CHOICE OF PUBLIC CONSTRUCTION PROCUREMENTS MODE IN COTE D'IVOIRE

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ABSTRACT

This paper aims to rationalize the choice of construction procurements mode by determining its explanatory factors. It contributes to the enrichment of the literature review on public procurement by adopting a partially degenerated Nested Logit model with two levels. We define some independent variables (CTMOD, COMPET, URGEN, TRACOMP, TECHN, SECR, REGULAR, INFRUCT and REATTRIB) which seem to motivate choices made by the government services. Our model is estimated by using the maximum likelihood method. The data is collected from construction procurements in Côte d'Ivoire during 2004-2008. The results indicate that the model used is well specified and all our independent variables contribute to explain the choices made.

1. INTRODUCTION

Many and varied are the studies that have focused on auction theory and its applications to public procurement. However, a selection made for those who deal exclusively with procurement procedures will expose some of which may serve as references on the subject. First, Che (1993) makes the design of a competition in public procurement by developing a bid dimensional quality and price, through which bids are evaluated on the basis of a rule established by the public purchaser. Then, Bulow and Klemperer (1996) questioned the procedure (auction without reserve price or trading) is most advantageous for the sale of a business. And they found that under certain assumptions, the auction is always beneficial to trading. Then, Branco (1997) develops multidimensional auction mechanisms in order to establish a correlation between the bid and the cost of the bidder. Contrary to the model to independent costs, the implementation of optimal income requires that the buyer uses an auction process into two stages: the first step, it selects a company, and the second step, he negotiated the quality to produce. Also, Perry and Sakovics (2003) assume a buyer whose needs are grouped into two separate lots at end of form two markets for the different

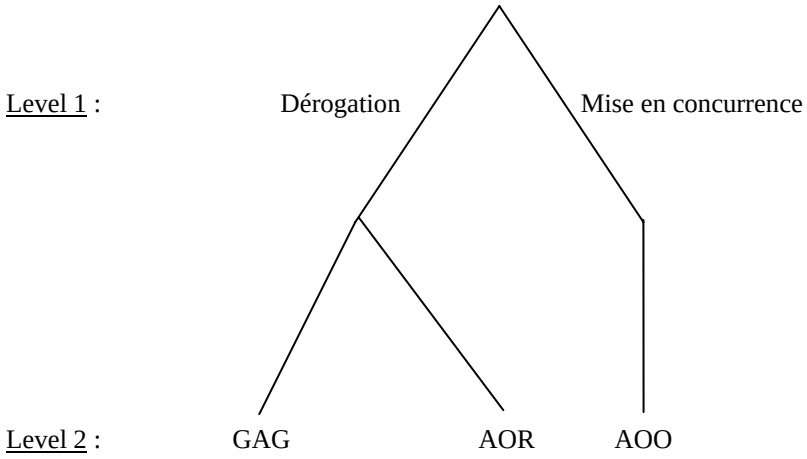
attribute, following sequential auction distinct second prize. In this conjecture and for a fixed number of suppliers, these two markets are more expensive for the buyer compared to cases where a single global market is over. As for Fabra et al. (2006), they characterize the behavior of bid and earnings generated in the uniform auction and discriminatory power. For these authors, although their comparison in terms of productive efficiency is ambiguous, the uniform auction leads to higher average prices than the discriminatory auction. Finally, Bajari et al. (2009) propose a framework for comparison between the tendering and negotiation starting construction contracts to private implications for works contracts. Their main conclusion is that most projects are complex with an anticipation of future, more direct negotiation is needed, while promoting competition is effective for simple projects.

This study contributes to the enrichment of the literature review on public procurement by adopting a partially degenerated Nested Logit Model with two levels to determine factors explaining the choice of procurement work. Such an approach allows to better understand the logic of the choices made by the public purchasers in a context where public infrastructure must fully assume its role as engine of growth[1] and poverty reduction[2]. This leads to the concern of how to streamline the procurement of works for a greater contribution of public infrastructure in the growth and development.

