian Bar Association Federal Council (OAB, 1996, 2004) for the number of lawyers in 1996 and 2004, Statistical and Geographical Brazilian Institute (IBGE) for data about population.

A lawyer is supposed to be admitted in a local section of the bar association in order to give assistance to a client. It is necessary to have a new register and to take the admission test again to work in a Brazilian state that is different to where

he was admitted the first time. As a result, different levels of competition among Brazilian states (Table 1) can be observed, expressed as different ratios of lawyers per inhabitant. There is no migration between states, the variation of these ratios between 1996 and 2004 does not show any sign of convergence. The proportion of lawyers dropped significantly in most of the states, with the exception of great Brazilian states and economic frontiers.

Besides the varying competition in legal markets, a lawyer's effort in conducting a case also can vary. Indeed, any lawyer could restrict his actuation to the minimal requirements of law. He could attend just to the mandatory procedures and exert the minimal possible effort in each case. On the other extreme, he could act proactively and anticipate the moves of the other party, make additional requirements to the judge, produce evidences and so forth. Briefly, there is room for a relational contract since there is a non-observable effort on the part of the lawyers, which would produce a better result to the client.

Regarding the ownership of assets, the decision of a company between having an internal legal department and hiring an external law firm would be comparable to integration and non-integration, respectively. However, the choice between two contractual forms would not be a possibility for a small company. First, small companies do not have a demand large enough to justify the creation of an internal legal department[5]. Second, small companies could be risk-averse, which poses unnecessary additional problems to the empirical analysis. To circumvent these problems, the empirical test the sample just included big companies.

The prediction in the empirical test is that in those markets where a greater flotation in competition between 1996 and 2004 can be observed, there would be a greater chance that companies would have internal legal departments if the BMG (2002) hypothesis were right. Since both the rising and the drop of market prices affect the temptation to renege a relational contract, such variation in competition must be taken in module. To summarize, we expect that a greater competition variation in legal market yields in a high proportion of companies with internal legal departments[6].

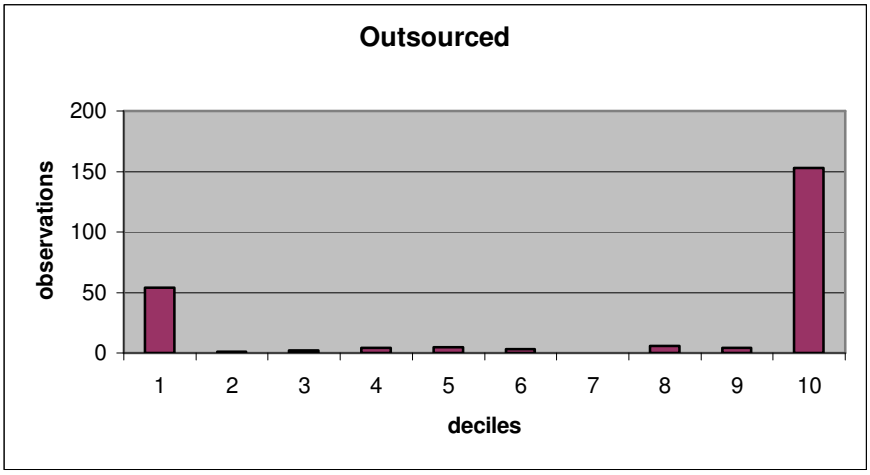
[5] During the elaboration of the research, Professor Barzel pointed out the possibility of a small company selling its extra capacity to another company. However, the legislation about legal profession, specially the conduct code (Law 8.906/94), does not allow this.

[6] During the interviews in the first phase of the research, some managers of legal departments alleged that the existence of a great number of judicial cases would be an incentive to have a legal department, since there would be scale gains. As Professor Barzel noticed during the discussion of this project, in this case there would be scale gains both to have an internal department and to hire an external law firm.

