RENEGOTIATION OF INFRASTRUCTURE TRANSPORT CONCESSION CONTRACTS IN PERU: AN EMPIRICAL ANALYSIS

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Abstract

The higher frequency of renegotiation of the transport infrastructure concession contracts motivates this paper. Applying a survival and time series analysis for the Peruvian infrastructure transport concession contracts, I found that the hazard of renegotiation increases due to some limitations at the designing and bidding process of the concession contracts, in particular, due to the incomplete expropriation of land at the beginning of the operation, the mechanism of regulation considered (price cap without RPI-X), the economic importance of the operator (number of countries in which the firm operates) and the award criteria (at the auction stage). Also, I found some correlation between electoral cycle and the incidence and re-incidence of renegotiation. These results could suggest some problems in the designing of contracts and a probable firm and/or government's strategic behavior considering the opportunities of future renegotiation of the contracts. As a consequence, a significant majority of the transport infrastructure concession contracts remain unmodified no more than 1.25 years. Certainly, these conclusions motivate further research on the contract theory in utilities for the Peruvian case, mainly its impact on the society.

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Key words: Survival analysis, Concessions, Renegotiations, Infrastructure, Transport

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1.- Introduction

In February 2001, the Peru's Jorge Chavez International Airport concession was granted and just after almost two months the contract was modified; in the next three more months, it was modified again. At 2011, this concession experienced five changes. One of the reasons of that was the incomplete land expropriation process at the beginning of the bidding process.[1] On the other hand, the interregional highway concession in the Peruvian south (specifically, IIRSA-Sur), sections 2, 3 and 4, as part of the Initiative for the Integration of Regional Infrastructure in South America (IIRSA), begun in August 2005 costing US$800 millions, however after five years, the concession contract was modified up to seven times, being the actual cost of the project US$1800 millions, because an initial miscalculation in the technical feasibility project.

Considering the actual 26 transport infrastructure concession contracts supervised by the Peru's regulator authority, Ositran, 20 contracts were modified (76%), meaning 68 addendums with an average time from award to first renegotiation of 1.82 years.[2] According to the World Bank, Peru has the highest rate of renegotiation in the region.[3]

Certainly, no contract is perfect, but it is essential to be aware of its imperfect nature due the presence of transaction costs (Coase, 1937; Williamson, 1995), and, it is not possible that contracting parties may define *ex ante* or predict all the contingencies that occur after the signing of the contract. Moreover, even if that is possible, it would be very expensive to explicit it into a contract and pretend that courts or authority be able to check all actions under each contingency to enforce them (Tirole, 1999).[4]

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[1] An investment commitment by the operator was the construction of a second runway at the 14th year of the concession. Due to the incomplete process of land expropriation required to meet this commitment, the contract had to be modified.

[2] According to Guasch (2004), renegotiation incidence and average time until renegotiation in Latin America and The Caribbean transport sector were 55% and 3.12 years, respectively.

[3] Newspaper "El Comercio", from Friday 3th, June 2011. Pp. B-13.

[4] For a very concise review of the literature studying the different factors that contribute to the success or failure of a concession, influencing the incidence of renegotiation, see Guasch (2004).

Furthermore, although the renegotiation of contracts may arrive at a better contract that could improve the social welfare, the concern focuses on the fact that the frequent changes could be due, rather, a bad designing or awarding process of the concession contracts, or a strategic behavior by the firm or the government, situation that will affect the society. This paper deals with that concern, trying to identify the main determinants of the renegotiation of transport infrastructure concession contracts in Peru.

There is a previous specific literature that studies the determinants of renegotiations of contracts from a theoretical and/or empirical perspective such as, Guasch et al. (2003, 2005, 2006 and 2008) and Guasch (2003 and 2004). In general, Guasch and his co-authors work over a theoretical model focusing on an analysis of firm-led renegotiation, obtaining a equation for the probability of renegotiation that allows them to derive theoretical prediction for some variables (mainly, infrastructure sector, activity, year of award, award criteria, size and duration of the concession, the institutional and regulatory context, the type of regulatory framework, the evolution of the main economic variables and the timing of national and local elections) related to concession contracts in different countries of Latin America and The Caribbean, covering the water and transport sectors for a period of 12 years and more than 300 concessions.

Applying a probit analysis, the authors find that conditions conducive to renegotiations are combinations of contract characteristics, regulatory environment and economic shocks. Specifically, the main pointed to renegotiations being more likely during recessions or after devaluations, after elections, for concessions awarded before a proper regulatory agency was put in place, regulated by a price cap, and when the contract included some type of minimum income guarantee. Also, the existence of investment was shown to reduce the incidence of renegotiation, while a worse institutional environment (captured by an index of bureaucratic quality) increases it. The table 1 shows the marginal effect of significant variables on the probability of renegotiation.

[Insert Table 1]

In addition to this, Ositran has also showed concern on the renegotiations. Indeed, some specialists developed technical reports analyzing the designing and awarding process of the concession contracts delivered by Proinversion (a public entity in charge of the promotion of the private investments in Peru). Fortunately, those reports were turned in academic working papers. Firstly, Fierro (2011) focuses on the importance of completing the expropriation of land process prior the signing of a concession contract; otherwise, the society's deadweight loss can be important. Making an analysis over a concession contract of a highway in the southern Peruvian coast, the author identifies some adverse qualitative impacts to the facilities' users, such as, delays by not having an adequate provision of infrastructure, lower chances of receiving more and better services, negative perception by the population because the increased of the fees for an unfinished road or delays in the execution of works because the uncompleted land expropriation process.

Secondly, Montesinos and Saavedra (2011) make a revision of the concession contracts in the Peruvian transport sector characterizing the key determinants of the renegotiations such as, redesign of works (i.e. delays in the construction stage), problems with financial sustainability of the concession, the subsidies transfer from the government to the firm and the extension of the term of the contract. Basically, the authors verify the empirical evidence found by Guash (2004) (Table 1) in the Peruvian case, making an analysis over the concession contracts supervised by Ositran in the ports, airports, roads and railways sectors.

Perhaps, Guasch and his co-authors, and Montesinos and Saavedra are the only ones who have estimated the probability of renegotiations in the transport sector at the Latin American and The Caribbean region and Peru, respectively, using the same methodology: a probit analysis. On the contrary, my paper distinguishes from the previous ones by applying a different methodology. Firstly, a duration analysis, based on Lancaster (1990) and Jenkins (1995, 2005) literature, in order to estimate the hazard of renegotiation of the Peru's transport infrastructure concession contracts and how long time they remain unmodified. An interpretation for a hazard function θ is that $\theta(t)dt$ is the probability of exit

from a state (leaving the "unmodified status") in the short interval of length *dt* after *t*, conditional on the state still being occupied at *t*. If *T* is length of a contract's time unmodified, measured in months, then $\theta(20)$ is (approximately) the probability of becoming a renegotiated contract between the months 20 and 21. The phrase "becoming a renegotiated" reflects the fact that the contract was unmodified up through month 20. That is, $\theta(20)$ is roughly the probability of becoming a renegotiated contract between months 20 and 21 conditional on having been unmodified through month 20.

Secondly, I estimate a quarterly-time series analysis with the aim of identify any relationship between electoral cycles and the incidence (and re-incidence) of renegotiation, trying to find any observational consequence depending on who initiates the renegotiation: more electoral votes (or populism), corruption or capture, or mutual interest, whether the renegotiation is initiated by the government, the concessionaire or both, respectively.

In the duration analysis I found that the transport infrastructure concession contracts remain unmodified few months, indeed no more than 1.25 years. I highlight that some critical variables regarding the designing (incomplete land expropriation process and mechanism of regulation of tariffs) and awarding (award criteria and economic importance of the operator) explain why the contracts in Peru survive short periods of time without being renegotiated.

In the time series analysis I found a positive statistically significant effect of the electoral cycle on the incidence (and re-incidence) of renegotiation whoever has initiated the renegotiation process

Up to my knowledge, there are not other papers using duration analysis on economics regulation. However, it has been used most often in apply work, such as, labor economics (unemployed/employed; employed/retired), marriage (married/separated), receipt of cash benefits (receiving benefit/receiving neither), housing tenure (owned-outright/owned with mortgage), crime (release of prison/recidivism), etc. (Lancaster, 1999; Jenkins, 2005 and Wooldridge, 2010).

On the other hand, the calculation of hazard rates of renegotiation is very important for the Peruvian context, in which the incoming new concessions require learning from the past experience in

order to guarantee, as much as possible, more stable contracts, and a clear and confident rule of law. Moreover, quantitative estimations of hazards rates of renegotiation lead to a better risk allocation when selecting and contracting public investment projects (Hinojosa, 2011). As I said at the beginning, the renegotiation of the IIRSA Sur concession contract in an interregional highway concession in the Peruvian south led an increase in costs more than doubled. An interesting study in Chile, by Engel et al. (2009), compares the renegotiated amounts with those invested and originally projected, finding that the costs of the projects increase 33% over the original investment estimated by the technical bids. Thus, the government and regulator can reduce transaction costs by identifying the main determinants of renegotiation.

The rest of the paper is as follows. Section 2 describes the Peruvian concession process and gives details about the database used. Section 3 presents the econometric models and the results. Section 4 concludes.

2.- The stages of concession process and data

I use a cross section data of 21 (of 26[5]) concession contracts of transport facilities –2 airports, 3 ports, 14 roads and 2 railways- regulated and supervised by Ositran (Table 2) granted between 1999 and 2010. This data contains information of some characteristics about the designing and awarding process and also some institutional features related to each concession contract.

[Insert Table 2]

Designing, awarding and supervising transport infrastructure concession contracts

The first stage of the concession process is the designing of the contract. Proinversion, a public entity in charge of the promotion of private investment in infrastructure and other regional projects, designs the concession contract. Achieving an appropriate balance between the different objectives of stakeholders (private companies on the one hand and the Estate on the other) is ultimately the target pursued by a designer of a concession contract (Kerf et al., 1995). This stage is very important because

[5] The rest of the concession contracts were not consider given that (i) one of them was granted in 1994 (and was supervised by the Ministry of Transport and Communications until the creation of the regulation authority, Ositran, four years later); and, (ii) the other four were granted during 2011.

the incompleteness of contracts. The role of Proinversion consists on the designing of specific rules for each part of the contract, choosing legal instruments, allocating responsibilities, designing pricing rules and performance targets, determining bonuses and penalties, duration and termination, adaptation mechanism to new or unforeseen circumstances and designing dispute settlement mechanisms. These items should be considered in every contract. During this stage, Ositran has a relevant participation, giving its opinion and recommendations about the draft version of the concession contract. Normally, the regulator's opinion is binding over contractual clauses related to tariff, quality of service, access conditions; otherwise, about clauses other than those mentioned -the criteria of selection in the auction process, for example- that opinion is not necessarily considered by Proinversion.

The awarding process of the contract constitutes the second stage. Proinversion is also responsible of the auction process choosing the award method, making decisions about prequalification and shortlisting, determining bid structure and evaluation method, determining bidding rules and procedures, and proceeding with the bidding.

After a contract is signed by the government and the winner bidder, the latter begins with the operation during the time agreed by contract (defined in the designing stage: more than 25 – 30 years, frequently) and the former supervises and regulates the operator through Ositran.

Here begins the third stage during which regulatory institutionalism is an important feature in order to guarantee contractual agreements: Ositran exercises its regulatory function as an autonomous regulatory agency implementing regulatory rules (determining the tariffs for regulated services based on efficiency, equity and affordability criteria for the sake of users, and seeking always the financial sustainability of the facility), surpervising and monitoring (verifying the compliance of the committed investments and the operation of the infrastructure according to service and quality standards agreed) and enforcing rules (imposing penalties, for example). In addition, when a process of renegotiation of a concession contract is initiated by the operator, government or both, Ositran must issue opinion on

whether the amendment is made at 100%, partially or not applicable. This opinion is complemented with the Ministry of Transports and Communications' one.

Data characteristics

The most interesting feature of the data is the frequency that concession contracts are modified or renegotiated. There are concession contracts that have been modified more than once (up to six times, inclusive) (Graph 1) and within short periods of time (three times within a year, for example) (Graph 2).

[Insert Graphs 1 and 2]

Thus, the incidence (and re-incidence[6]) of renegotiation is critical. Many renegotiations in short periods of time could be suggesting: on the one hand, a bad designing and awarding process, besides restrictions on the regulatory activity over them, and also no learning curve from the past experience; and, on the other, perhaps a signal of strategic behavior by the operator, the government or both.

In order to assess if there are any relationship between the designing, awarding and monitoring process, and the renegotiation of concession contracts, I considered some available variables according to the stages of concession contract mentioned previously, i.e. (i) designing process; (ii) awarding process; and (iii) exercise of regulatory function. Even these variables are similar to those used by Montesinos and Saavedra (2011) and Guasch (2004) in their probit analysis, the methodology I apply, a hazard and time series analysis, is different.

For the designing process, I use the following variables for each transport infrastructure concession contract: *typereg*, a dummy variable taking values 1, when the mechanism of regulation is a price-cap scheme without RPI-X, and zero if a price-cap scheme with RPI-X is considered; *land*, a dummy variable been 1 if the 100% of lands was given to the operator before subscription of the contract and zero otherwise; *finance*, a dummy variable taking values 1 in case of a private operation and zero for a private-public partnership (PPP); and, *duration* which is the length (in years) of the contract.

