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# Contracting out and quality of road maintenance service in Uganda using panel data

*Miriam Katunze*

*miriamkatunze@ln.hk/miriam.katunze@gmail.com*

*Department of Economics*

*Lingnan University, Hong Kong*

## Abstract

There is strong evidence that outsourcing can give rise to cost savings in public service delivery. Although this evidence is compelling and associative, it lacks dynamism and an outlook on developing countries. Moreover, there is still a need for an all-encompassing perspective, especially for public technical services like road maintenance. This paper examines the effect of contracting out on the quality of road maintenance services using panel data. Selection bias has been controlled by accounting for the year, region, and topography. The results reveal a negative effect of contracting out on the quality of road maintenance.

The findings are robust to alternative model specifications including imputation of missing values and transformations of some control variables; and corroborate prior related research in various fields such as education, prisons, and workers' compensation claims. The negative effect could be attributed to the possibility that contracting out lowers the investment on road maintenance, which consequentially reduces the quality, as stakeholders are predisposed to cost savings. This could be true in Uganda's case, as in most developing countries, where the bureaucracy and the legal institution are relatively weak. Besides, the poor contractual management practices and delays arising from weak legal enforcement may give rise to the negative effect of contracting out on road maintenance quality.

**Key words:** contracting out, road maintenance, quality, cost

## 1. Introduction

A recent trend in privatization has popularized contracting out over and above other public management reform systems (Kidokoro, 2003). Research has demonstrated a myriad of cost saving benefits (Sultana, Rahman, & Chowdhury, 2013) that result from contracting out. In the transport sector, for instance, contracting out has been proved to result into longer road length (Meduri & Annamalai, 2013), and a flexibility of delivery (Dempsey, Burton, & Selin, 2016). Contracting out has also demonstrated high road maintenance quality and efficiency (Blom-Hansen, 2003) because it provides a price-determining criterion (Lindholst, Hansen, Randrup, Persson, & Kristoffersson, 2018).

Despite this compelling evidence, the following reasons merit the current research. First, majority of the studies demonstrate associative than dynamic evidence. This pattern is common for both social services like elderly care (Stolt, Blomqvist, & Winblad, 2011) and technical services like road maintenance (Blom-Hansen, 2003; Petersen & Houlberg, 2016). This study is similar to a few studies such as Blom-Hansen (2003), and Petersen and Houlberg (2017) that examined the gains from contracting out in Denmark's road maintenance using panel data. Previous studies that have investigated contracting out in waste collection are followed closely due to their use of panel data (Dijkgraaf and Gradus, 2013; Soukopová, Vaceková, Klimovský, 2017). Therefore, longitudinal effects are crucial in establishing lasting contracting out benefits.

Second, prior studies have focused either on transactions costs (Hefetz and Warner, 2012) or on service quality (Blom-Hansen, 2003; Petersen and Houlberg, 2017). A review of literature shows that empirical studies use transaction costs as the outcome variable and a few that study service quality incorporate the quality variable as a control. This study contributes to literature by using a service quality variable as the outcome, with contracting out as the main independent variable and cost as one of the control variables.

Third, few research papers have been written demonstrating the benefits of contracting out in developing countries. According to a systematic review on contracting out by Petersen, Hjelmar and Vrangbaek (2014), only one study by Pina and Torres (2006) focuses on Africa. This suggests a call for more although noted are some key African (Awortwi, 2012; McPake & Hongoro, 1995) studies on contracting out (Pessoa, 2008).

Against this background, this paper poses the following research question: what is the effect of contracting out on the quality of road maintenance? Based on the Uganda panel data, the results reveal a negative effect, which is contrary to various studies. The rest of the paper is organized as follows. Section 1.1 provides a background of private sector involvement in road maintenance services in Uganda. Section 2 briefly reviews the existing literature. Section 3 presents the methodology and the data while Section 4 report the empirical results. The final section discusses the results and concludes the paper.