3.1 The Dependent Variable

It is necessary to define the dependent variable in the empirical test. It is unlikely that one company would choose either to outsource all judicial cases or to have a legal department deal with all of these cases. It is expected that a company would have a mixed strategy, depending on the nature of the case at hand. For those cases that are less frequent in the company, it is expected that companies would outsource them, so the real choice would be about the most frequent cases. From the interviewing companies and law firms, it was possible to identify six areas that will be more frequent in big companies, namely taxes, labour cases, consumer rights, torts, environmental cases and credit contracts. The number of observations unfolded in the number of interviewed companies within these six areas. As there were twenty-seven companies and six areas, and because the sample separates those judicial cases filled in courts near the company from those filled in another city, there were almost 240 observations[7].

Graph 1: Percentage of cases outsourced



The nature of the dependent variable, whether it is a continuous or dichotomy variable, could be inferred from analyzing the distribution of outsourced cases (Graph 1 below). The graphic shows the percentiles of outsourced cases in the horizontal axis, and the number of observations in the vertical axis. It can be observed that the distribution is bi-modal, with most of the observations either below 10% or above 90%. The dependent variable was considered dichotomous,

[7] The difference is due the fact that not all legal areas were found in all companies surveyed, and sometimes the company just filed cases within the city where they operate.

and those observations above the average value (0.73) were rounded to 1 (one) and those below this value were normalized to 0 (zero).

3.2 The Econometric Model

Since the dependent variable shows only whether the judicial cases were outsourced (assuming respectively the value of 1 and 0), it is necessary to deal with econometric methods that are appropriate for the analysis of dichotomous variables. The probit model could be useful. It results in increasing the probability that the result would be one if we change an independent variable. The model takes the form bellow:

$$P(y = 1 \mid x) = F(\beta_0 + x\beta) \tag{1}$$

Here, *x* is the vector of explanatory variables, which includes the variation of the level of competition in the legal market and other control variables, such as the GDP *per capita*, average years of schooling and percentage of urban population. This function gives us the probability that one parameter *z* is determined in linear form by the regressors, which could be expressed by the notation $P_i=F(z_i)$. The function *F* is the standard normal cumulative distribution function (cdf), expressed as an integral:

$$P_i = F(z_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{z_i} e^{-s^2} \Big/ 2 \tag{2}$$

Here, *s* is a variable with normal distribution, zero mean and unitary variance. The probability slope that yields will be steeper in the middle and the estimation of parameters is done using the maximum likelihood criterion. The downside of the model is that it shows the linear influence of the regressors over the *Z* parameter of the cumulative distribution function instead the coefficients. Furthermore, the variation of the probability is not linear along the probability slope, and it is bigger in the region around the mean value of the parameters and lower as it goes to both edges of the slope. To circumvent these problems, the values presented are the response of the probability to one infinitesimal variation in each regressor around the mean value (in other words, the first derivative in the point with probability 0.5). Standard deviations were computed using the White matrix, robust to heterokedasticity.

It could also be argued that the causality runs in the opposite way. Instead of having variation in the level of competition as a determinant of the chance of having an outsourced legal department, one could claim that local markets with higher proportions of outsourced legal departments would experience more variation (increases) in competition. This phenomenon would be caused by the better work conditions that law firms offer when compared with the wages in legal departments. Several researchers examined the difference in incentives between

integrated and non-integrated firms (Williamson, 1985, Holmström, Roberts, 1998, Baker, Hubbard, 2001)[8].

An econometric model, departing from Amemiya's Generalized Last Squares method, is used to circumvent the problems with endogenous variables. The structural parameter estimators are calculated from the reduced form parameter estimators. Following the proposition of Newey (1987), the parameters are obtained by the resource to GLS method to estimate the coefficients of the reduced form, using the residues of this regression as additional explanatory variables. This article describes in details the method in Appendix 1. The two-equation model used in the regression analysis regarding the influence of competition over probability of the outsourcing of legal activities is:

$$P\left(\text{Outsourced} = 1 \middle| \text{Competition}, X_1\right) = G\left(\gamma_1 \text{Competition} + X_1\beta_1 + u_1\right) \quad (3)$$

$$\text{Competition} = \gamma_2 P\left(\text{Outsourced} = 1\right) + X_2\beta_2 + u_2 \quad (4)$$