[6] That is, those modified contracts renegotiated again.

Summary statistics on these variables show that most frequent renegotiations (also within the first and second year of life of the concession) have placed mainly in the case of contracts with price-cap without RPI-X schemes, percentage of delivered lands to the operator below 100%, funded by a PPP mechanism and exceeding 15 years of length.

[Insert Table 3]

Regarding the awarding process of the contract, I use the following variables: *bidders*, which is the number of firms competing for a concession contract in the auction; *foreign*, a dummy variable which takes 1 if the operator is a Peruvian firm and zero whether the firm is a foreigner or associated one with a local firm; *impope*, as a proxy of the economic importance of the operator according to the number of countries (besides of Peru) in which the firm operates; and, *criteria*, a dummy variable with 1 if the selection criteria implied an economic transfer from the firm to the government, and zero, otherwise.

The descriptive data shows that most frequent renegotiations (even in the first and second year of life of the concession) have placed mainly when the auction is not competitive (fewer bidders pursuing the concession contract), the concessionaire is a national or local operator and use to operate in more than one country (besides of Peru), and the criteria of selection in the auction implied a monetary transfer (lowest subsidy and/or a canon as the highest periodical payment from the concessionaire to the government).

On the other hand, for the exercise of the regulatory function (mainly, monitoring and supervising roles by Ositran), I use the following variables: *expreg*, which is the experience of the regulator measured in years; *timeopi*, is the maximum time (in days) (mandatory by law) the regulator must issue any opinion about the project of new concession contracts; *accepted* is the percentage of acceptations by Proinversion of the regulator´s opinions on draft versions of concession contracts (designed by Proinversion). In addition, in order to control for the macroeconomic environment

(economic conjuncture), *gdp*, the yearly gross domestic production percentage change is considered to account for a possible impact of economic cycle.

The data shows that most frequent renegotiations has occurred between the 6th and 10th year of experience of the regulator, in cases where Ositran used the maximum time to provide opinions and when the percentage of opinions accepted by the concession contract's designer (Proinversion) is between 70% and 90%.

Finally, to estimate the relationship between electoral cycles and renegotiation, I regressed the incidence of renegotiation (i.e. modified concession contracts in a quarter-yearly / total number of concession contracts in a quarter-yearly) and re-incidence of renegotiation (i.e. modified concession contracts renegotiated more than once in a quarter-yearly / total number of modified contracts in a quarter-yearly) initiated by the operator, the government or both of them on a dummy variable, *electoral cycle*, which takes 1 if the quarter is an electoral period, and zero, otherwise. The quarterly gross domestic production percentage change is also used as control.

These time series exercises are basically motivated in Graphs 3 and 4, in which apparently it can be observed how the number of modifications increases with the electoral turnover. There are three observational consequences that can be inferred from this, depending on who initiates the renegotiation, more electoral votes (or populism), corruption or capture, or mutual interest, if the renegotiation is initiated by the government, the concessionaire or both, respectively.

[Insert Graphs 3 and 4]

3.- Econometric methodology and results

Two exercises are made. Firstly, given the small number of observations (21 concession contracts, granted between 1999 and 2010), the exercise consists on looking at the transition from the state 'no renegotiated' to the state 'renegotiated' of each concession contract, conditioned on time-invariant (and some time-variant) covariates in time applying a survival and hazard (nonparametric and parametric) analysis. Secondly, as it was explained before, a time series analysis is implemented in order

to test any observational consequence between the incidence (and re-incidence) of renegotiation and electoral cycles.

3.1.- The survival and hazard analysis

Following to Lancaster (1990), I use a survival analysis to model the time taken between the granting of a concession contract and its renegotiation. A nonnegative random variable *T* is defined here as the duration (or spell) between the granting and the renegotiation. Let us define the probability that a concession contract that has occupied a (unmodified) state for a time *t* leaves it in the short interval of length *dt* after *t*. The probability that such a contract leaves the state within an interval *dt* at or after *t* is $P(t \le T < t + dt \mid T \ge t)$, where the conditioning event that $T \ge t$ is just the event that the state is still occupied at *t*, that has not left before then. Dividing this probability by *dt*, we get the average probability of leaving per unit time period over a short time interval after *t*, and by considering this average over shorter and shorter intervals, the hazard function is:

$$(1) \qquad \theta(t) = \lim_{dt \to 0} \frac{P(t \le T < t + dT \mid T \ge t)}{dt} = \frac{f(t)}{1 - F(t)} = \frac{f(t)}{S(t)},$$

which is the instantaneous rate of leaving per unit time period at *t*.[7]

$\theta(t)dt$ can be interpreted as the probability of exit from the unmodified state in the short interval of length *dt* after *t*, conditional on the state being occupied at *t*. It is also perfectly sensible to talk about the probability of exit in the short interval of length *dt* after *t without* the condition $T \ge t$, but this is a quite different concept from the hazard function. The hazard function gives the probability that a contract will be modified at its twentieth month of operation whereas the unconditional concept gives the probability that a concession contract will be modified at the twentieth month of operation. In terms of relative frequencies $\theta(20)dt$ gives the proportion of twenty-months-operating contract which is modified within

[7] Equation (1) can be understood as: $\theta(t) = Risk = \frac{P(Failure)}{P(Survival)}$, where Failure is the unconditional probability that an event will occur, Survival is the probability that "up until now" the event has not yet occurred, and Risk is the conditional failure rate –given the event has not yet occurred, what are the chances that it will occur? [Available at: https://files.nyu.edu/mrg217/public/essex.htm , visited on Febrary 2nd, 2012]

dt at its twentieth month of operation. The unconditional concept gives the proportion of contracts which is modified within *dt* at the twentieth month of operation.

Let the duration distribution function be $P(T < t) = F(t)$, $t \geq 0$, at the point *t*, and the associated probability density function be $f(t) = dF(t)/dt$. *f(t)*is sometimes known as the unconditional failure rate. Survival analysis makes use of the complement to the cumulative distribution function and is written as $S(t) = 1 - F(t) = P(T \geq t)$.That is, the survival function gives the contract's probability of survival remains unmodified to *t*, and also can be expressed as[8]:

$$(2) \qquad S(T) = \exp\left\{-\int_0^t \theta(s)ds\right\}.$$

and, from (1) and (2):

$$(3) \qquad f(t) = \theta(t)\exp\left\{-\int_0^t \theta(s)ds\right\}$$

For a parametric estimation, I am also introducing regressors (time-invariant and time-variant covariates), relevant characteristics (vector X) from the concession contracts data (section 2), into the hazard function. Thus, at *t* this is defined as being conditional on the value of X:

$$(4) \qquad \theta(t;x) = \lim_{dt\to 0} \frac{P(t \leq T < t + dT \mid T \geq t, x)}{dt} = \frac{f(t;x)}{S(t;x)} = \exp\left\{-\int_0^t \theta(s;x)ds\right\},$$

with time-invariant-covariates, and,

$$(5) \qquad \theta(t;X(t)) = \lim_{dt\to 0} \frac{P(t \leq T < t + dT \mid T \geq t, X(t+dt))}{dt} = \exp\left\{-\int_0^t \theta(s;X(s)ds\right\},$$

with time-variant covariates.

Nonparametric estimation

Recall that the hazard, $\theta(t_j)$, is the rate at which spells are completed at duration t_j, conditional upon the spell having a duration of at least t_j. So, a natural estimator for $\theta(t_j)$ is: $\hat{\theta}(t_j) = d_j / n_j$, i.e., the number of "failures" at duration t_j, divided by the number of spells "at risk" at duration t_j. The

[8] For the detailed mathematical derivation of the hazard and survival functions in nonparametric and parametric estimations see Lancaster (1990:6-8) and Jenkins (2005: 55-58).

corresponding estimator for the survival function is: $S(t_j) = \prod_{i=1}^{j}(1-\frac{d_j}{n_j})$, which indicates the probability of surviving past time *t*, and is the so-called Kaplan-Meier (product-limit) estimator. From this can be estimated the Nelson-Aalen estimator cumulative hazard: $\hat{H}(t_j) = \sum_{j|t_j<t}\left(\frac{d_j}{n_j}\right)$, which measures the total amount of risk accumulated up to time *t*, that is, the expected number of failures at each observed time is just the number of failures at each time period divided by the number at risk, i.e. d_j/n_j. The cumulative hazard rate is just the sum of these over time.

The tabular form of the Kaplan-Meier estimates are in Table 4 (column 5), obtained in STATA, which basically tell us the probability of contracts surviving past time *t*. According to this, the 45% of the total of concession contracts remained unmodified after the 15th month, the median duration is between the 14th and 15th month, and closely to the 45th month, and practically all concession contracts are modified.

[Insert Table 4]

Graphically, the Kaplan-Meier survival function (Graph 5.a) starts at 1 since all contracts are unmodified at $t = 0$. However, it declines as they are modified (fail) over time. In addition, cumulative hazard function (Table 4.b and Graph 5.b) can be thought of as the total number of expected (failures = renegotiations) in (0, *t*) for a contract, if renegotiation were a repeatable process (which indeed it is!). Thus, graph 5.b suggests that it can be expected to renegotiate (failure) two times in a period of 3.5 years, approximately, if they could renegotiate repeatedly.

[Insert Graph 5]

Looking at how the survival times vary according to whether the concession contracts were granted considering some characteristics, it can be seen that only the nonparametric estimation for the data subgroups stratified by criteria of selection (Graph 7.f) shows a clear pattern indicating that contracts being awarded by an economic transfer (dummy variable with 1) appear to have shorter

survival times[9]. This observed difference in the survivor functions is statistically significant[10]. However, for the other variables, during the time analysis, even the survival function decreases, it is not clear the pattern of each subgroup, even the economical importance of the operator, in which the observed difference in the survivor functions is not statistically significant (Graphs 7.a – 7.e). This makes more appropriate to explore the parametric estimation.

Parametric estimation

Even if an underlying duration is properly viewed as being continuous, measurements are necessarily discrete. When the measurements are fairly precise, it is sensible to treat the durations as continuous random variables. But when the measurement are coarse –such as monthly, or perhaps even weekly- it can be important to account for the discreteness in the estimation (Wooldridge, 2010).

For the parametric estimation, I estimate a discrete time model based on Jenkins (1995 and 2005)'s "easy estimation" methods, applying a standard binary dependent variable model, in which for each concession contract there are as many data row as there are time intervals at risk of the event occurring for each contract. If concession contract *i*'s survival time is censored, the binary dependent variable is equal to 0 for all *i*'s spell months; if contract *i*'s survival time is not censored, the binary dependent variable is equal to 0 for all but the last of *i*'s spell months (month 1, …, T_{i-1}) and equal to 1 for the last month (month T_i). Thus, I have a panel data set where each cross section observation is a vector of binary responses with covariates. Because of the sequential nature of the data, time-varying covariates are easily introduced (Wooldridge, 2010).

The discrete time models are estimated by maximum likelihood[11] and, in particular for this paper, I use a discrete time proportional hazard model named the "complementary log-log" and the non-proportional hazard specification named the "logistic". The hazard model with time-invariant can be

[9] This result will be analyzed deeply later.
[10] Two standard test used were the Log-rank and the Wilcoxon tests. If the chi-squared value associated with the test of sufficiently large (associated *p*-value sufficiently small), then the null hypothesis of no subgroup differences in survivor functions is rejected. In this case, the probability that the observed differences occur by chance is 0.0129 and 0.0209 by Log-rank and Wilcoxon tests, respectively. Thus, the null hypothesis is rejected.
[11] See Jenkins (1995: 131-135) and Wooldridge (2010: 1010-1015) for the construction of the likelihood function..

written as $\theta(t;x) = k(x)\lambda_0(t)$ where $k(\cdot) > 0$ is a positive function of x and $\lambda_0(t) > 0$ is called the baseline hazard. This is common to all the concession contracts. Individual hazard functions differ proportionately based on the function *k(x)* of observed covariates (explanatory variables described before). $k(\cdot)$ can be parameterized as $k(x) = \exp(x\beta)$, where β is the vector of parameters I am interested on. Thus, $\log\theta(t;x) = z(t) = x\beta + \log\lambda_0(t)$ and β_j measures the semielasticity of the hazard with respect to x_j.[12] I use the Complementary log-log ("cloglog") discrete time hazard function, *p(t)*, where

$$\log[-\log(1-p(t))] = z(t) \Rightarrow p(t) = 1 - \exp[-\exp(z(t))],$$

and a discrete time proportional hazard model named the Logistic discrete time hazard function ("logistic"), *p(t)*, where

$$\log[p(t)/(1-p(t))] = z(t) \Rightarrow p(t) = [1+\exp(-z(t))]^{-1}$$

The cloglog has the property that the resulting model is the discrete-time counterpart of an underlying continuous-time proportional hazards model (Prentices and Gloecker, 1978[13]). On the other hand, the logistic has exactly the same form as that for a standard binary logit regression model (applied to the reorganized data set). The logistic model turns out to be very similar to the complementary log-log one in most empirical applications. The reason is that the logistic model converges to a proportional hazard model as the hazard rates become increasingly small, and the rate is indeed sufficiently small in most applications. (Jenkins, 1995)

The hazard estimations are reported in Table 5.a. The mechanism of regulation and the percentage of land delivered to the operator at the beginning of the concession are the only significant designing process' explanatory variables. According to the parametric estimation, the sign of the coefficients of these variables suggests that a price-cap without RPI-X regime and contracts granted with a full land expropriation completed process increases and decreases the hazard of renegotiation,

[12] If x_j is the log of an underlying variable, say $x_j = log(z_j)$, β_j is the elasticity of the hazard with respect to z_j.
[13] Cited by Jenkins (1995).

respectively. In addition, the hazard of renegotiation of concession contracts considering a price-cap without RPI-X mechanism of regulation is 5.07 (by cloglog and 5.74 by logistic estimation) percentage points higher than those regulated by price-cap with RPI-X. Moreover, the hazard of renegotiation when the concession contracts are granted with land completely expropriated is 98.65 (by cloglog and 83.86 by logistic estimation) percentage points lower than those granted with an incomplete land expropriation process.