2. METHODS

The method of treatment of our problem will be through the use of Nested Logit two levels. Indeed, for the procurement, especially for construction contracts, public purchaser may choose between “dérogation” and “mise en concurrence”. The exemption, subject to prior authorization of the Minister of Finance, refers to “gré à gré” (GAG) and “Appel d’Offres Restreint” (AOR), while promoting competition refers to the “Appel d’Offres Restreint” (AOO). And each of these modes (or alternatives) has special characteristics that distinguish it from others.
Thus, the decision of choosing the mode of procurement by the public purchasers can be simplified as follows:

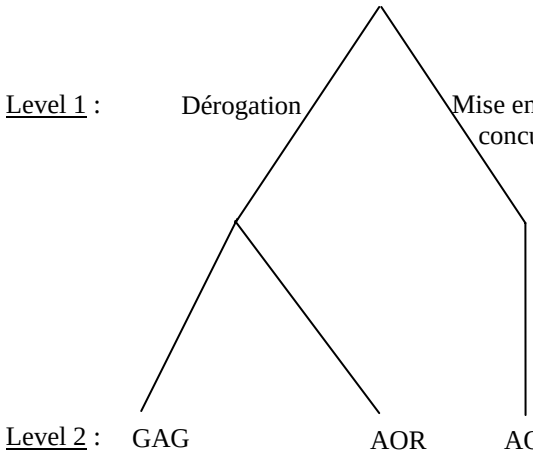
[1] Banque Mondiale (1994), Jacquet et Charnoz (2003), Limao et Venables (2000), Willoughby (2003).
[2] Booth et al. (2002), DFIP (2002), Jacquet et Charnoz (2003).



Level 2 defines all the possible choices, and level 1 defines the partition choices made by gathering in nests. Thus, modeling of such a decision leads to resort to the use of Nested Logit Model. We note also that the branch "mise en concurrence" of the tree contains a single choice, then we say that the model is partially degenerated.

We define two types of variables. On the one hand the level 1 variables that measure the common qualities to choices in a group, should not vary from one choice to another in the same group; while on the other hand, level 2 variables are characteristics that vary from one choice to another.

Whatever the mode chosen for awarding a contract, it admits a cost in terms of duration of the procedure and cost of communication and information. Thus we consider the variable cost of procurement mode (CTMOD) as determinants of level 2. So is it only for certain specific reasons, well known (urgency of need, its secrecy, its complementary nature, need to have a special technique), using the exemption is encouraged. Therefore, variables urgency of the need (URGEN), secrecy of the need (SECR), need to have a particular technique at one's disposal for contract execution (TECHN), complementary nature of work to be implemented (TRACOMP) and competition (COMPET) were selected as determinants of level 1. To these factors, we add the case of regularization (REGULAR) for contracts that have been concluded on the sidelines of the regulation, failure (INFRUCT) due to the fact that no company can meet the conditions and reallocation (REATTRIB) when the owner withdraws or is faulty and that the contract is awarded to another company. Thus, the chart below completes the previous tree by representing explanatory variables at each level of the model:



Formalization: Let $L = 2$ be the number of groups resulting from the partition of the space of choice. In each l group there are J_l possible choices indexed by $j(l)$. So for each procurement contract, public purchasers have $J = J_1 + J_2$ possible options indexed by j. $J_1 = 2$ and $J_2 = 1$.

We note x_l, the level 1 variables and $x_{j(l)}$ the level 2. Let U_{ij} be the indirect utility function associated to the procurement contract i when the mode j is chosen.

$$U_{ij} = \mu_{ij} + \varepsilon_{ij} \qquad j = 1, 2, 3$$

(1.1)

where μ_{ij} designs a determinist function of the procurement contract i specifications and the modality j attributes,

and ε_{i1}, ε_{i2} and ε_{i3} the random terms associated with alternatives.

We write the joint bivariated distribution between similar modes (1=GAG et 2=AOR) as (McFadden, 1978):

$$F(\varepsilon_{i1}, \varepsilon_{i2}) = \exp\{-[\exp(-\frac{\varepsilon_{i1}}{\rho}) + \exp(-\frac{\varepsilon_{i2}}{\rho})]^{\rho}\} \quad ,$$

$$0 < \rho \leq 1 \quad (1.2)$$

It's the law of Extreme Value Type II. ρ assesses the independence degree of residuals ε_{i1} and ε_{i2}. More greater ρ is, less choices between modes 1 and 2 are correlated. The correlation coefficient ε_{i1} and ε_{i2} is $1-\rho^2$. If $\rho = 1$, that means independence, and

$F(\varepsilon_{i1}, \varepsilon_{i2})$ becomes the product of two law of Extreme Value Type 1. In this case, we get a *Multinomial Logit*.