Here, *Competition* is the percentile variation in competition between 1996 and 2004, X_1 is a vector of exogenous variables, β_1 is a vector of regressor parameters and u_1 is a vector of disturbances in equation (1). In equation (2), X_2 is a vector of instrumental variables excluded from equation (1). The function G is a standard normal cumulative function, giving us a probit model with an endogenous explanatory variable.

The instrumental variable used in the regressions was the number of places offered in state law schools in each Brazilian state. Given that state universities have a high standard of education, the number of places is highly correlated with the variation in competition in local legal services market. On the other hand, there is no way for this variable to influence the proportion of outsourced legal departments except through the influence over competition level. Bound, Jaeger and Baker (1995) raised the problem with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variables is weak, and Hahn and Hausman (2003) suggest that the cause of weak instruments is often stated to be a low R^2 or F statistic of the reduced-form equation, in the most commonly occurring situation of one right-hand-side endogenous variable. The correlation between the number of places in state law schools and the variation in competition is high (0.67), showing that this is an acceptable instrumental variable.

[8] The low powered incentives inside firms would be a result of the multitask problem if an agent is responsible for two different tasks and the marginal returns of the effort in each task are not equilibrated, the agent would neglect the activity with the low return. In this case, low powered incentives are likely to be found inside firms (Holmström, Milgrom, 1994).

4 Results

Tables 2 and 3 show the results of regressions and in all cases were found to support the BGM (2002) hypothesis, in general above the 1% of significance level. Regressions one through three in second table show the result for regular probit regressions, and equations four through six in third table present results for AGLS method, having the number of places in state law schools as an instrument.

Each equation included, as control variables, GDP *per capita*, average years of schooling and percentage of urban population. It also included variables trying to measure the monopoly power of bar associations. The hypothesis was that the greater the market power of bar associations, the more these associations would work to limit the hiring of lawyers in legal departments, as the work conditions and wages in legal firms are better. The proxies for market power used were the size of market (bar associations would face trouble trying to exert control in greater markets) in equations three and six, and the level of competition (monopoly power would be hard to exert where it is found more competition) in equations two and five. These variables were omitted in the results because they were found to not be significant. The locale of litigation, a dummy variable that assumes value 1 if the judicial case was brought to a court located in the same city where the headquarters of the company was located, and 0 if it was found not significant and was therefore omitted[9].

For the same reason, variables that tried to measure the relation-specific assets were also omitted, which would test the *holdup* problem pointed to by Klein *et al* (1978) and Williamson (1985). The variables that tried to measure the control that each party has over the result in judicial cases, which would test Barzel's prediction about the outsourcing of judicial cases (Barzel, 1997, p. 80) were also omitted. See Appendix 2 for a discussion about these hypotheses and results.

State-owned companies face a highly regulated procedure when outsourcing activities (Law 8666/93), which could result in a lower degree of outsourcing. In order to control for this hypothesis, it was added in each model as a dummy variable that has value 1 in the case of a state-owned company and 0 otherwise. In fact, state-owned companies stand between an 11% and 44% less chance of having an outsourced legal department.

[9] The distance from the company is a criterion usually used to measure relationship-specific assets and to verify the effect of *holdup* problems (Joskow, 1992).