In addition, the predictions (within and out of – sample) performed with the hazard estimations show that for any duration of the contracts (15, 25 and 30 years) the hazard rates of renegotiation increase quickly for those with a price-cap without RPI-X mechanism of regulation (graphs 7.a, 8.a, 9.a, 10.a) or has a short period survival (as an unmodified contract) (graph 10.b). Regarding, the percentage of land delivered to the operator, the predictions exercises report that the contracts remain more time without being modified when that percentage is 100% (graphs 7.b, 8.b, 9.b and 10.c).

[Insert Graphs 7, 8, 9 and 10]

On the contrary, the variables *foreign* and *duration* of the contract are not significant. This suggests that neither the type of financial structure of the concession (PPP or private operation) nor the length of the concession influence on the hazard of renegotiation.

[Insert Tables 5a and 5b]

Regarding the adjudication group of variables, the economic importance of the operator and the award criteria are the only significant invariant covariates and have a positive effect on the hazard of renegotiation; however, their marginal impact is scarce: the operation of the firm in another country in addition to those already involved increases the hazard of renegotiation in just 0.35 percentage points; and, the hazard of renegotiation of concession contracts granted under a criteria of selection considering a economic transfer is 4.67 (by cloglog and 5.17 by logistic estimations) percentage points higher than those granted under a non-economic transfer as a criteria of selection.

Furthermore, the predictions (within and out of – sample) performed with the hazard estimations show that for any duration of the contracts (15, 25 and 30 years) the hazard rates of renegotiation increase quickly for those with an economic transfer as an award criteria (graphs 7.f, 8.f and 9.f) or has a short period survival (as an unmodified contract) (graph 10.g). Regarding, the economical importance of the operator, the predictions exercises report that the contracts remain more time without being modified with operator less important (graphs 7.e, 8.e, 9.e and 10.f).

Perhaps, the negative sign of the variable *bidders* could highlight how a competitive process (more than one bidder at the adjudication process) reduces the hazard of renegotiation, but it is not significant. In addition, the nationality of the operator has not influence on the hazard of renegotiation.

Regarding the institutional variables, only the macroeconomic environment is significant, accounting for a possible impact of economic cycle on the hazard of renegotiation. In the case of the other two variables, experience of the regulator and the percentage of acceptations by Proinversion of the Ositran's opinions on draft versions of concession contracts (designed by Proinversion), the negative sign of the former, which suggests that more Ositran's expertise reduces the hazard of renegotiation, it is not significant; and the latter, apparently would not have any impact on the hazard of renegotiation.

3.2- Quarterly-times series analysis

I implement a quarterly-time series for the incidence of renegotiation (modified concession contracts in a quarter / total number of concession contracts) initiated by the operator, the government or both on an *electoral cycle* dummy variable, taking the value 1 if the quarter is a electoral period, and zero, otherwise. Also, I evaluate if the re-incidence of renegotiation (i.e. modified concession contracts renegotiated more than once / total number of modified contracts) is influenced by the cycle electoral too.

These exercises are basically motivated in Graphs 3 and 4, in which apparently it can be observed how the number of modifications increases with the electoral turnover. There are three observational consequences that can be inferred from this, depending on who initiates the renegotiation,

(i) more electoral votes (or populism), (ii) corruption or capture, or (iii) mutual interests, depending on whether the renegotiation is initiated by the government, the concessionaire or both, respectively.

I want to test if there is any relationship between electoral cycles (measured in quarterly-years) and the incidence of renegotiation in order to find observational consequences as partial evidence of strategic behavior by the operator, the government or both.

The models to be estimated are:

$$Incidence\ of\ \ renegotiation_t = \alpha_t + \gamma\, Electoral\, Cycle_t + \beta\ GDP_t + \varepsilon_t \qquad (1)$$

$$Incidence\ of\ \ renegotiation_t = \alpha_t + \gamma\, Electoral\, Cycle_{t+1} + \beta\ GDP_t + \varepsilon_t \qquad (2)$$

$$Incidence\ of\ \ renegotiation_t = \alpha_t + \gamma\, Electoral\, Cycle_t + \beta\ GDP_{t-1} + \varepsilon_t \qquad (3)$$

where γ is the parameter of interest for the dummy *Electoral Cycle*$_t$ taking the value 1 if the quarter-yearly is an electoral period (or in the next quarter) and zero otherwise; GDP_t and GDP_{t-1} is the current and lagged yearly gross domestic product (percentage change), respectively, and ε is the error term. The dependent variable *Incidence of renegotiation*$_t$ (and *Re-incidence of renegotiation)* is measured as the ratio "number of modified concession contracts in the quarter-yearly t to stock of concession contracts modified and unmodified in the quarter-yearly t" (and "number of more than once modified concession contracts in the quarter-yearly t to stock of concession contracts already modified in the quarter-yearly t") . The results of regressions are displayed in Tables 6.

[Insert Table 6]

In general, results show a positive statistically significant effect of the electoral cycle on the incidence (and re-incidence) of renegotiation whoever has initiated the renegotiation process (columns 1 and 2 in each table). Moreover, when the dependent variable is the incidence (and re-incidence) of renegotiation initiated by the firm (columns 5 and 6 in each table), the electoral cycle has a positive statistically significant effect either with the current quarterly percent change of the PIB or with a lagged one period quarterly percent change of the PIB (tables 6.a. to 6.d). But, when the cycle electoral is

forwarded one quarter, this variable has a positive statistically significant effect on the re-incidence of renegotiations initiated by the government (tables 6.e and 6.f).

4.- Concluding remarks

The estimations suggest that the transport infrastructure concession contracts remain unmodified few months, indeed no more than 1.25 years. Certainly, it is a very short duration compared to the 3.12 years, in average, calculated by Guasch (2004) for the Latin American region. However, it is important have on consideration that *per se* a renegotiation is not bad unless the new conditions of the modified contract do not improve the welfare of the parts (operator and government). Certainly this paper does not analyze the impact of the renegotiation but is concerned on why the contracts do not survive more time without being modified. As I mentioned in the introductory section, applying a survival analysis, I highlight that some critical variables regarding the designing and awarding process of a concession contract could be explaining why the contracts in Peru survive short periods of time without being renegotiated.

According to the Ositran's Legal Advisory Area, the main reasons which have determined amendments to the infrastructure concession contracts are related to: (i) "works", which represents 47% of the cases of the renegotiations, meaning procedures for recognition of work in progress, details of some technical aspects, and additional investments necessary to modify the construction of the infrastructure; (ii) "funding" and "assets of the concession", each one with 10%. The former means some limitations accessing to financial support by banks, which will make easy the execution of the works or the operation of the concession; the latter refers to features about the concessions' assets in terms of ownership and management; (iii) "budget difficulties", which represents 8% of the renegotiations (and only related to Public-Private Partnership highway concessions), caused by necessary upgrade of the initial budget (which was elaborated based on preliminary studies before the concession) necessary for additional works and new traffic flows conditions roads; (iv) "payments to the operator", "extension of duration of the contract" represent 6% each one. While the former refers to the

recognition of additional activities defined at first place by contract, the latter deals with the term of the contract; (v) “land expropriation” and “completion of the contract” controversies have 5% each one; (vi) arbitrage controversies with 4%; (vii) “tariffs settings” and “retribution to the state” with 3% each one; and, (viii) “others" categories such as modifications to the first technical design, salaries, insurance and guarantees. In some way, the variables I used in the survival analysis are in relation with the previous issues, such as, land expropriation, mechanism of regulation (tariffs), award criteria, finance of the concession (PPP or private), and duration of the contract.

The incomplete process of expropriation of land adjacent to areas of scope of concessions is the first critical variable, which has a strong statistical effect on the instability of the contracts. Looking at the sample, 64.7% (11 contracts) of the 17 renegotiated contracts were granted with an incomplete land expropriation process (Table 3). The problem is compounded because many contracts have an explicit clause of granting revocation for failure in delivering of land. Fierro (2011) explains in a deeply way the consequences of this issue. The Ministry of Transport and Communications, entity in charge of the mechanism of land expropriation, is constrained with some difficulties to complete the process. Problems such as failing to reach an agreement in prices with the landowners, finding them in their locations (because many do not live in the city or in the country), or some legal problems associated with the property (licenses, taxes, etc.) take place.

Thus, an adequate study of the land conditions has to be performed before any concession process. Otherwise, problems will arise given the delays in the construction phases of the concession, which will lead to make amendments to the contracts. Moreover, it could create a not convenient precedent that may be rather used for strategic purposes by new operators, knowing that it is possible to modify the contract in the future concession contracts grants. In terms of social welfare, users and government are losers, the former because they cannot have an on time access to the facilities (paid with taxes, in essence) and the latter have to change conditions (in the contract) as a consequence of the renegotiation, besides the deterioration of its reputation from an institutional perspective.

On the other hand, trying to understand why the mechanism of regulation determines a lower survival rate of the concession contracts is not simple. According to my estimations, the hazard of renegotiation considering a price-cap without RPI-X mechanism is between 5 and 6 percentage points higher than those contracts regulated by a price-cap with RPI-X mechanism. Contrary to the Guasch and others' studies, in which the contracts analyzed are regulated through a price-cap, rate-of-return or hybrid regimes, in the Peruvian case, price-cap (with or without RPI-X) has been the regime most widely used. When the RPI-X is not considered, the tariffs were contractually stipulated (price-cap) and updated by a polynomial formula (considering the inflation rates, mainly).

Looking at the sample, 76.5% (13 contracts) of the 17 renegotiated contracts were granted with price-cap without RPI-X (Table 3), in roads and railways, particularly. Looking at the addendums in more detail, one can see that the reasons why an operator renegotiates a contract depend of many factors which are tied. For example, Proinversion arrives to the final design of the concession contract after a referential or a pre-feasibility study of the project, instead of feasibility one. So it is possible that this fact makes that the operator demands a change in the tariffs set by contract because the projected demand in the referential study was wrong. However, even the RPI-X mechanism had been considered[14], this do not necessary decrease the intention to renegotiate, because all the risk of demand (and input costs) is transferred to the operator, motivating instead a renegotiation for change the minimal conditions of standards quality of some inputs (Guasch, 2004).

The award criteria is the third critical variable, which increases around 5 percentage points the hazard of renegotiation when they were granted under a economic transfer, such as the highest transfer fee, used in the first concession contracts at the end and beginning of 2000, in the case of the International Airport Jorge Chavez, the Matarani Port, and the Central, South and South-West Railways.

[14] For roads, railways and for the first and second group of regional airports the tariffs were stipulated in the contract. However, for the ports and the International Airport, tariffs were fixed during a first period of time, and from then the contract orders the application of the RPI-X, every five years. According to the theory of regulation, one advantage of the RPI-X regulation mechanism is the incentive it places on firms to improve efficiency (Viscusi, et al., 2005).

Looking at the sample, 82.4% (14 contracts) of the 17 renegotiated contracts were granted considering an economic transfer as award criteria (Table 3).

The theory of auctions explains that through an auction wins the highest efficient firm, however, it is important considering the award criteria given the risk that a firm bids a to high offer ("the winner's curse") that rather, in the future, cannot fulfill with the clauses of the contract, for example, the committed investments (Demsetz, 1968). An example of this, was the International Airport Jorge Chavez concession that was granted to a consortium (led by Frankfurt Airport operator, Bechtel, and a local partner), which submitted the highest bid, given that the criteria of selection was the percentage of the gross revenue that the operator would commit to turn over to the state.[15] Shortly after the award, the concession contract was renegotiated at the end of 2003, because the operator has been delaying agree-upon investments. Hinojosa (2008) recalls the importance of mitigate a potential renegotiation due to problems of "lowballing", which refers to the case in which a bidder could make a risky bid (a high payment) in order to make a subsequent contract renegotiation, which would be facilitated by contractual gaps and a high capacity of lobby.

The economic importance of the operator is the fourth variable that has an effect on the duration of contracts being modified in shorter periods. Approximated by the number of countries besides of Peru, in which the operator runs other utilities, it implies higher possibility of getting experience ("learning by doing") at the auction stages of the contract with strategic purposes. As Guash (2004) explains, once players anticipate renegotiation, the game changes strategically. The objective is to secure the concession and renegotiate for better terms. That might induce risky offers and lead to the selection not of the most efficient operator but one most skilled in renegotiation.