## 1.1. To what extent are local contractors and communities involved in road maintenance in Uganda

Since the early 1990s, contracting out of public service delivery has been observed in Uganda in various sectors such as local markets, bus parks, slaughterhouses, recreation centers, and roads. The observed public-private partnerships (PPPs) in Uganda are not uniform across local governments, with some fully privatizing street parking while others still depending on in-house provision (Ndandiko, 2006). Bretzer, Pesson, and Randrup (2016) find that urban municipalities with higher budget allocations attribute this pattern to a finding that suggests well-developed markets are likely to contract out service delivery to the private sector. It is of interest that Ndandiko (2006) finds that Kampala municipality (urban area) contracts out street parking while this is not the case in Arua, Kabale, and Mbarara municipalities.

While road maintenance in Uganda is centralized through the Roads fund, it is implemented through a decentralized system. The Road fund disburses road maintenance funds to districts, which then implement road maintenance programs through various contractual arrangements. Such is the practice, particularly with funds from the roads rehabilitation grant, according to Road fund act, 15, (2008).

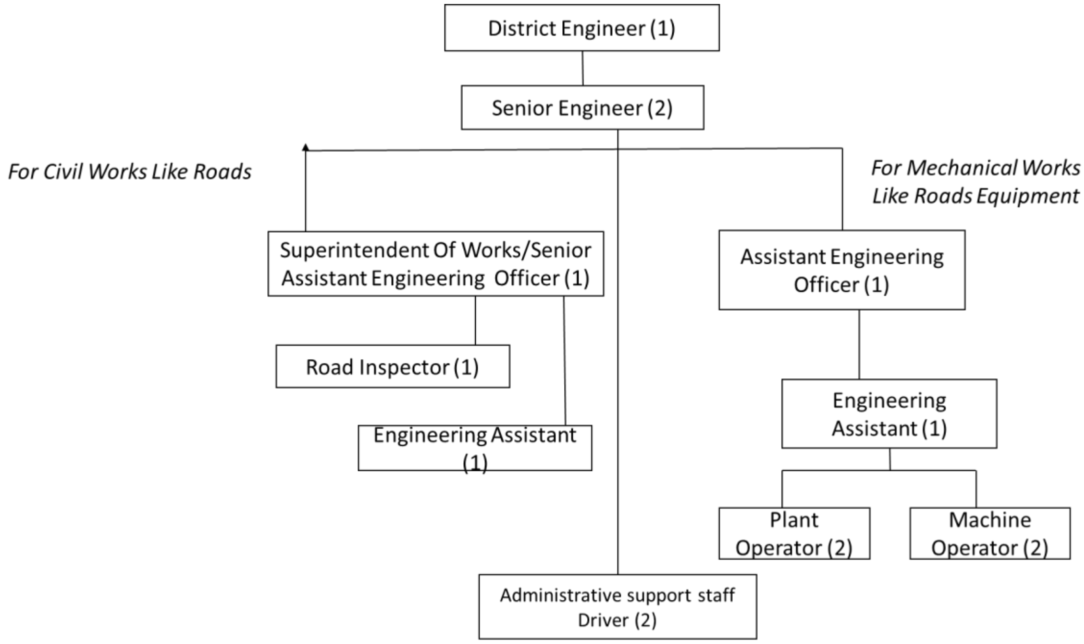
Private local or domestic involvement in Uganda's road maintenance should ideally be felt through the Labor Based Contracting Programme (LBCP), which had started on 1993 solely by the government (Larcher, 1998) under the unction of the World Bank (Stock and de Veen, 1996, Kabasweka, 2016). Indeed, private sector delivery of most road operations, including maintenance, was apparent, especially in the early late 1990s and early 2000s. The private sector mitigated local government's lack of capacity and relieved the Administration of extra burdens related to road operations and management (Leyland, Tumwebaze and Lubega-Kagere, 2001). However, the LBCP has lost its appeal, as it remains project-oriented rather than being part of national infrastructure programs (Kabasweka, 2016).

Moreover, while LBCP was proposed for its usefulness of substituting for the high capital needed that most LGs lacked, it is presently dependent on equipment. Equipment-based methods are now taking a significant proportion of road maintenance works, suggesting a declining presence of domestic contractors. For instance, in FY 2011/2012, 47 % of the road maintenance was done using equipment-based methods (ibid).