Table 2. Likelihood of having an outsourced legal department

	1	2	3
Variation in competition, module	-0,075*** (0,018)	-0,005** (0,002)	-0,005** (0,002)
Variation in competition, percentile	-0,058*** (0,017)		
State Owned Company	-0,409*** (0,105)	-0,111 (0,132)	-0,126 (0,127)
GDP *per capita*	0,129** (0,053)	0,166*** (0,037)	0,159*** (0,037)
Average years of schooling	-0,293** (0,141)	-0,397*** (0,086)	-0,382*** (0,087)
Percentage of urban population	-0,029* (0,011)	-0,010 (0,007)	-0,008 (0,006)
Expected duration of case	0,072 (0,045)	0,028** (0,013)	0,023* (0,012)
Observations	232	232	232
Pseudo R^2	0,44	0,28	0,28

Instead the coefficients, the table shows the alteration in dependent variable due to a slight change around the mean in the explanatory variable (dF/dx), when if is a continuous variable, or for the change from 0 to 1 with dichotomous variables. Standard errors calculated using Huber/White matrix. The result is predicted to be 1 when the probability is higher than 0.50, and 0 otherwise. *** Significant at 1% ** significant at 5% * significant at 10%.

The main result, however, is that greater variation in the level of competition (taken as a module) yields less outsourced cases, which means a great variation of results in less relational contracts as predicted by BGM (2002). Each 1% variation in the competition of a given local market would result in a decreasing in the likelihood of having an outsourced legal department between 0.5% and 10.5%. There is also a great difference between the regression calculated with ordinary probit regressions and those calculated with the AGLS method. It seems that there is an endogenous effect, and the net effect of the BGM hypothesis is even greater when the 2SIV method is applied (equation 1, 2 and 3 compared respectively with equations 4, 5 and 6).

Indeed, the history that these results show is that a greater variation in the level of competition, no matter whether this level raised or dropped, makes relational contracts unfeasible. In the case under analysis, these relational contracts do not always predict the payment of bonuses – sometimes the compensation for a good performance of the law firm would be just the promise of a generous portion of the new business with the company. When competition rises, the price of services drops in the market, so the company might break its promise of giving new business to the law firm (or they might not pay the agreed upon bonuses), giving business instead to new and less expensive law firms. Alternatively, the reduction in competition raises prices to such a level that law firms might make efforts only for new clients, who would pay more for their services. In any case, as each party

would be aware of this failure in relational contracts, the effort level would be minimal.

Table 3. Likelihood of having an outsourced legal department – AGLS Model

Variables	1	2	3
Variation in competition, module	-0,105*** (0,025)	-0,027** (0,009)	-0,023*** (0,006)
Variation in competition, percentile	-0,069*** (0,022)		
State Owned Company	-0,441*** (0,142)	-0,315* (0,207)	-0,224 (0,168)
GDP *per capita*	-0,076 (0,108)	0,113*** (0,045)	0,068 (0,043)
Average years of schooling	0,152 (0,253)	-0,210** (0,121)	-0,195** (0,102)
Percentage of urban population	-0,029*** (0,011)	0,007 (0,010)	-0,005 (0,007)
Expected duration of case	0,060*** (0,025)	0,039*** (0,013)	0,038** (0,015)
Observations	232	232	232
Pseudo R^2	0,30	0,30	0,33

Instead the coefficients, the table shows the alteration in dependent variable due to a slight change around the mean in the explanatory variable (dF/dx), when if is a continuous variable, or for the change from 0 to 1 with dichotomous variables. Standard errors calculated using Huber/White matrix. The result is predicted to be 1 when the probability is higher than 0.50, and 0 otherwise. *** Significant at 1% ** significant at 5% * significant at 10%.

The resource of internal legal departments in such environments would be easily explained. Since there is no point in offering a relational contract, firms can substitute the payment of bonuses for supervision. Indeed, the integration of activities would permit the supervision of teamwork (Alchian, Demsetz, 1972). It also explains a contractual arrangement between companies and law firms, in which the latter receives a fixed payment per month to follow a certain number of cases, with no regard for the performance in these cases. This arrangement provides a poor incentive, and would be explained by the unfeasibility of relational contracts in legal services.

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Appendix I: The AGLS Model

The regressions of the research were made with a probit model using endogenous explanatory variables, developed as a user command for Stata statistical software by Joe Harkness, from Johns Hopkins University. The program implements an Amemiya Generalized Least Squares (AGLS) estimator for probit and Tobit with endogenous regressors.