In Peru there is a particular situation with a Brazilian firm, which has an important participation in the construction of the highways of IIRSA-Sur (and also in another infrastructure sectors -e.g.

[15] The winning bid offered the state 47% of gross revenue in addition to a commitment to invest more than US$ 1 billion and construct a second landing strip by the 11th year of the 30-year concession. As Guash (2004) says, it means that from the residual 53% of gross revenue, the operator will be able to cover operating costs, amortize investments, and earn a fair rate of return on investments.

hydroelectric- in Peru and in other countries). Its reputation in the media is that it has a strong lobby influence on the government. An anecdotic situation results the construction of a monument for a former president as a "donation".[16]

Finally, regarding the impact of economic cycle on the hazard of renegotiation, it can be conjectured that Peru has been experimenting interesting growing rates in the last 10 years, influencing the incidence of renegotiation. However, this fact is more interesting if is seen jointly with the electoral cycles.

Applying a quarterly-time series analysis, I find a positive correlation between electoral cycles and the incidence (and re-incidence) of renegotiation. Thinking on corruption and mutual interests suppose that operators see the government as an entity subject to influence, increasing their possibilities of renegotiation, and capture additional rents (Guash, 2004). Regarding populism, an interesting paper by Mejía et al. (2008) analyzed the factors that explain budgetary allocations for road infrastructure during the first Uribe administration, in Colombia. Concretely, the analysis contrasts the importance of technical and political criteria in budgetary decisions. Their evidence suggests that some political criteria have predominance and that technical criteria have no incidence in the definition of investment on road infrastructure. Their data shows a positive relationship between spending on roads and holding Consejos Comunales, supporting the hypothesis that spending on road infrastructure is a populist.

The results I obtained in time series analysis let me make some conjectures related to the Guash (2004) and Mejia et al. (2008) findings. First, the electoral cycles influence the incidence and re-incidence of renegotiation. During the 1990s and the first half of the 2000s the political speech was that Peru had to be open to the foreign investment for the operation of public firms under efficiency criteria. Privatization was the first option and the government initiated an aggressive way of privatizations and concessions. However, during the second half of the 2000s and beginnings of 2010 - 2012 period, the political speech changed to "social inclusion" is necessary. Precisely, during the Alan Garcia's

[16] See: http://www.larepublica.pe/13-06-2011/odebrecht-es-el-aportante-del-cristo-de-alan-garcia

government have the highest rates of incidence of renegotiation suggesting a conflict between technical and political criteria. The designer of the concession contracts gave signals that the goal was "sell" as soon as they can because it is important for the Peruvian economic development.

The result is a suboptimal concession contract. For instance, the interregional highway concession in the south of Peru (IIRSA-Sur), sections, 2, 3 and 4, which were granted with the low subsidy as an (economic transfer) award criteria. In this particular case, as I mentioned above, the design of the contract depends on the preliminary technical studies conducted by Proinversion, determining a total cost of the project in US$ 0.8 billion, however the concession contract was modified given that the true cost of the project was US$ 1.8 billion, because an initial miscalculation in the technical feasibility project.

I have to recognize some limitations of my estimations. Firstly, a weakness of the econometric estimates is that, one could argue contract clauses are endogenous (Guasch, Laffont, and Straub, 2003), because two dimensions: (i) an ex ante self-selection problem, because the contracting parties would select specific clauses, type of regulation, and financing according to their (sometimes unobservable) characteristics or to the characteristics of the project. This can be the case of the conflict between technical and political criteria in the Peruvian policy of concessions, and (ii) an ex post moral hazard problem. Once the contract has been signed, the firm and the government would act strategically given the nature of this contract.

Secondly, the presence of unobserved heterogeneity ("frailty) given omitted variables (unobservable variables in the available data) or measurement errors in observed survival time or regresors (Lancaster, 1990; Jenkins 2005). If this is ignored, the duration literature suggests several disadvantages: (i) the "no-frailty- model will over-estimate the degree of negative duration dependence in the hazard (i.e. underestimated the degree of positive duration dependence), (ii) the proportionate response of a given regressor on the hazard rate is no longer constant and independent of survival time, and (iii) the presence of unobserved heterogeneity attenuates the proportionate response of the hazard to

variation in each regressor at any survival time. In short the estimate of a positive (negative) β_k derived from the (wrong) no-frailty model will underestimate (overestimate) the "true" estimate.

I do not deal with the first problem considering instrumental variables, but for the second I estimate the frailty models in STATA, and the frailty problem is not important suggesting that my initial results are correct.[17]

Finally, it is important to have on consideration that the sample is small (21 observations), another handicap, so it will be interesting to develop a survival analysis with a sample more extended and establish some comparisons between the Latin American countries. And, this paper is concerned on highlight why the transport infrastructure concession contracts remain unchanged for short periods of time looking at variables which can explain a quickly decreasing rate of survival. From an efficiency perspective, if a concession contract is modified, it is because it improves the Peruvian society welfare. Like in Chile (Engel et al., 2009), research on this topic is an interest issue for future studies.

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Table 1.- Marginal effects of significant variables on the probability of renegotiation

Variable	Marginal effect (%)
Existence of regulatory body	20 – 40
Award criteria	20 – 30
Type of regulation	20 – 30
Autonomy of regulatory body	10 – 30
Investment obligations	10 – 20
Nationality of concessionaire	10 – 20
Extent of competition in award process	10 – 20
Macroeconomic shocks (devaluations)	10 – 15
Electoral cycles	3 – 5
Award process	10 - 20

Source: Guasch (2004)

Table 2.- Concessions of transport infrastructure supervised by Ositran

Infrastructure	Year of subscription
Airports	
1.- Aeropuerto Internacional Jorge Chávez*	2001
2.- Primer grupo de aeropuertos regionales* (Iquitos, Pucallpa, Trujillo, Tarapoto, Cajamarca, Tumbes, Anta, Chachapoyas, Talara, Piura, Chiclayo y Pisco)	2006
3.-Segundo grupo de aeropuertos regionales (Andahuaylas, Ayacucho, Juliaca, Arequipa, Puerto Maldonado y Tacna)	2011
Roads	
4.-IIRSA-Norte (Eje Multimodal Amazonas Norte: Paita – Yurimaguas)*	2005
5.- Red Vial 5 (Ancón – Huacho – Pativilca)*	2003
6.- Red Vial 6 (Puente Pucusana-Cerro Azul-Ica)*	2005
7.- Autopista del Sol Trujillo – Sullana*	2009
8.- IIRSA Sur T5 (Azángaro – Juliaca; Puerto de Matarani e Ilo)*	2007
9.- IIRSA Sur T4 (Azángaro – Inambari)*	2005
10.- IIRSA Sur T3 (Inambari – Iñapari)*	2005
11.- IIRSA Sur T2 (Urcos – Inambari)*	2005
12.- IIRSA Sur T1 (Marcona – Urcos)*	2007
13.- Buenos Aires – Canchaque*	2007
14.- Tramo Vial Nuevo Mocupe – Cayaltí – Oyotún)*	2009
15.- Red Vial 4 (Pativilca – Santa – Trujillo y Puerto Salaverry – Empalme R01N)*	2009
16.- Tramo Vial Óvalo Chancay/Desvío Variante Pasamayo – Huaral – Acos)*	2009
17.- IIRSA Centro Tramo 2*	2010
Railways	
18.- Ferrocarril del Centro*	1999
19.- Ferrocarril del Sur y Sur Oriente*	1999
20.- Tren Eléctrico-Línea 1 (Villa El Salvador – Av. Grau – San Juan de Lurigancho)	2011
Ports	
21.- Terminal Portuario de Matarani*	1999
22.- Nuevo Terminal de Contenedores del Muelle Sur*	2006
23.- Terminal Portuario de Paita*	2009
24.-Terminal de Embarque de Concentrado de Minerales	2011
25.- Terminal Norte Multipropósito en el Terminal Portuario del Callao	2011
26.- Nuevo Terminal Portuario de Yurimaguas - Nueva Reforma	2011

Source: Online portal of Ositran.
*Concession contracts considered in the econometric analysis.

Table 3.- Summary statistics

		(1)		(2)		(3)		(4)		(5)	
		Modified		Modified within 1st year		Modified within 2nd year		Modified within 3rd year		Modified within 4th year	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Mechanism of regulation	RPI-X		4 (23.53)	3 (33.33)	1 (12.50)	2 (18.18)	2 (33.33)	4 (25.00)		3 (20.00)	1 (50.00)
	No RPI-X	4 (100.00)	13 (76.47)	6 (66.67)	7 (87.50)	9 (81.82)	4 (66.67)	12 (75.00)	1 (100.00)	12 (80.00)	1 (50.00)
% of lands given to the operator	<100	4 (100.00)	11 (64.71)	5 (55.56)	6 (75.00)	8 (72.73)	3 (50.00)	10 (62.50)		10 (66.67)	1 (50.00)
	100		6 (35.29)	4 (44.44)	2 (25.00)	3 (27.27)	3 (50.00)	6 (37.50)	1 (100.00)	5 (33.33)	1 (50.00)
Type of Financing	Private	1 (25.00)	9 (52.94)	4 (44.44)	5 (62.50)	7 (63.64)	2 (33.33)	8 (50.00)		8 (53.33)	1 (50.00)
	PPP	3 (75.00)	8 (47.06)	5 (55.56)	3 (37.50)	4 (36.36)	4 (66.67)	8 (50.00)	1 (100.00)	7 (46.67)	1 (50.00)
Duration (years)	15	1 (25.00)	2 (11.76)	1 (11.11)	1 (12.50)	1 (9.09)	1 (16.67)	2 (12.50)		2 (13.33)	
	25	3 (75.00)	8 (47.06)	4 (44.44)	4 (50.00)	6 (54.55)	2 (33.33)	7 (43.75)	1 (100.00)	7 (46.67)	1 (50.00)
	30		5 (29.41)	4 (44.44)	1 (12.50)	2 (18.18)	3 (50.00)	5 (31.25)		4 (26.67)	1 (50.00)
	35		1 (5.88)		1 (12.50)	1 (9.09)		1 (6.25)		1 (6.67)	
	40		1 (5.88)		1 (12.50)	1 (9.09)		1 (6.25)		1 (6.67)	
Bidders	1	1 (25.00)	11 (64.71)	6 (66.67)	5 (62.50)	7 (63.64)	4 (66.67)	10 (62.50)	1 (100.00)	10 (66.67)	1 (50.00)
	2		4 (23.53)	2 (22.22)	2 (25.00)	2 (18.18)	2 (33.33)	4 (25.00)		4 (26.67)	
	3		2 (11.76)	1 (11.11)	1 (12.50)	2 (18.18)		2 (12.50)		1 (6.67)	1 (50.00)
	4	1 (25.00)									
	5	1 (25.00)									
	10	1 (25.00)									
Nationality	No local	2 (50.00)	6 (35.29)	4 (44.44)	2 (25.00)	4 (36.36)	2 (33.33)	6 (37.50)		4 (26.67)	2 (100.00)
	Local	2 (50.00)	11 (64.71)	5 (55.56)	6 (75.00)	7 (63.64)	4 (66.67)	10 (62.50)	1 (100.00)	11 (73.33)	
Economic Importance of the operator (number of countries besides of Peru)	1	1 (25.00)	5 (29.41)	3 (33.33)	2 (25.00)	2 (18.18)	3 (50.00)	5 (31.25)		5 (33.33)	
	2	1 (25.00)	2 (11.76)	2 (22.22)		1 (9.09)	1 (16.67)	2 (12.50)		1 (6.67)	1 (50.00)
	3	1 (25.00)									
	4		3 (17.65)	2 (22.22)	1 (12.50)	2 (18.18)	1 (16.67)	2 (12.50)	1 (100.00)	3 (20.00)	
	7	1 (25.00)									
	14		1 (5.88)	1 (11.11)			1 (16.67)	1 (6.25)		1 (6.67)	
	19		1 (5.88)		1 (12.50)	1 (9.09)		1 (6.25)		1 (6.67)	
	25		1 (5.88)		1 (12.50)	1 (9.09)		1 (6.25)		1 (6.67)	
	31		1 (5.88)	1 (11.11)		1 (9.09)		1 (6.25)			1 (50.00)
	35		3 (17.65)		3 (37.50)	3 (27.27)		3 (18.75)		3 (20.00)	
Selection criteria	No transfer	4 (100.00)	3 (17.65)	3 (33.33)		1 (9.09)	2 (33.33)	3 (18.75)		2 (13.33)	1 (50.00)
	Transfer		14 (82.35)	6 (66.67)	8 (100.00)	10 (90.91)	4 (66.67)	13 (81.25)	1 (100.00)	13 (86.67)	1 (50.00)
Regulatory experience (years)	mean	12.25	7.53	8.67	6.25	7.18	8.17	7.38	10	7.27	9.5
Maximum time to provide opinions (days)	3	1 (25.00)									
	10	1 (25.00)									
	30	2 (50.00)	17 (100.00)	9 (100.00)	8 (100.00)	11 (100.00)	6 (100.00)	16 (100.00)	1 (100.00)	15 (100.00)	2 (100.00)
% of acceptations by Proinversion	mean	.95	.73	.78	.68	.64	.89	.77	0	.71	.83

Note: The first column describes how many contracts were (and not) modified (in general over the 21 concession contracts analyzed) and columns 2 to 5 consider whether a contract was modified within the first, second, third and fourth year according to each variable considered. The sum of values in each block is equal to the number of observations. Percentages in relation to the total of a column are shown in parenthesis.