$0 < \rho \leq 1$ is McFadden (1978) necessary and sufficient condition for *Nested Logit* to be considered as discrete choices Random Utility Models.

For the third modality that is independent from the two other, we assume ε_{i3} to be distributed as type 1 extreme values:

$$F(\varepsilon_{i3}) = \exp[-\exp(-\varepsilon_{i3})] \quad (1.3)$$

and that $COV(\varepsilon_{i3}, \varepsilon_{i1}) = 0$ and $COV(\varepsilon_{i3}, \varepsilon_{i2}) = 0$.

Under all these assumptions, we have:

$$\Pr[y_i = GAG / x] = \frac{\exp(\frac{\mu_{i1}}{\rho})}{\exp(\frac{\mu_{i1}}{\rho}) + \exp(\frac{\mu_{i2}}{\rho})} \quad (1.4)$$

$$\Pr[y_i = AOR / x] = \frac{\exp(\frac{\mu_{i2}}{\rho})}{\exp(\frac{\mu_{i1}}{\rho}) + \exp(\frac{\mu_{i2}}{\rho})} \quad (1.5)$$

and

$$\Pr[y_i = AOO / x] = \frac{\exp(\mu_{i3})}{\exp(\mu_{i3}) + \left[\exp(\frac{\mu_{i1}}{\rho}) + \exp(\frac{\mu_{i2}}{\rho})\right]^{\rho}} \quad (1.6)$$

with $\mu_{ij} = x_{il}\alpha + \rho_l x_{ij(l)}\beta_l$, $\rho_l > 0$.

In the expression above, ρ_l means the dissimilarity parameters related to the inclusive values attached to the two groups. They assess the degree of correlation between choices into each group. So for group1, we have $\rho_1 = \rho \in]0;1]$. And for group 2 that contains only one option, the correlation has no sense; so we set ρ_2 value to 1.

3. DATA AND VARIABLES

Our data have been collected from the Record Office of Côte d'Ivoire Public Procurement Department. They relate a sample of 955 construction procurement contracts from 2004 to 2008. And this period of analysis was chosen because of the limited availability of information relating to the justification of choice of procurement contract awarding mode.

We estimate our choice model by using STATA9 software. First we gather the data as described in the table below:

N	ID	MODE	PROC	Y	CTMOD	COMPET	URGEN	TRACOMP	TECHN	SECR	REGULAR	INFRUCT	REATTRIB
1	1	1	1	0	60	0	0	0	0	0	0	0	0
2	1	2	1	0	180	0	0	0	0	0	0	0	0
3	1	3	2	1	150	1	0	0	0	0	0	0	0
4	2	1	1	0	60	0	0	0	0	0	0	0	0
5	2	2	1	0	180	0	0	0	0	0	0	0	0
6	2	3	2	1	150	1	0	0	0	0	0	0	0
7	3	1	1	0	60	0	0	0	0	0	0	0	0
8	3	2	1	0	180	0	0	0	0	0	0	0	0
9	3	3	2	1	150	1	0	0	0	0	0	0	0
.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.
2860	954	1	1	0	60	0	0	0	0	0	0	0	0
2861	954	2	1	0	180	0	0	0	0	0	0	0	0
2862	954	3	2	1	150	1	0	0	0	0	0	0	0
2863	955	1	1	0	60	0	0	0	0	0	0	0	0
2864	955	2	1	0	180	0	0	0	0	0	0	0	0
2865	955	3	2	1	150	1	0	0	0	0	0	0	0

Related to the alternatives number in the choice process, we reproduce 3 times our sample. So each procurement contract is reproduced 3 times. The sample size becomes N=2865. We have a total of 13 variables. Y designs the dependent variable. It's a binary variable that takes the value 1 when the phenomenon is observed and 0 otherwise. ID is a variable that identify the procurement contract. MODE and PROC are booth alternatives variables. But MODE designs alternatives variable of level 2 (bottom) and PROC is for alternatives variable of level 1 (top). MODE takes the value 1 for GAG, 2 for AOR and 3 for AOO. The variable PROC takes the values 1 for "derogation" and 2 for "mise en concurrence".