This estimator is obtained by applying probit to the reduced form for the equation of interest and then solving back via a generalized least squares approach to obtain the structural parameters. To see how it is done, consider the two-equation model[10]:

$$y_{1i} = \gamma_1 y_{2i} + \beta' x_{1i} + u_{1i}$$
$$y_{2i} = \gamma_2 y_{1i} + \beta' x_{2i} + u_{2i}$$

This can be expressed in matrix notation as:

$$y_1 = \gamma_1 y_2 + X_1\beta_1 + u_1 \quad (1)$$

$$y_2 = \gamma_2 y_1 + X_2\beta_2 + u_2 \quad (2)$$

Moreover, having the following reduced forms:

$$y_1 = X\Pi_1 + v_1 \quad (3)$$

$$y_2 = X\Pi_2 + v_2 \quad (4)$$

It is possible to define two matrices J_1 and J_2 in a way that $XJ_1=X_1$ and $XJ_2=X_2$. Substituting (4a) into (1a), it will be found that:

$$y_1 = \gamma_1 X\Pi_2 + XJ_1\beta_1 + \gamma_1 v_2 + u_1 \quad (5)$$

If one equals (5a) to (3a), after some calculus one will get:

$$\Pi_1 = \gamma_1\Pi_2 + J_1\beta_1 \quad (6)$$

Similarly, if one substitutes (3a) into (2a) and equals the result to (4a), the result will be:

$$\Pi_2 = \gamma_2\Pi_1 + J_2\beta_2 \quad (7)$$

Amemyia suggests estimating equations (6a) and (7a) directly by regression methods, writing $\hat{\Pi}_1$ for Π_1 and $\hat{\Pi}_2$ for Π_2. In this case, the equation (6a) would be:

$$\hat{\Pi}_1 = \gamma_1\hat{\Pi}_2 + J_1\beta_1 + \eta_1 \quad (8)$$

Where

[10] This section comes from the detailed description that Maddala (1983) made about Amemyia (1979) suggestion regarding some estimators' alternative to the two-stage estimator used by Nelson and Olsen (1978).

$$\eta_1 = \hat{\Pi}_1 - \Pi_1 - \gamma_1(\hat{\Pi}_2 - \Pi_2) \tag{9}$$

Newey (1986) proposed that this estimator would be calculated by applying GLS to estimates of the reduced form coefficients that are obtained by using reduced form residuals as additional explanatory variables. He derives these estimators from general results on the asymptotic efficiency of two-stage and Amemyia GLS estimators[11]. He proposes a general model that can subsume several different limited dependent variable models.

To begin with, let us consider the following endogenous explanatory variables model:

$$y_t^* = Y_t\beta_0 + X_{1t}\gamma_0 + u_t = Z_t\delta_0 + u_t, \qquad t = 1,...,n, \tag{10}$$

where $Z_t = [Y_t, X_{1t}], \delta_0' = [\beta_0', \gamma_0']$, Y_t is the *t* th observation of a 1 x *r* vector of endogenous explanatory variables, X_1 is a 1 x *s* vector of exogenous explanatory variables, and δ_0 is the *q* x 1 vector of regression parameters for this equation, with $q \equiv r + s$. The real value of y_t* is not observable, but rather a value of *y* that results from $\tau(y_t^*, \psi_0)$, where the second parameter is a vector of parameters with *m* x 1 size. If this function were the maximum value of *y** between *y** and zero, we would have a censored regression model. It is also possible to have just two values as a result, either zero or one, expressing a binary choice model.

The equation below relates the endogenous variables of the model to a 1 x *K* vector of instrumental variables, and is the reduced form equation for the endogenous explanatory variables in equation (10a):

$$Y_t = X_t\Pi_0 + V_t = X_{1t}\Pi_{10} + X_{2t}\Pi_{20} + V_t \tag{11}$$

Where Π_{10} is an *s* x *r* matrix of coefficients for the instrumental variables that are included in equation (10), Π_{20} is a (*K* – *s*) x *r* matrix of coefficients for the instrumental variables that are *excluded* from equation (10a), $\Pi_0 \circ [\Pi'_{10}, \Pi'_{20}]'$ and *V* is a 1 x *r* vector of disturbances.