Table 4.a.- The Kaplan-Meier estimates of unmodified contracts survival

(1)	(2)	(3)	(4)	(5)	(6)
Time	Total number of contracts at risk, n_j	Contracts modified at eacht time, d_j	Number of contracts censored	Survivor function, $S(t_j)$	Std. error
2	21	1	0	0.9524	0.0465
6	20	2	0	0.8571	0.0764
7	18	3	0	0.7143	0.0986
9	15	0	1	0.7143	0.0986
10	14	1	0	0.6633	0.1039
11	13	1	0	0.6122	0.1077
14	12	2	0	0.5102	0.1113
15	10	1	0	0.4592	0.1113
22	9	1	1	0.4082	0.11
24	7	2	0	0.2915	0.105
26	5	0	1	0.2915	0.105
29	4	0	1	0.2915	0.105
37	3	1	0	0.1944	0.1058
38	2	1	0	0.0972	0.0867
44	1	1	0	0	.

Table 4.b.- Nelson-Aalen estimates of cumulative hazard of unmodified contracts survival

Time	Total number of contracts at risk, n_j	Contracts modified at eacht time, d_j	Number of contracts censored	Nelson-Aalen Hazard, $H(t_j)$	Std. error
2	21	1	0	0.0476	0.0476
6	20	2	0	0.1476	0.0853
7	18	3	0	0.3143	0.1286
9	15	0	1	0.3143	0.1286
10	14	1	0	0.3857	0.1471
11	13	1	0	0.4626	0.166
14	12	2	0	0.6293	0.2036
15	10	1	0	0.7293	0.2268
22	9	1	1	0.8404	0.2525
24	7	2	0	1.1261	0.3234
26	5	0	1	1.1261	0.3234
29	4	0	1	1.1261	0.3234
37	3	1	0	1.4595	0.4644
38	2	1	0	1.9595	0.6824
44	1	1	0	2.9595	1.2107

Table 5.a- The effects of explanatory variables on hazard of renegotiation

	Cloglog model		Logistic model	
	(1)	(2)	(1)	(2)
Design				
Mechanism of regulation	15.99*	15.41*	16.09*	15.57
	(8.869)	(8.67)	(9.721)	(9.505)
Land	-25.43**	-25.66*	-25.60**	-25.68*
	(12.24)	(14.67)	(13.05)	(14.6)
Finance	6.145	5.57	6.241	5.6
	(4.669)	(5.899)	(5.279)	(6.148)
Duration	-0.682	-0.726	-0.696	-0.745
	(0.486)	(0.463)	(0.548)	(0.547)
Adjudication				
Bidders	-4.367	-4.34	-4.411	-4.41
	(3.435)	(3.652)	(3.671)	(3.768)
Foreign	-0.547	-1.198	-0.688	-1.5
	(2.442)	(2.602)	(2.52)	(3.162)
Impope	0.313*	0.322*	0.313*	0.321*
	(0.169)	(0.175)	(0.185)	(0.187)
Criteria	4.203*	3.281	4.131	3.036
	(2.545)	(3.274)	(2.671)	(3.293)
Institucional				
Experience of the regulator		-0.363		-0.405
		(0.707)		(0.663)
Accepted	0.157	-0.317	-0.009	-0.675
	(2.79)	(2.473)	(3.02)	(3.103)
Pib (% change)		0.145*		0.149*
		(0.0864)		(0.0798)
Observations	343	343	343	343
Sector dummies	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses. Both models are discrete time models (complementary log-log and logistic) and error standard are clustered. Models (1) and (2) consider time-invariant and time-variant covariates, respectively. In all models *timeopi* was dropped by Stata.*Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level.

Table 5.b.- Impact (marginal) effects on hazard of renegotiation

	Cloglog model		Logistic model	
	(1)	(2)	(1)	(2)
Desing				
Mechanism of regulation	0.0507	0.03057	0.0575	0.03508
	(0.0461)	(0.03308)	(0.0459)	(0.03383)
Land	-0.9866**	-0.95902**	-0.83866**	-0.78363**
	(0.06996)	(0.31345)	(0.18612)	(0.38551)
Adjudication				
Impope	0.00031	0.00022	0.000353	0.00025
	(0.00075)	(0.00053)	(0.00087)	(0.00061)
Criteria	0.00468	0.00223	0.005176	0.00226
	(0.01004)	(0.00447)	(0.01131)	(0.00479)
Institutional				
PIB (% change)		0.00009		0.000115
		(0.00026)		(0.00032)
Marginal effects of dependent variable	0.00099	0.000682	0.00113	0.000767

Note: dy/dx is for discrete change of dummy variable from 0 to 1. Standard errors in parentheses. Both models are discrete time models (complementary log-log and logistic) and error standard are clustered. Models (1) and (2) consider time-invariant and time-variant covariates, respectively. *Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level.

Table 6.- The effects of electoral cycles

6.a.- On the incidence of renegotiation

			By the government		By the firm		By both	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Electoral quarter	0.134**	0.136***	0.0309	0.0314	0.0902*	0.0924*	0.0131	0.0125
	(0.0513)	(0.0505)	(0.0213)	(0.0217)	(0.0504)	(0.0500)	(0.0121)	(0.0127)
Pib		0.00359		0.00116		0.00140		0.00103*
		(0.00553)		(0.00149)		(0.00523)		(0.00060)
Constant	0.0628***	0.0455	0.0173**	0.0118	0.0413***	0.0346	0.00418*	-0.000790
	(0.0125)	(0.0301)	(0.00657)	(0.00988)	(0.0102)	(0.0278)	(0.00239)	(0.00227)
Observations	69	68	69	68	69	68	69	68
R-squared	0.143	0.161	0.045	0.055	0.075	0.081	0.029	0.045

6.b.- On the re-incidence of renegotiation

			By the government		By the firm		By both	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Electoral quarter	0.140***	0.142***	0.0336	0.0344	0.0923*	0.0938*	0.0143	0.0137
	(0.0515)	(0.0507)	(0.0221)	(0.0224)	(0.0507)	(0.0502)	(0.0125)	(0.0130)
Pib		0.00369		0.00115		0.00139		0.00114*
		(0.00565)		(0.00162)		(0.00528)		(0.00064)
Constant	0.0655***	0.0478	0.0184***	0.0129	0.0428***	0.0361	0.00438*	-0.00111
	(0.0131)	(0.0314)	(0.00692)	(0.0110)	(0.0105)	(0.0284)	(0.00249)	(0.00259)
Observations	69	68	69	68	69	68	69	68
R-squared	0.151	0.168	0.050	0.059	0.077	0.082	0.033	0.050

6.c.- On the incidence of renegotiation

			By the government		By the firm		By both	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Electoral quarter	0.141***	0.137***	0.033	0.032	0.094*	0.093*	0.014	0.012
	(0.053)	(0.051)	(0.022)	(0.023)	(0.05)	(0.051)	(0.013)	(0.012)
Pib (-1)		0.003		0.0004		0.001		0.0018**
		(0.004)		(0.002)		(0.004)		(0.0009)
Constant	0.063***	0.046*	0.017**	0.015*	0.041***	0.036	0.004	-0.0044
	(0.013)	(0.025)	(0.007)	(0.009)	(0.012)	(0.022)	(0.002)	(0.00403)
Observations	68	68	68	68	68	68	68	68
R-squared	0.154	0.16	0.05	0.05	0.08	0.08	0.03	0.07

6.d.- On the re-incidence of renegotiation

			By the government		By the firm		By both	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Electoral quarter	0.147***	0.143***	0.0359	0.0354	0.0956*	0.0942*	0.0152	0.013
	(0.0532)	(0.052)	(0.023)	(0.0235)	(0.0527)	(0.0513)	(0.0129)	(0.012)
Pib (-1)		0.0037		0.00048		0.00128		0.00192**
		(0.005)		(0.0017)		(0.0039)		(0.00093)
Constant	0.066***	0.048*	0.018***	0.0161*	0.0428***	0.0366	0.00438*	-0.00486
	(0.0013)	(0.026)	(0.007)	(0.0093)	(0.0105)	(0.0225)	(0.0025)	(0.00418)
Observations	68	68	68	68	68	68	68	68
R-squared	0.161	0.168	0.06	0.06	0.08	0.08	0.04	0.08

Note: The series used in these estimations are stationary. *Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level.

Table 6.- (*continue…*) The effects of electoral cycles

6.e.- On the incidence of renegotiation

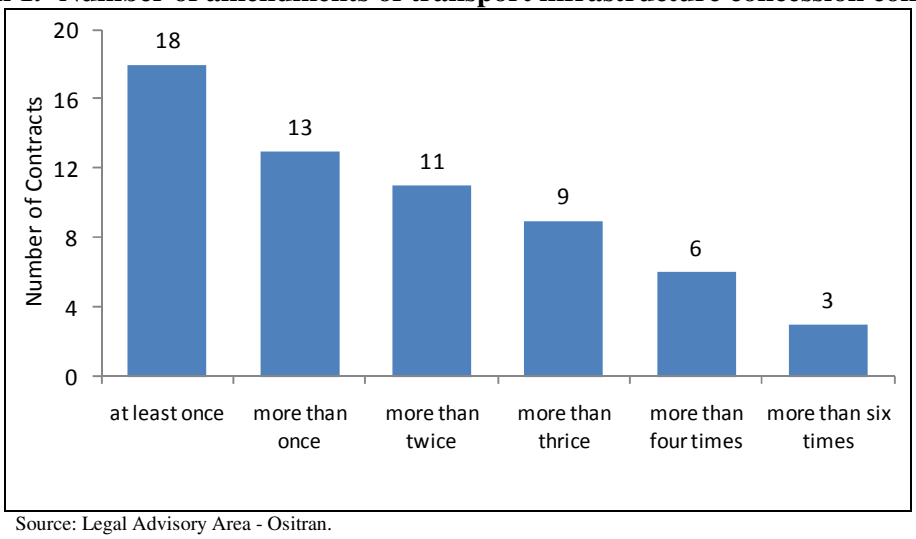
			By the government		By the firm		By both	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Electoral quarter (+1)	0.081	0.075	0.036	0.035	0.031	0.028	0.014	0.013
	(0.051)	(0.048)	(0.022)	(0.022)	(0.049)	(0.048)	(0.013)	(0.013)
Pib		0.005		0.001		0.003		0.001*
		(0.005)		(0.002)		(0.005)		(0.0006)
Constant	0.083*	0.060*	0.016**	0.011	0.063***	0.050	0.004*	-0.0009
	(0.019)	(0.034)	(0.007)	(0.01)	(0.02)	(0.03)	(0.002)	(0.002)
Observations	68	68	68	68	68	68	68	68
R-squared	0.05	0.06	0.06	0.07	0.01	0.01	0.03	0.05

6.f.- On the re-incidence of renegotiation

			By the government		By the firm		By both	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Electoral quarter (+1)	0.088*	0.082*	0.039*	0.038*	0.033	0.029	0.015	0.014
	(0.052)	(0.048)	(0.023)	(0.022)	(0.049)	(0.045)	(0.013)	(0.013)
Pib		0.005		0.001		0.003		0.0012*
		(0.006)		(0.002)		(0.005)		(0.0007)
Constant	0.085***	0.062*	0.017**	0.012	0.064***	0.052	0.004*	-0.001
	(0.019)	(0.036)	(0.007)	(0.011)	(0.018)	(0.034)	(0.002)	(0.003)
Observations	68	68	68	68	68	68	68	68
R-squared	0.057	0.07	0.07	0.07	0.001	0.01	0.04	0.05

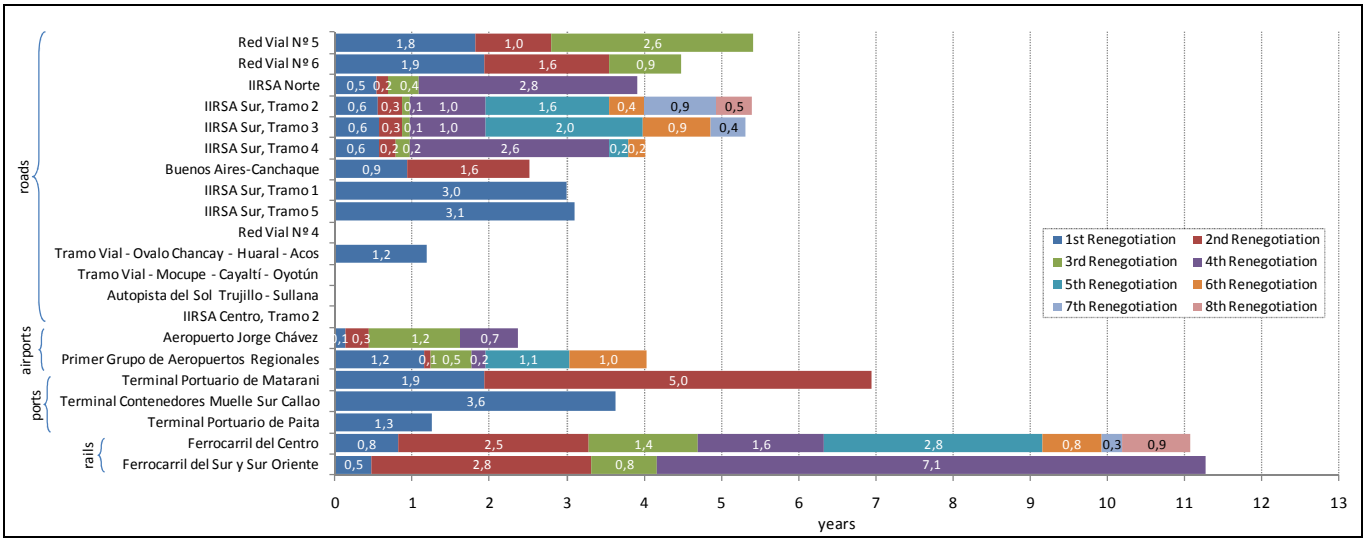
Note: The series used in these estimations are stationary. *Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level.