Uganda's road maintenance structure has changed over the last 20 years. Road maintenance of roads used force account- as system where the government agency used its resources, including technical expertise and equipment until the late 1990's. From that time, contracting of road maintenance services replaced the force account. From 2013, the force account system of road maintenance was re-introduced (CrossRoads, 2015). [1] Presently, the works department headed by a district engineer administers the road maintenance at local governments, i.e., the district level. The road maintenance structure at the district is illustrated in the diagram below:

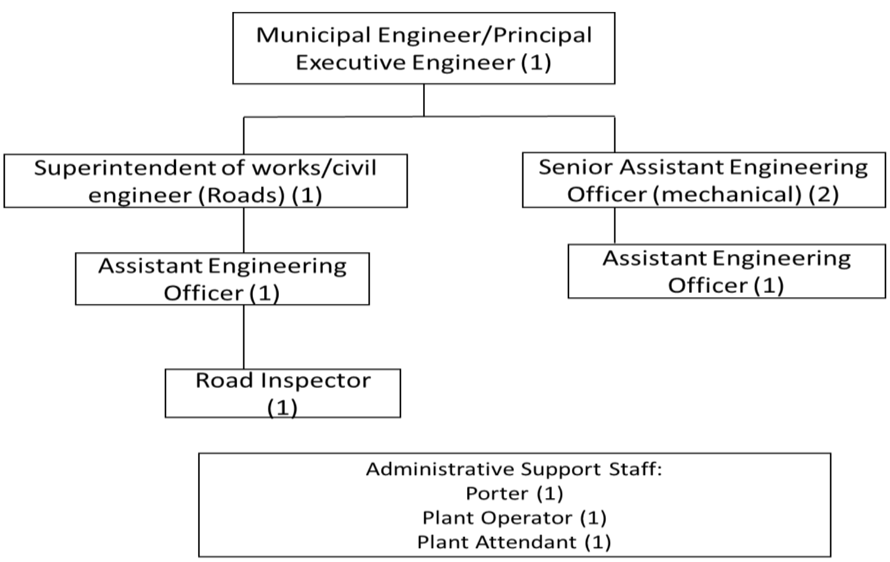
[1] Also based on key informant interviews with district and municipal engineers, sub county chiefs (Soroti, Kisoro, Mbarara, Kotido, Moroto districts) and Uganda National Road Authority- Head of Maintenance held 10th July to 20th August 2019

*Figure 1Approved roads maintenance staffing structure*




Source: Author's illustration based on the approved structure for local governments Government of Uganda. (2016). *Approved structure for district local governments.* (online). Uganda: Ministry of Public service, Government of Uganda. Retrieved from https://publicservice.go.ug/download/approved-structure-for-district-local-governments/. The staffing structure for the water unit has been eliminated.

*Figure 2: Approved works structure for municipal councils*




Source: Author's illustration based on the approved structure for Municipal councils Government of Uganda. (2016). *Approved structure for municipal councils.* (Online). Uganda: Ministry of Public Service Government of Uganda. Retrieved from https://publicservice.go.ug/download/approved-structure-for-municipal-councils/.

Figure 1 shows that the district road-maintenance structure is divided into two units. The roads unit for actual road maintenance has a principal role of monitoring and supervising road maintenance works. The mechanical works unit is mainly for the operation and maintenance of road equipment. While this structure is ideal, many districts have not managed to attain it (structure) due to the reducing wage bill.[2] Moreover, while Figure 2 illustrates the ideal road maintenance structure for municipal councils, it is equally not attained due to the same decreasing wage bill challenge. Majority of government agencies are inadequately staffed. The inability of LGs to meet the ideal staffing structure further motivates the feasibility of alternative service provision such as contracting out.

While districts and municipal councils are mandated to use force account, inputs and specific technical expertise for road maintenance are contracted. For instance, inputs such as gravel, fuel, cement, etc. are procured following Public Procurement and Disposal of Public Assets (PPDA) regulations, and routine maintenance[3] is done using contractors known as road gangs.