It is possible to have the reduced form equation for y_t* by substituting equation (11a) in equation (10a), as follows:

$$y_t* = (X_t\Pi_0 + V_t)\beta_0 + X_{1t}\gamma_0 + u_t \tag{12}$$

$$y_t* = X_{1t}\Pi_{10}\beta_0 + X_{2t}\Pi_{20}\beta_0 + V_t\beta_0 + X_{1t}\gamma_0 + u_t \tag{13}$$

[11] See Newey (1987), especially section five for the background of Harkness's implementation of the 'divprob' Stata user command. Some passages of this article are reproduced here, with additional details included.

Rearranging similar terms and taking $\alpha_{10} \circ \Pi_{10}\beta_0 + \gamma_0, \alpha_{10} \circ \Pi_{20}\beta_0, \alpha_0 \circ (\alpha'_{10}, \alpha'_{20})'$ and $v_t \circ u_t + V_t\beta_0$, one gets:

$$y_t^* = X_t\alpha_0 + v_t \tag{14}$$

The parameters are related by the equation:

$$\alpha_0 = D(\Pi_0)\delta_0 \tag{15}$$

Where $D(\Pi_0) \circ [\Pi, I_1]$ and I_1 is the K x s selection matrix such that $X_{1t} = X_t I_1$. The identification assumption rank $(\Pi_{20}) = r$ is satisfied and δ_0 is the unique solution to equation (15a).

Rivers and Vuong (1984) suggested an estimator to δ for the probit model, substituting the least squares estimator $\hat{\Pi}$ in the conditional log-likelihood for y_t, under the assumption that the disturbances of equations (10) and (11) are multivariate normal, conditional on X_t. From the derivation of a general relationship between two-stage and AGLS estimators, Newey (1986) concludes that the AGLS estimator of δ is a member of the class of minimum distance estimators $\hat{\delta}_W$ that solves:

$$\min_{\delta} (\hat{\alpha} - \hat{D}\delta)'\hat{W}(\hat{\alpha} - \hat{D}\delta) \tag{16}$$

Where $\hat{W}$ is a positive semi-definite matrix with $\text{plim}(\hat{W}) = W$, and $\hat{\delta}_W$ obtained by minimizing the distance between two estimates, $\hat{\alpha}$ and $\hat{D}\delta$, of the reduced form coefficients, with $\hat{W}$ measuring the distance. The AGLS estimator $\hat{\delta}_A$ is obtained by choosing $\hat{W} = \hat{\Omega}^{-1}$~, where $\hat{\Omega}$ is a consistent estimator of the asymptotic covariance matrix Ω of $\sqrt{n}(\hat{\alpha} - \hat{D}\delta_0)$, assumed as a non-singular. The construction of a consistent estimator of Ω requires the use of a consistent estimator of δ as well as a consistent estimator of the joint asymptotic covariance of $\hat{\alpha}$ and $\hat{\Pi}$. The two stages instrumental variables (2SIV) estimator can be used in the construction of $\hat{\Omega}$, or it can use $\hat{\delta}_W$ for some choice of non-random $\hat{W}$, which means $\hat{W}$ equal to an identity matrix.

Amemyia (1978) showed that the AGLS estimator is asymptotically efficient relative to any other estimator $\hat{\delta}_W$ obtained from (16a).

Newey (1986) uses this previous result and the result of the comparison of efficiency of the AGLS estimator related to the minimum chi-square (MCS) estimator to propose a simple way to compute the AGLS estimator. He reaches to a relative simple form of Ω, which allows one to have a consistent estimator of Ω, departing from the residuals of a 2SIV of Y_t. The calculus of Ω is also drawn

from the use of any of the standard estimators of the covariance matrix of the maximum likelihood estimator in specific models where the conditional log-likelihood has a standard form, which is the case of the probit model used in this article. For a more detailed approach of this procedures, see Newey, especially section 5.