Graph 1.- Number of amendments of transport infrastructure concession contracts



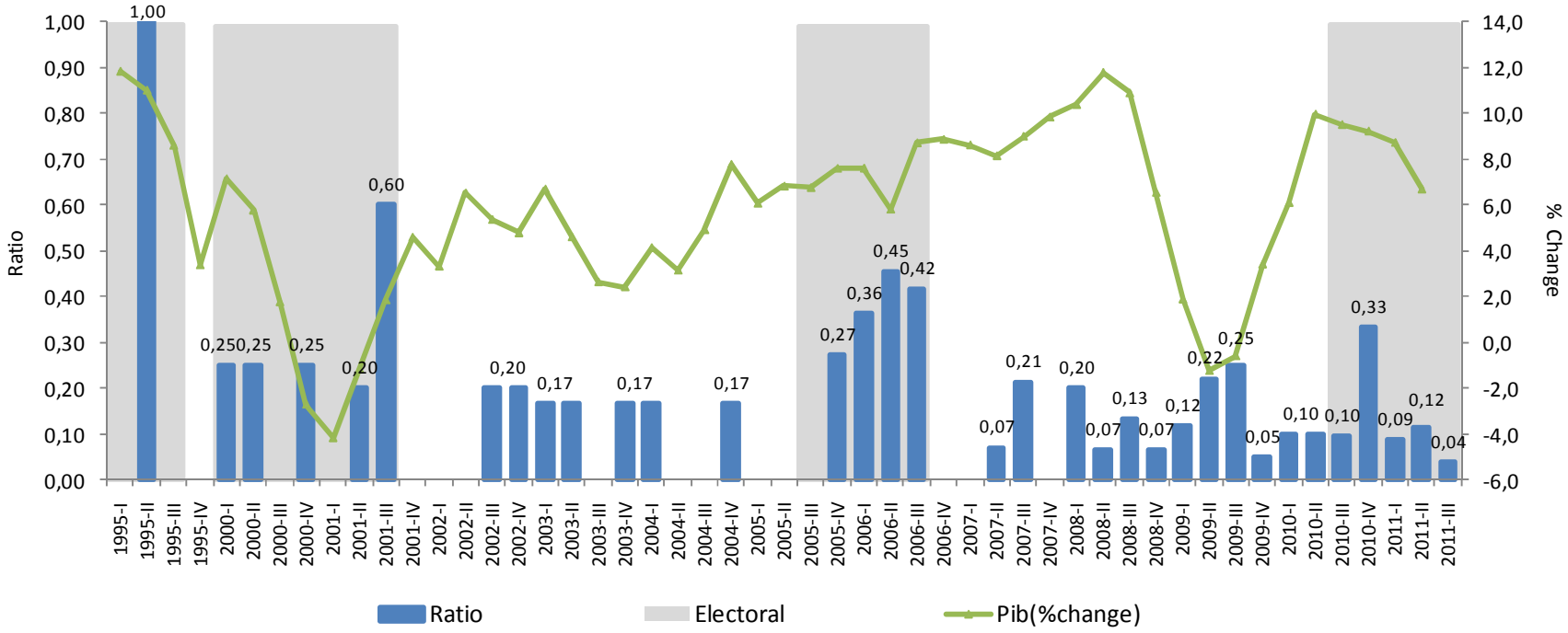
Source: Legal Advisory Area - Ositran.
Own elaboration

Graph 2.- Frequency of modification of transport infrastructure concession contracts

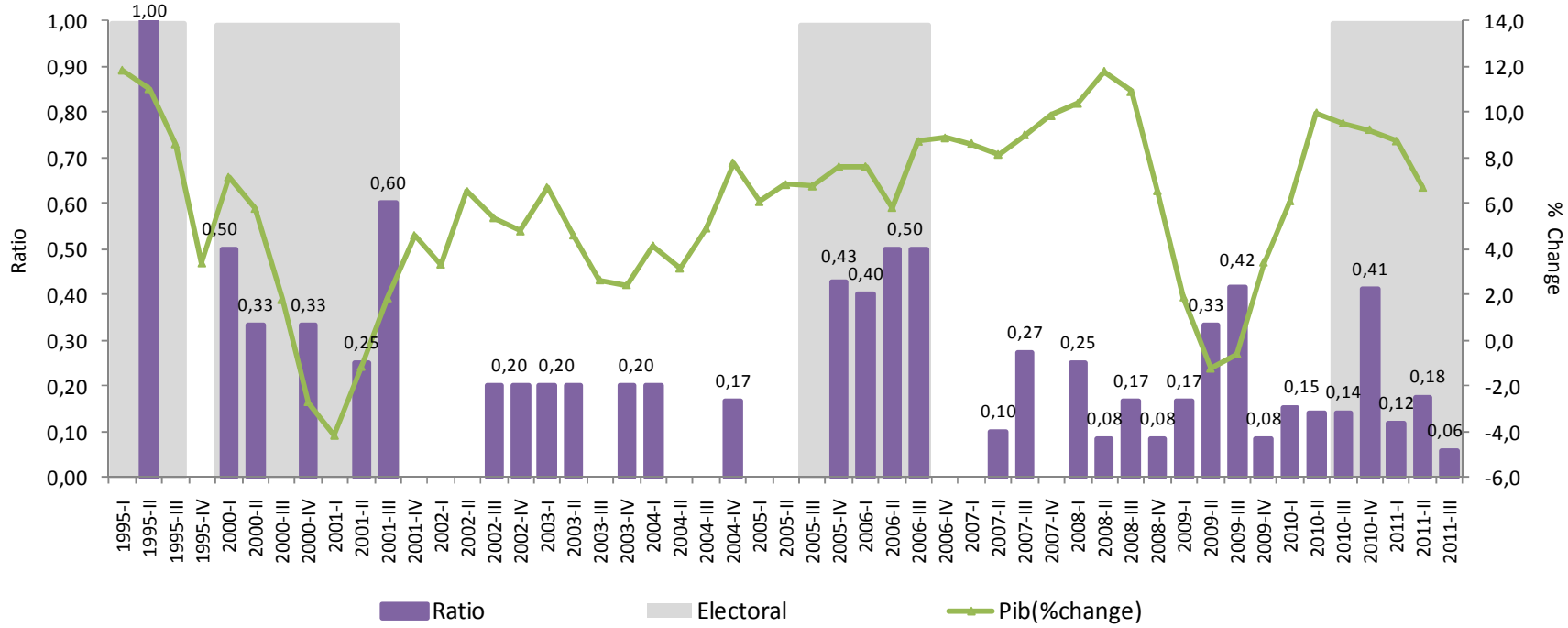


Source: Legal Advisory Area - Ositran.
Own elaboration

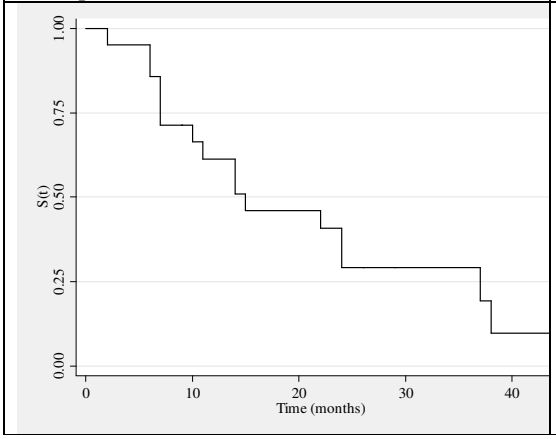
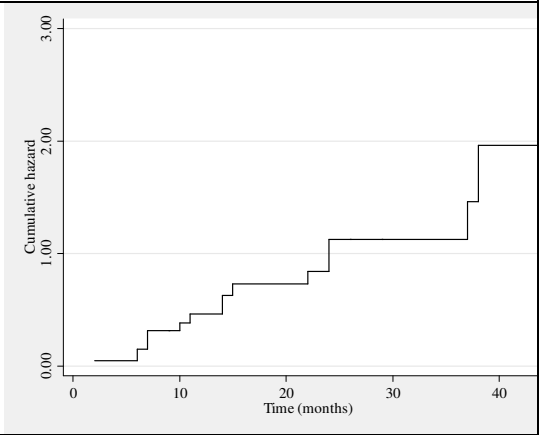
Graph 3.- The incidence of renegotiation and Cycle Electoral Quarterly



Graph 4.- The re-incidence of renegotiation and Cycle Electoral Quarterly

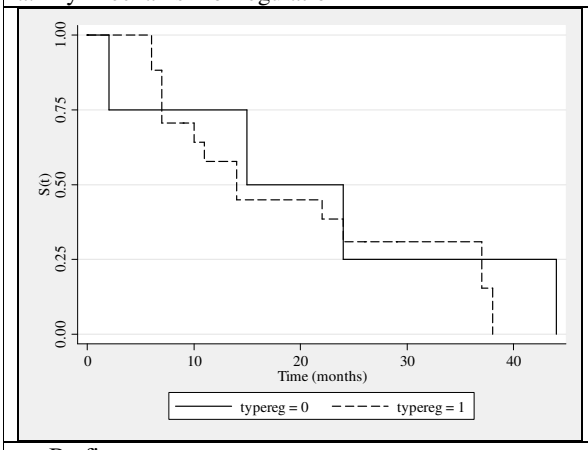


Graph 5.- Survival and hazard functions

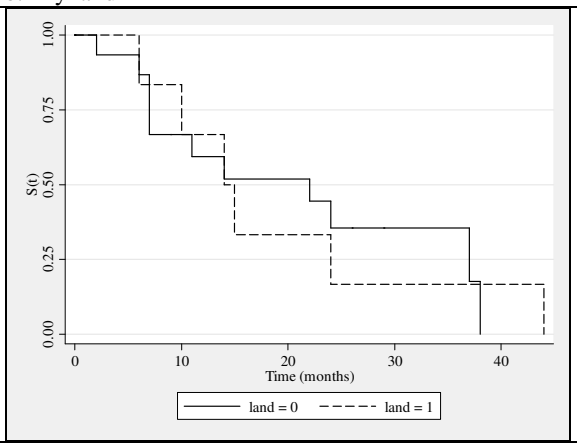
a.- Kaplan-Meier survival function	b.- Nelson-Aalen Cumulative hazard function
	