Private contracting of road maintenance services is synonymous with the Uganda National Roads Authority (UNRA) - a government agency responsible for constructing and maintaining National roads (those connecting districts). According to a stakeholder interview in UNRA, contractors do 85 percent of road maintenance works on national roads[4]. In order to respond to emergencies like floods and landslides that may sweep away roads, UNRA has rendered 15 percent of national roads to be maintained through force account.

## 2. Literature review

Papers that have studied road maintenance efficiency and contracting-out are motivated by an ownership and competition argument, which were popularized by Blom-Hansen (2003). The private sector is faced with several challenges and the most significant among them is the threat of bankruptcy. Cognizant of this risk, private players have the incentive to perform efficiently, hence the ownership argument. Moreover, the public sector is innately a monopoly, not driven by competition, unlike the private sector. While the former is obliged to make resource allocation decisions, these are often made with a lack of basic knowledge on demand and supply. As such, the former is likely to behave

[2] Based on key informant interviews with district and municipal engineers, sub county chiefs (Soroti, Kisoro, Mbarara, Kotido, and Moroto districts) held 10 July to 20 August 2019.

[3] Casual laborers on annual performance-based contracts do routine maintenance monthly. Activities include slashing, desilting drainages/culverts, pothole-filling using rudimentary tools (KIIs, July-August, 2019).

[4] National roads connect district to district and region to region. Over 25000 km is maintained by UNRA, which is responsible for national roads.

inefficiently (Alonso, Clifton and Diaz-Fluentes, 2015; Blom-Hansen, 2003; Jensen and Stonecash, 2004). In addition, the public sector is not pressured through accountability to shareholders and therefore is less driven to efficiency (Bennmarker, Grönqvist, and Öckert, 2013).

Private involvement is indeed found to lead to cost savings while maintaining good service quality. While the reasons behind this finding were not investigated, explanations follow the ownership and competition arguments mentioned earlier. Nonetheless, a competitive tendering policy is likely to increase public efficiency (Blom-Hansen, 2003). Cost savings are not uniform in all Municipalities of Denmark as some indicated increased costs under contracting out also known as outsourcing (Petersen and Houlberg, 2016). Even so, cost savings are highest with the first tender and lower with the subsequent contracts (Lindholst, Hansen, Randrup, Persson and Kristoffersson, 2018a).

Short-term contracts of about 5 years enable the cost saving advantage from private involvement. In the waste collection category, advantages of contracting out are fewer compared to intermunicipal cooperation - another decentralization system when municipal fixed and duration effects are considered. It is necessary to account for municipal fixed effects especially if a large dataset is available. Unfortunately, while my paper aligns with that of Dijkgraaf & Gradus (2013), I am unable to incorporate their suggestion due to the relatively small dataset, as will be outlined in the data section. Nonetheless, my study uses panel data, which ensures the results are not static, as suggested by Dijkgraaf, & Gradus (2013).

The use of cross-section may produce overestimated and biased effects of contracting out especially if an insufficient control of exogenous differences between the units of analysis exists (Petersen and Houlberg, 2016). The outsourcing/contracting out parameter estimate in Petersen and Houlberg (2016) reduces by 40 percent with fixed effects, further stressing the importance of using panel data. Compared to other public good-management solutions such as public private partnerships (PPPs), internal sourcing, and multinational corporations, contracting out is consistently showing cost saving effects even in municipalities with a population over 1000 inhabitants (Soukopová et al.,2017).

I also review papers not relating to road maintenance and not using panel data, but were using quality as outcome variable for analysis. Majority of these studies are qualitative and have developed a quality index. Findings of studies on quality of service and contracting out reveal mixed associations. For instance, Mouwen and Rietvel (2013) find a mixed effect, positive for Dutch regions that tendered public transport for first time and negative for those that tendered during the second round. Mouwen and Rietvel's (2013)'s findings reiterate those of Lindholst et al. (2018). Rho (2013) finds a positive association between contracting out a portion of the budget and performance of Texas schools.