We have a total of nine (9) independent variables distributed in level 1 variables (COMPET, URGEN, SECR, TECHN, TRACOMP, RGULAR, INFRUCT, and REATTRIB) and in level 2 variables (CTMOD). Each level 2 variable is a qualitative binary variable taking the value 1 when the phenomenon is observed and 0 otherwise. While level 2 variable is a quantitative variable measuring the cost associated with the choice of procurement contract award mode. And for convenience, we assume that the financial costs are zero, retaining only the costs in terms of duration of the procedure. So for a procurement mode GAG, AOR or AOO, the corresponding mean cost is respectively 60 days, 180 days or 150 days.

Finally, we have to estimate 10 parameters: 8 parameters α for level 1 independent variables, 1 parameter β for level 2 independent variable and 1 parameter ρ_1 for group 1 dissimilarity parameter. Let's remember that for group 2 that contains only one option, we set ρ_2 value to 1.

4. RESULTS

The Maximum Likelihood Method is used for our model regression. Results are described in the estimation tables below.

```
. nlogit y (mode = ctmod ) (proc = compet urgen tracomp techn secr regular infruct reattrib ),

tree structure specified for the nested logit model

        top --> bottom

        proc          mode
-------------------------------
           1             1
                         2
           2             3

User-defined constraints:
    IV constraints:
         [proc2]_cons = 1

initial:       log likelihood = -216.49593
rescale:       log likelihood = -207.54365
rescale eq:    log likelihood = -207.17485
Iteration 0:   log likelihood = -207.17485
Iteration 1:   log likelihood = -207.16906  (backed up)
Iteration 2:   log likelihood = -207.16906
```

```
Nested logit regression
Levels             =          2                  Number of obs      =      2865
Dependent variable =          y                  LR chi2(2)         =  1684.011
Log likelihood     = -207.16906                  Prob > chi2        =    0.0000
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
mode						
ctmod	.0003903	.0009641	0.40	0.686	-.0014994	.0022799
proc						
compet	38.50972	.	.	.	.	.
urgen	38.49632	.	.	.	.	.
tracomp	38.50972	.	.	.	.	.
techn	38.50972	.	.	.	.	.
secr	37.57608	.	.	.	.	.
regular	38.4729	.	.	.	.	.
infruct	38.50972	.	.	.	.	.
reattrib	38.50972	.	.	.	.	.
(incl. value parameters)						
proc						
/proc1	.25	1.14e+07	0.00	1.000	-2.23e+07	2.23e+07
/proc2	1	.	.	.	.	.

LR test of homoskedasticity (iv = 1): chi2(-7)= 0.00 Prob > chi2 = .

For the global significant test of the model, we use the Likelihood Ratio (LR) test. And on a chi2 table, we can read the value 5,991 at 5% for a chi2(2). As LR=1684,011>5,991 according to the estimation table, we conclude that our model is globally significant.

The LR test of homoskedasticity is also significant, which indicate that we should use the nested logit model.

For parameters significance test, we have the following results.

```
. testparm mode proc ctmod compet urgen tracomp techn secr regular infruct reattrib

 ( 1)  [mode]ctmod = 0
 ( 2)  [proc]compet = 0
 ( 3)  [proc]urgen = 0
 ( 4)  [proc]tracomp = 0
 ( 5)  [proc]techn = 0
 ( 6)  [proc]secr = 0
 ( 7)  [proc]regular = 0
 ( 8)  [proc]infruct = 0
 ( 9)  [proc]reattrib = 0
       Constraint 2 dropped
       Constraint 3 dropped
       Constraint 4 dropped
       Constraint 5 dropped
       Constraint 6 dropped
       Constraint 7 dropped
       Constraint 8 dropped
       Constraint 9 dropped

           chi2(  1) =    0.16
         Prob > chi2 =    0.6856
```

As Prob>chi2, we conclude that the parameters are all significant.

5. ACKNOWLEDGMENTS

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6. CONCLUSION

This paper investigates to rationalize the choice of construction procurements mode by determining its explanatory factors. We define some independent variables in a nested logit model that estimated by using the maximum likelihood methods.
This empirical analysis is base on construction procurements in Côte d'Ivoire during 2004-2008. After estimation, we firstly remain that the model is well specified. That means we should use the Nested Logit model. Secondly, the independent variables used are all significant according to the test of parameters significance. So these variables can be used to explain choices of construction procurement mode made by the public purchaser.

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