Graph 6.- Stratification of survival functions

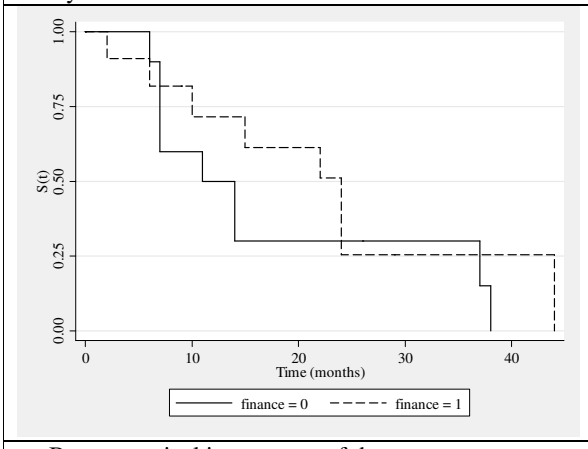
a.- By mechanism of regulation



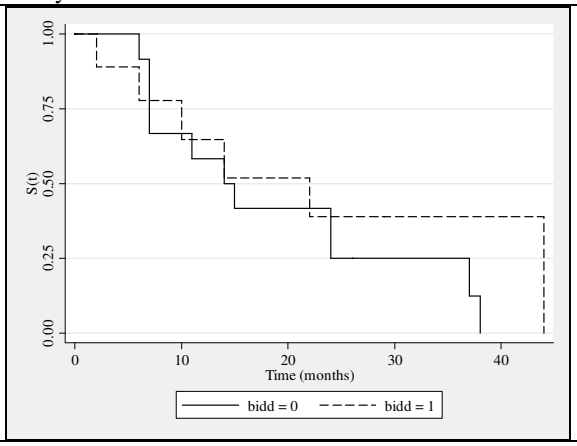
b.- By land



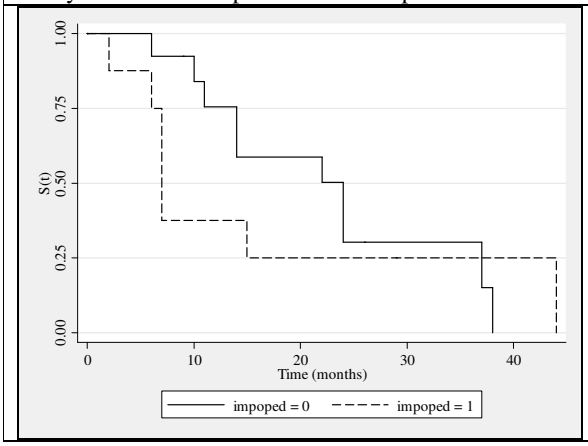
c.- By finance



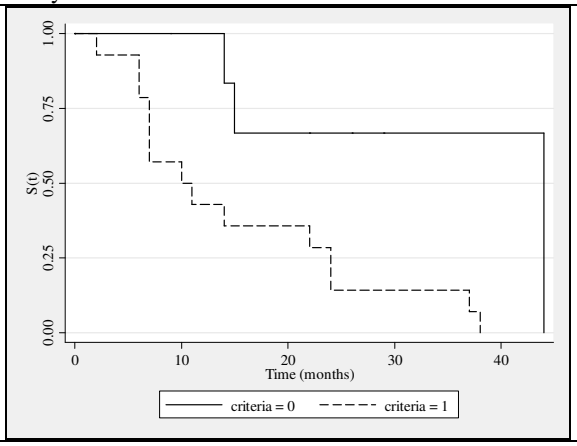
d.- By bidders



e.- By economical importance of the operator

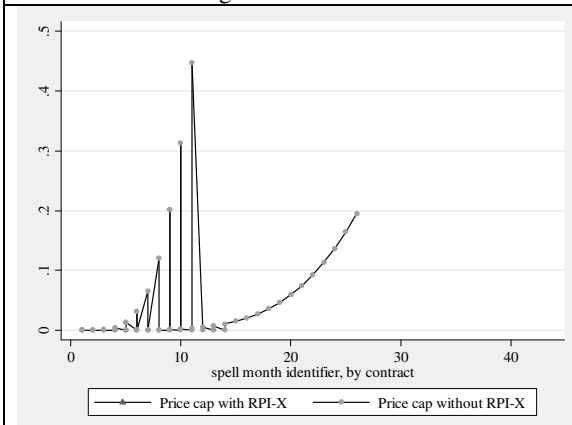


f.- By criteria of selection

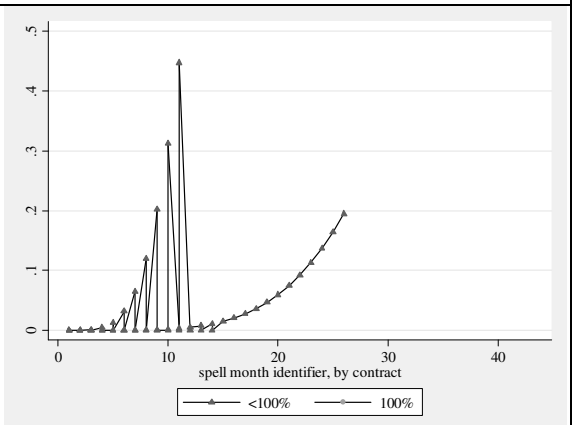


Graph 7.- Within-sample hazard rates prediction for a 15-years concession contracts duration

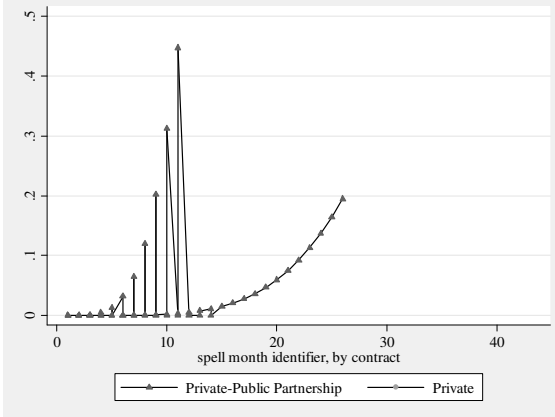
a.- Mechanism of regulation



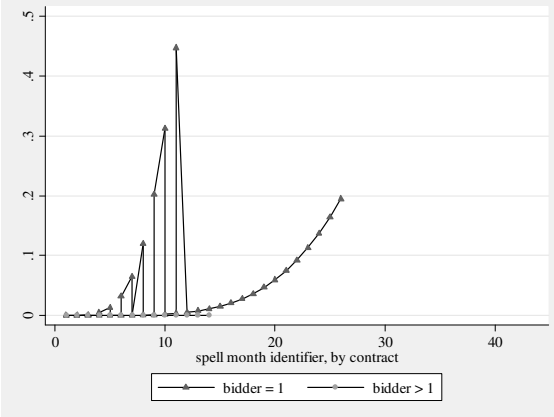
b.- Land



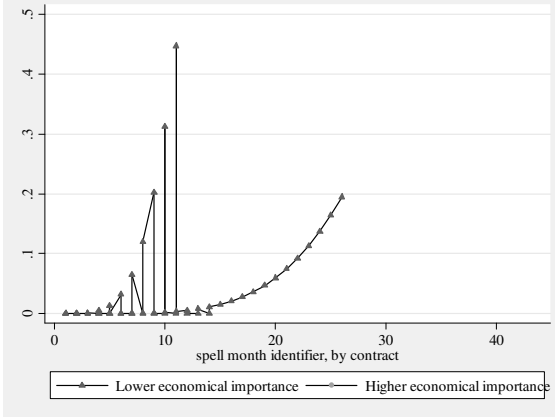
c.- Finance



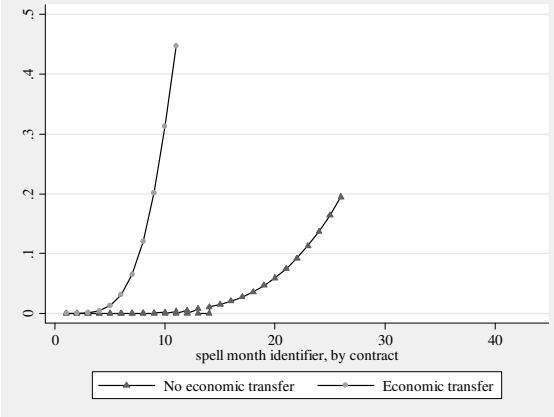
d.- Bidders



e.- Economical importance of the operator

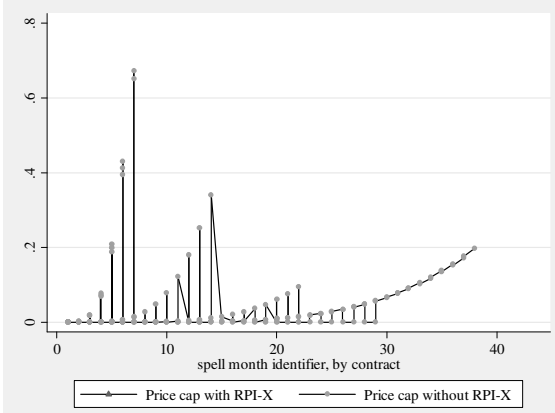


f.- Criteria of selection

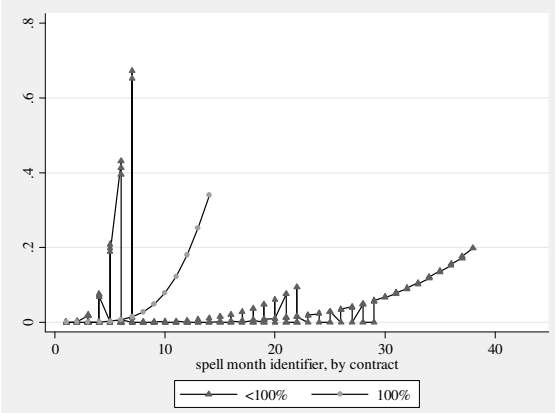


Graph 8.- Within-sample hazard rates prediction for a 25-years concession contracts duration

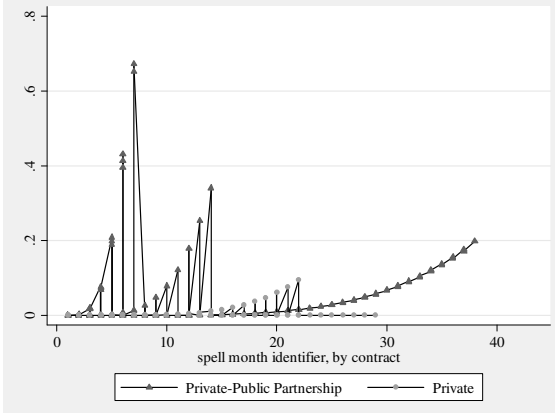
a.- Mechanism of regulation



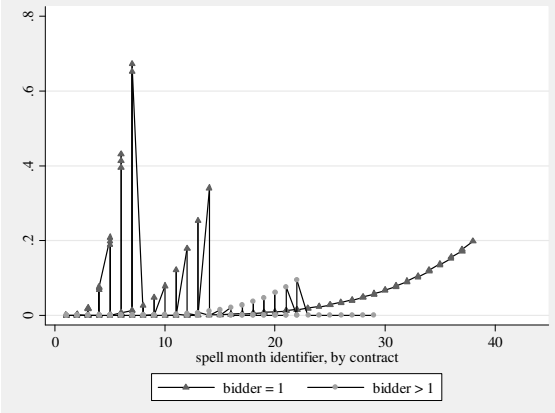
b.- Land



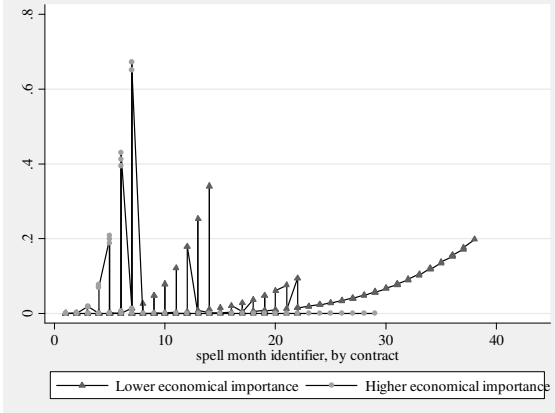
c.- Finance



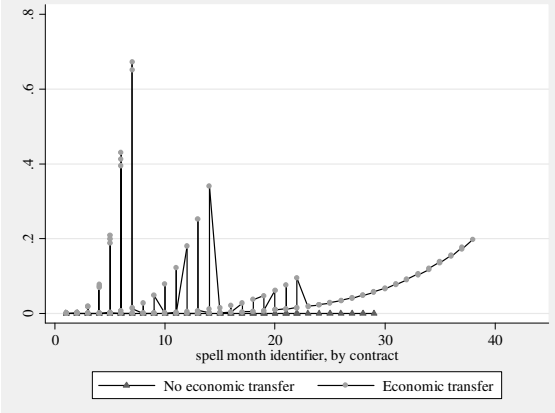
d.- Bidders



e.- Economical importance of the operator

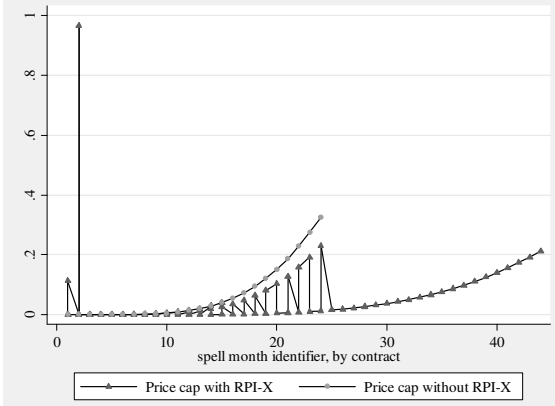


f.- Criteria of selection

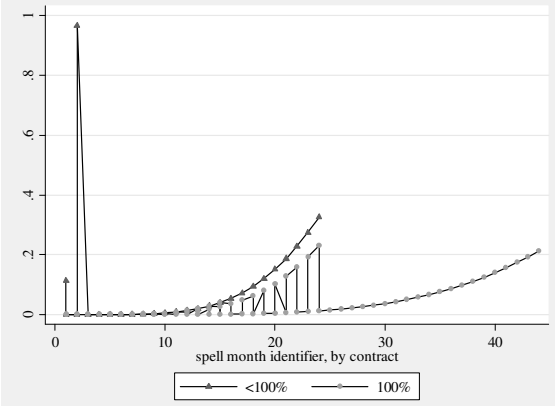


Graph 9.- Within-sample hazard rates prediction for a 30-years concession contracts duration