## 3. Methods and data

Let quality (Qt) be our response variable taking on the values $\{1, 2, 3, \ldots \ldots . j\}$ with j representing an unknown integer. The ordered logit model for Qt results from a latent variable, which is determined by equation 1:

$$Qt^* = x\beta + u \qquad u|x \sim Normal(0,1) \tag{1}$$

Where $x$ represents contracting out and other control variables, $\beta$ is Kx1

Let $\alpha_2 < \alpha_3 \ldots \ldots \ldots \ldots < \alpha_j$ be the threshold parameters defined as:

$$Qt = 1 \; if \; Qt^* \leq \alpha_2$$

$$Qt = 2 \; if \; \alpha_2 < Qt^* \leq \alpha_3 \tag{2}$$

:

:

$$Qt = J \; if \; Qt^* > \alpha_J$$

Since Qt takes on values 1, 2 and 3, the cut points become $\alpha_2$ and $\alpha_3$ .

Given the standard normal assumption for $u$, the conditional distribution of Qt given x, are computing each response probability given in equation (3):

$$P(Qt = 1|x) = P(Qt^* \leq \alpha_2|x) = P(x\beta + u \leq \alpha_2|x) = \Phi(\alpha_2 - x\beta)$$

$$P(Qt = 2|x) = P(Qt^* \leq \alpha_3|x) = P(x\beta + u \leq \alpha_3|x) = \Phi(\alpha_3 - x\beta)$$

:

:

$$P(Qt = J - 1|x) = P\left(\alpha_{J-1} < Qt^* \leq \alpha_J|x\right) = \Phi\left(\alpha_J - x\beta\right) - \Phi\left(\alpha_{J-1} - x\beta\right)$$

$$P(Qt = J|x) = P\left(Qt^* > \alpha_J|x\right) - 1 - \Phi\left(\alpha_J - x\beta\right)$$

Parameters $\alpha$ and $\beta$ are estimated by an ordered logit maximum likelihood random effects model. For each $i$, the log likelihood function is (Wooldrige, 2002):

$$\ell_i\left(\alpha_, \beta\right) = 1[Qt_i = 1]log[\Phi(\alpha_2 x_i\beta)] + 1[Qt_i = 1]log[\Phi(\alpha_3 - x_i\beta) - \Phi(\alpha_2 - x_i\beta)] + \cdots + 1[Qt_i = J]log\left[1 = \Phi\left(\alpha_J - x_i\beta\right)\right] \tag{3}$$

The variables as shown in $x$ are presented as they appear in the dataset discussed below. The quality of road changes:

- If local governments hereby known as LGs contract road maintenance to private sector
- If the number of households in the LG increases. Petersen and Houlberg (2016) considers the number of inhabitants per kilometer as a measure of urbanization.
- If kilometers of total lengths of road in the LG increases.
- If kilometers of road maintenance increases. Prior research has considered the length of roads as an indicator of economies of scale (Blom-Hansen, 2003; Petersen and Houlberg 2016)
- If the commonest transport to reach the road changes. This variable is a proxy of the number of commuters – an indicator of the wear and tear of the road (Blom-Hansen, 2003; Petersen and Houlberg 2016)
- If the frequency of repairs on roads changes.
- As the time invariant regional fixed effects change, hence the need to include a variable capturing the region and the terrain. Alder and Kondo used the terrain a proxy for costs.
- As the fixed time effects change, hence I add a variable capturing time. Note that while the estimation is a maximum likelihood random effects model (meaning that effects are analyzed as variables and not part of the options in a regression estimation); I add variables capturing the region and the year in order to see changes in the main explanatory variables. Adding Year dummies controls for changes in technology, financial condition, national regulations and other factors (Petersen and Houlberg 2016). Djikgraaf and Gradus (2013) have adopted similar effects, although their model uses the ordinary least squares estimation.
- If the cost of maintaining the road changes. This variable has been studied in various studies as the outcome (Blom-Hansen, 2003; Petersen and Houlberg 2016). According to Lindholst et al. (2018a), costs saving is statistically significant and therefore unrelated to managers' satisfaction to service quality. Their proposal of the relationship between cost saving and service quality motivates our model specification. Note that our model specification takes quality as the response variable and cost as part of the control variables, unlike the previous research. The results of the model are discussed in section four.