Appendix II: Alternative Hypotheses - Williamson and Barzel

It was mentioned in section four that some results were omitted for simplicity because they produced insignificant results. Among these, two would be of a particular interest as they confront the BGM (2002) hypothesis with some traditional hypothesis in the field of the theory of the firm. We add some comments about these omitted tests.

It was necessary to find objective measures of such dimensions as the specificity of a legal area, or the greater or lower influence of the client's actions over the result of the trial. In these two cases, the objective measure was calculated using a specialist's panel. The technique was to ask a group of lawyers, both from legal departments and legal firms, to assess the level of specificity or the influence of the client over the result in each area. They were supposed to point to an appropriate measure in a graphic scale (Seelltiz *et al,* 1986) ranging from 1 to 7. The number of items on these graphic scales was chosen using information from previous studies about central tendency of respondents, the need for an odd or even number of items and other aspects (Thurstone, 1959, pages 39 to 49, Edward, 1957, pages 20 to 29, Green *et al,* 1974, pages 184-191 and Albaum *et al,* 1973, Masters, 1972).

One main concern about this specialist panel is its accuracy. Is the developed methodology able to measure these variables? The measurement errors could be behind the non-significance of these variables in the empirical test. Although it is not possible to discharge the possibility of measurement errors, it is worthy to mention that the methodology developed by Ribeiro (2005) was successfully employed in other studies. In trying to measure the amount of regulation in legal areas (or more exactly, the amount of non-disposal contractual norms), Ferrão and Ribeiro (2006) took resources to the same methodology. The measures found in this way were significant in their research.

II.1 The Williamson's Hypothesis

One of the traditional approaches to the theory of the firm is to relate the decision between making and buying to relationship-specific assets (Williamson, 1985). According to this hypothesis, assets that are more specific would raise concerns about the *holdup* problem, which could deter investments in specialization. As a result, the only way to instate these investments would be by integrating those activities. Relationship-specific assets are not restricted to physical assets. In the case examined by the empirical test, the specialization in a legal area of interest of

only few firms could be understood as a specific asset. For example, specialization in regulation of exploration of mines or hydrocarbon and petroleum would be useful just for one or two Brazilian companies.

In the empirical approach, we could estimate the specificity of each legal area through the calculus of an index of specificity described in the beginning of this paper. This index varies between 1 and 7, and was calculated using the information given by a panel of specialists. The results were not found as significant in all equations tested, so these regressions were excluded from the results.

II.2 The Barzel's Hypothesis

In his work, The Economic Analysis of Property Rights (1997), Barzel states that those in a position to improve an asset's value must be the residual claimant of the asset's property rights. The incentives provided by the ownership of the asset would result in this person making his best efforts to reach the best result, which yields a socially optimal result. His proposition is in line with the models presented by Grossman and Hart (1986, see also Hart 1995), although Barzel points out some divergence with these authors.

In explaining his theory, Barzel (1997, page 80) makes a proposition about an empirically testable hypothesis in the legal market. According to him,

> The model here is testable. For instance, it yields a prediction as to the type of legal services one is to employ. In the case of someone who seeks such services, the more he or she can affect the outcome by his or her own behaviour, the greater is the person's expected share in the outcome variability. Thus, an explicit dispute about money between a firm and a party it deals with that depends primarily on the legal aspect of the argument is expected to be handled by an outside lawyer on a contingence fee basis, not by the firm's own in-house counsel.

To test this prediction, it was assessed with the same methodology earlier described as the preponderance of *de facto* aspects over *de jure* aspects in each legal area. The legal area received the score 1 if judicial cases in this area rely solely in *de facto* aspects, 7 if it depends solely on *de jure* aspects and 4 if both aspects have the same weight. The results were found to not be significant in all regressions and these equations were excluded from the results.