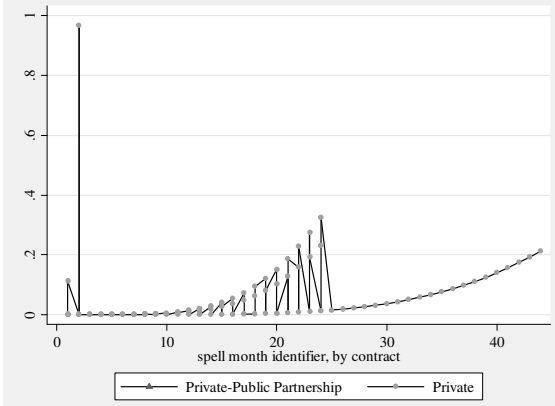
a.- Mechanism of regulation



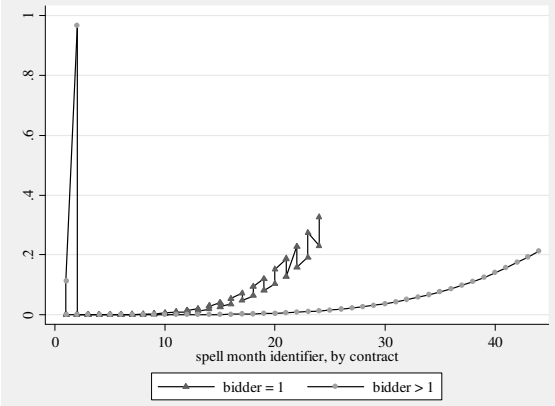
b.- Land



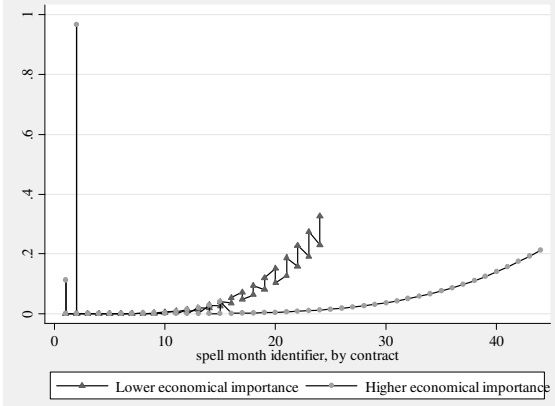
c.- Finance



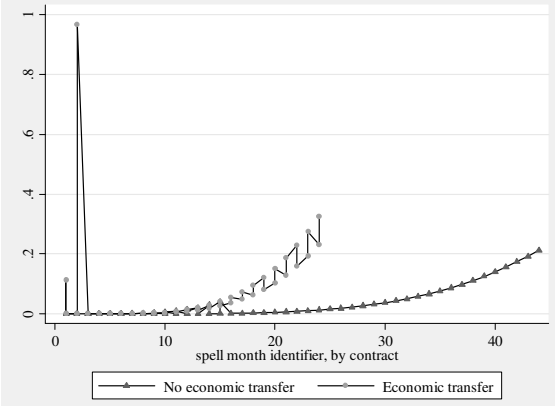
d.- Bidders



e.- Economical importance of the operator

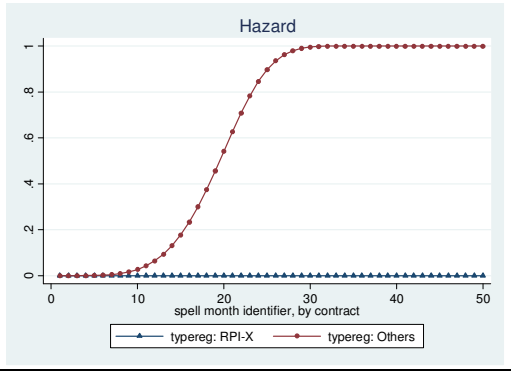


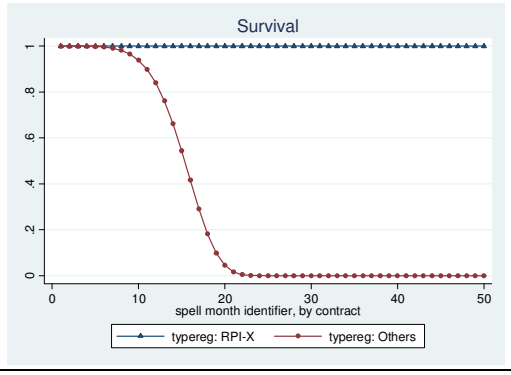
f.- Criteria of selection



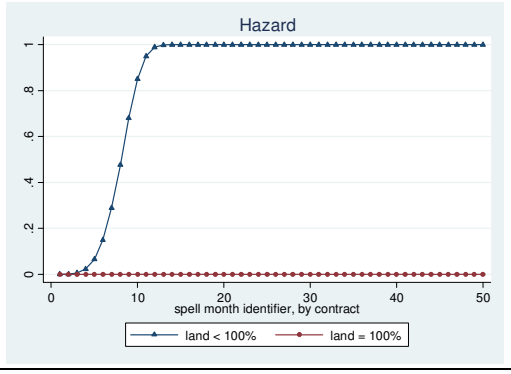
Graph 10.- Out-of-sample prediction hazard rates

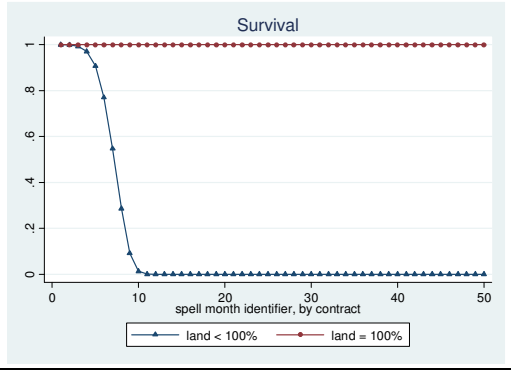
a.- Mechanism of regulation



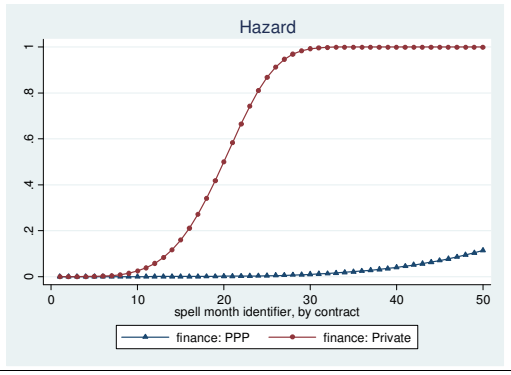


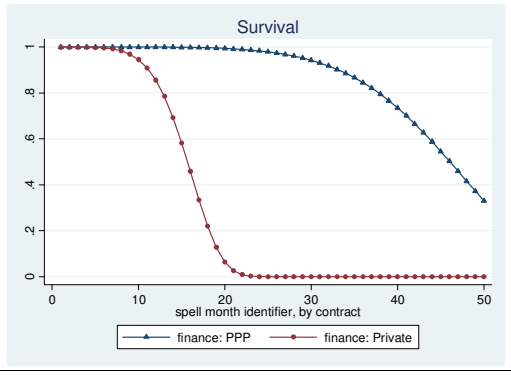
b.- Land





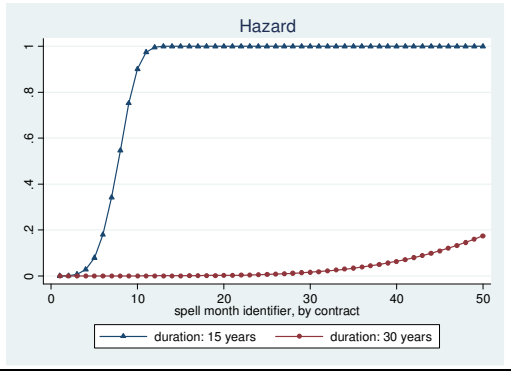
c.- Finance

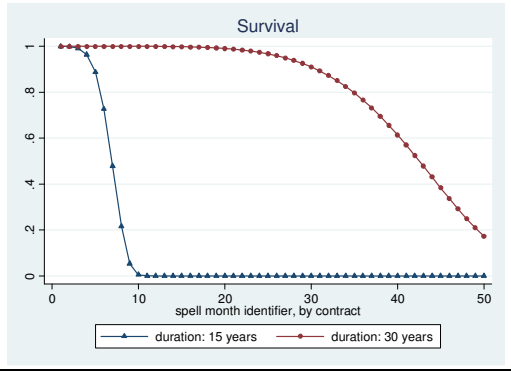




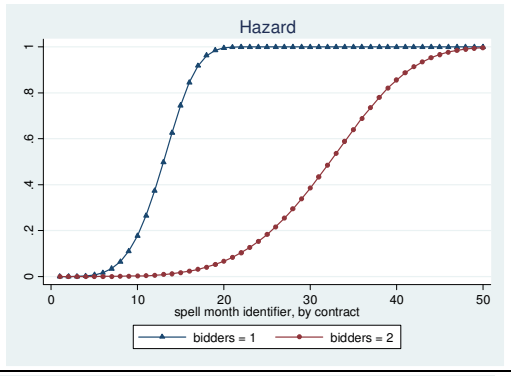
Graph 10.- (…*continue*) Out-of-sample prediction hazard rates

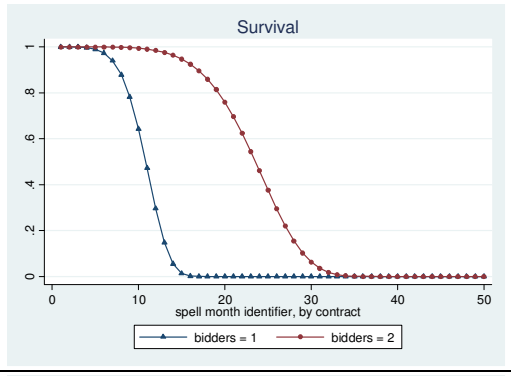
d.- Duration

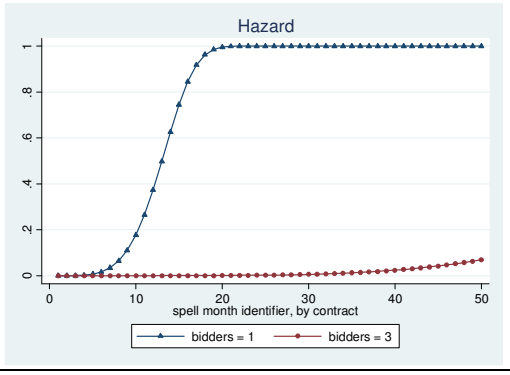


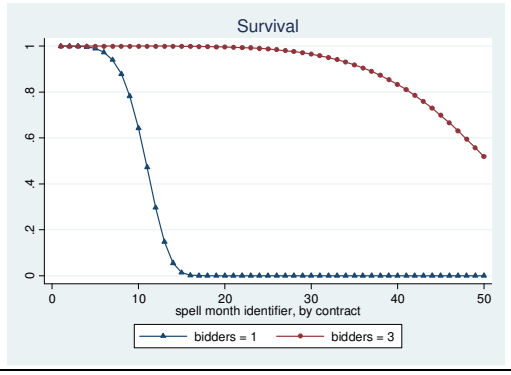


e.- Bidders



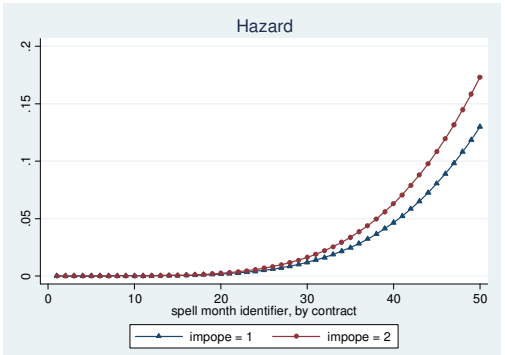


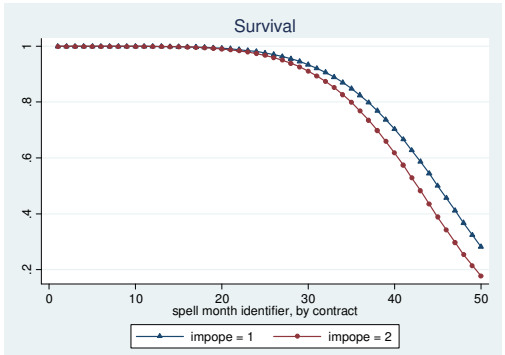


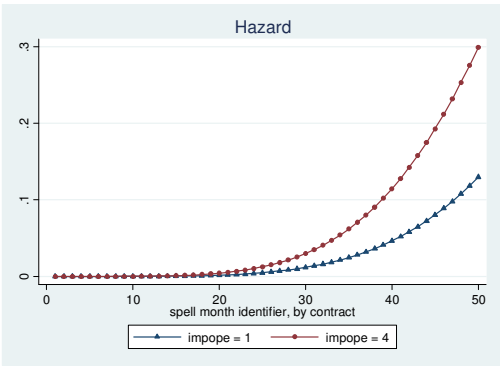


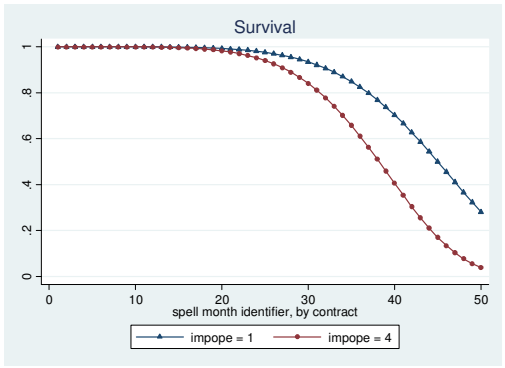
Graph 10.- (…*continue*) Out-of-sample prediction hazard rates

f.- Economical importance of operator









g.- Criteria of selection