Data for the analysis is from the Uganda Household Panel Survey (UNPS), the community model for 2013/14 and 2015/16. The community model captures information from community leaders and heads of selected facilities such as health, education and road maintenance on the availability and satisfaction of service delivery. Information on community needs, actions and achievements is requested. Community leaders also provide information on community groups and on resource allocation. Quality of service of road being maintained is a categorical taking on values 1= good, 2= Average, and 3= poor. I recode quality by having the “good” category take on the value of 1, therefore making the variable suitable for estimation using the ordered logit model. Though the main actor responsible for road maintenance, I do not include it as one of the explanatory variables as service quality may be related to the contracting out of services to private sector or to the nature of actor responsible. Moreover, road maintenance may occur at the same time from both contractors and government MDAs, as is the case in Uganda, hence the need to eliminate the actor from the analysis.

The variable depicting presence of the private sector in maintaining roads is posed as *Do you contract out maintenance of road to private sector*? Note that four types of roads are investigated including paved, gravel, feeder and community access roads (CARs). This paper’s focus is on CARs alone for purposes of ensuring statistical power. Paved and gravel roads, also known as national and district roads, are not common in communities/villages, which is our unit of analysis. I have unbalanced panel of 594 observations for the CARs. The variable on cost is calculated by dividing the variable that asks how much was released for maintaining roads in the last financial year by a variable that asks the total length of road in the sub county. A log transformation of the cost variable is taken. Descriptive statistics are displayed in Table 1.

*Table 1: Descriptive statistics 2013-2016. Overall, between and within variation*

| Variable | | Mean | Std. Dev. | Min | Max | Observations |
|---|---|---|---|---|---|---|
| Quality | Overall | 1.87 | 0.61 | 1 | 3 | 357 |
| | Between | | 0.54 | 1 | 3 | 236 |
| | Within | | 0.3 | 0.87 | 2.87 | 1.51 |
| Contracting out | Overall | 1.67 | 0.47 | 1 | 2 | 357 |
| | Between | | 0.44 | 1 | 2 | 236 |
| | Within | | 0.22 | 1.17 | 2.17 | 1.51 |
| Population | Overall | 351.7 | 646.64 | 13 | 10118 | 548 |
| | Between | | 696.44 | 17 | 10118 | 325 |
| | Within | | 240.64 | -1798.3 | 2501.70 | 1.67 |
| Total road length (km) | Overall | 90.61 | 72.55 | 2 | 588.19 | 353 |
| | Between | | 68.31 | 2 | 413.445 | 233 |
| | Within | | 27.14 | -84.13 | 265.36 | 1.52 |
| Usual transport to road | Overall | 1.11 | 0.31 | 1 | 2 | 358 |
| | Between | | 0.3 | 1 | 2 | 237 |
| | Within | | 0.13 | 0.61 | 1.61 | 1.51 |
| Frequency of repairs | Overall | 2.95 | 1.51 | 1 | 5 | 357 |
| | Between | | 1.4 | 1 | 5 | 236 |
| | Within | | 0.63 | 0.95 | 4.95 | 1.51 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Length of road maintained (km) | Overall | 27.74 | 38.55 | 0 | 312 | 352 |
| | Between | | 41.3 | 0 | 312 | 232 |
| | Within | | 12.94 | -51.51 | 106.99 | 1.52 |
| Cost (log) | Overall | 11.86 | 1.86 | -3.71 | 16.55 | 289 |
| | Between | | 2.07 | -3.71 | 16.55 | 195 |
| | Within | | 0.42 | 9.88 | 13.84 | 1.48 |

Source: Author based on UNPS 2013-2016

# 4. Results

Table 2 shows the results from the ordered logit maximum likelihood random effects estimation. In this section, I include five specifications. The first two are non-robust specifications - without (1) and with fixed year and regional time-invariant effects (2), respectively. Robust standard errors have been specified - without fixed effects in model 3, with both year and regional effects in models 4 and 5. Selected regions[5] are included as regional fixed effects in model 5 - see full estimation of Table 2 in Table A1 of the Appendix.

According to these models, the contracting-out coefficient is found to be significant and negative. The interpretation of the ordered log-odd estimate of comparing LGs that do not contract out to those that do on quality- taking other variables constant is given as follows. The ordered logit for LGs that do contract out being in the good quality category is 1.20-1.58 less than LGs that do not contract out. The coefficient is higher for models where fixed effects are accounted, contrary to Djikgraaf and Gradus (2013), Petersen, and Houlberg (2016). The relationship between quality and contracting out is significant at 5 percent (models 1, 3, and 4) and 1 percent level (models 2 and 5).

The control variables generally show the expected relationship with quality of road maintained. The total length and cost are positively related to quality. This is the ordered log-odds estimate for a one-unit increase in the expected level of total road length and cost, other variables are held constant. If a LG were to increase its total road length (presumably, if new roads are constructed) or its cost, its ordered log-odds of being in a good quality category would increase by 0.01 and 0.3, respectively. Total length of road and the cost are significant at 5 percent level.

The length of road maintained is negatively related to quality, contrary to the proposed hypothesis. This is the ordered log-odds estimate for a one-unit increase in the expected level of length of road maintained other variables constant. If a LG were to increase its length of road maintained, its ordered log-odds of being in a good quality category would

[5] I selected regions that were significant in models 2 and 4.

decrease by 0.014-0.02. The relationship between quality and the length of road maintained is significant at 5 percent level. The result is contrary to theory.

I also find significant results for some categories in the frequency of repairs. This is the ordered log-odds estimate of comparing routine manual to mechanized repairs on the expected quality, holding other variables constant. The ordered logit for routine and regular mechanized repairs being in a good quality category is 1.26-1.53 and 1.53-1.64, respectively, less than routine manual repairs. Results in the mechanized categories are significant at the 5-10 percent level in models 2, 4 and 5.

The coefficient in cut point1 differentiates the low category from the average and good quality categories while the coefficient in cut point 2- the low and average categories from the good quality category when the predictor variables are estimated at zero. As such, LGs that have value of (-6.70)-(-4.66) or less and 0.16-1.38 or greater are classified as low and good quality respectively given that each of the predictors has a value zero. LGs with a value between the following ranges, (-6.70)-(-4.66) and 0.16-1.38 are classified as having an average quality. Note that all other control variables are not significant i.e. *population*, *usual transportation to road* and some categories of the *frequency of repairs*.

As a robustness check, I ran a Multiple Imputation (MI) estimation. However, MI does not support an ordered logistic or probit model with panel data. Therefore, a binary logit model, with zero depicting local governments that reported poor quality and one as good quality was estimated. In other words, average and good quality categories in Table 3 were collapsed into one category. As such, results of the MI in Table 3 show that the coefficient doubled- significantly different from the results in Table 2 by about 1.5 points. Noteworthy are the insignificant results of the control variables. The variable *frequency of repairs* was not included in the MI estimation because of problems encountered during imputation, which necessitated its removal. Since the paper focuses on the effect of contracting out on quality, the MI estimation in Table 3 confirm that the result on contracting out is reliable.

Another robustness check is in Table 4, where the population has been transformed, and a sample of the capital city (Kampala) has been removed. In models 1-3 of Table 4, the population variable has been transformed to bands, centered to the mean and logarithms, respectively. Specifically, the bands in model 1 are as follows. In the low population group, there are less or equal to 119 households, in the middle category- between 120 and 250 households and in the high population group- more than 250 households. While the sign of the coefficient on contracting out has not changed, it has increased to 1.72 where population has been turned to bands. Moreover, the high population group is positively associated with quality. This means that LGs are likely to report high quality road maintenance. This result can be explained by high expenditures allocated to areas with high traffic levels, which, in this case, is signaled by highly populated LGs.

Even so, the coefficient on contracting out does not change when the values on the capital city (Kampala) have been removed from the analysis. Since the capital city is related to high traffic levels, the thought was that the effect of contracting out would be stronger; however, the result in model 5 of Table 5 proves that this is not true (see also the full estimation in Table 4 in Appendix Table A2).

*Table 2: Effect of contracting out on road maintenance quality*

| | 1 | 2 | 3[a] | 4[a] | 5[a] |
|---|---|---|---|---|---|
| Contracting out (Ref= No) | -1.20* | -1.55** | -1.20* | -1.55* | -1.58** |
| | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 |
| Population | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 0.51 | 0.66 | 0.52 | 0.71 | 0.51 |
| Total road length (km) | 0.01* | 0.01* | 0.01* | 0.01* | 0.01* |
| | 0.03 | 0.02 | 0.02 | 0.01 | 0.03 |
| Usual Transport to road (ref= Walking) | 0.04 | 0.12 | 0.04 | 0.12 | 0.09 |
| | 0.95 | 0.88 | 0.96 | 0.90 | 0.92 |
| **Frequency of repairs (ref=routine manual)** | | | | | |
| *Routine-mechanized* | -0.29 | 1.53* | -0.29 | 1.53* | 1.26+ |
| | 0.64 | 0.05 | 0.61 | 0.04 | 0.08 |
| *Regular manual* | 0.38 | 0.65 | 0.38 | 0.65 | 0.64 |
| | 0.54 | 0.33 | 0.57 | 0.35 | 0.37 |
| *Regular-mechanized* | 0.52 | 1.53+ | 0.52 | 1.52+ | 1.64* |
| | 0.43 | 0.07 | 0.44 | 0.06 | 0.03 |
| *Other* | -0.69 | 0.22 | -0.69 | 0.22 | 0.50 |
| | 0.28 | 0.77 | 0.33 | 0.80 | 0.54 |
| Length of road maintained (KMs) | -0.02* | -0.02+ | -0.02** | -0.02* | -0.01* |
| | 0.01 | 0.05 | 0.00 | 0.03 | 0.02 |
| Cost (log) | 0.28* | 0.3* | 0.3* | 0.3* | 0.25* |
| | 0.03 | 0.04 | 0.01 | 0.01 | 0.03 |
| Year fixed effects | No | yes | No | Yes | yes |
| Regional fixed effects | No | yes | No | Yes | yes |
| cut1 | -1.38 | -0.16 | -1.38 | -0.16 | -1.31 |
| | 0.37 | 0.94 | 0.29 | 0.93 | 0.45 |
| cut2 | 4.66* | 6.70** | 4.66** | 6.70** | 5.44* |
| | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 |

| | | | | | |
|---|---|---|---|---|---|
| sigma2_u | 4.51+ | 4.23 | 4.51+ | 4.23 | 4.58+ |
| | 0.07 | 0.10 | 0.06 | 0.11 | 0.07 |
| Observations | 282 | 282 | 282 | 282 | 282 |
| Wald chi2 | 13.51 | 9.91[b] | 18.92 | 39.09 | 29.72 |
| prob>chi2 | 0 | 0 | 0.04 | 0.06 | 0.03 |

Notes: P-values (+ 0.10 * 0.05 ** 0.01 *** 0.001). [a] Models 3-5 are based on robust estimates. [b] Different from models 3-5 as LR test vs. ologit model: chibar2 is considered. Source: Author based on UNPS 2013-2016

*Table 3: Robustness check of the effect of contracting out on road maintenance quality on imputed values (MI estimation)*

| | 1 | 2 | 3 |
|---|---|---|---|
| Contracting out(ref=No) | -2.54** | -2.59** | -2.52** |
| | 0.00 | 0.00 | 0.00 |
| Usual Transport to road (ref= Walking) | 0.09 | 0.01 | -0.02 |
| | 0.87 | 0.99 | 0.98 |
| Population | 0.00 | 0.00 | 0.00 |
| | 0.13 | 0.12 | 0.13 |
| Total road length | 0.00 | 0.00 | 0.00 |
| | 0.74 | 0.80 | 0.98 |
| Length of road maintained | 0.00 | 0.00 | 0.00 |
| | 0.87 | 0.85 | 0.85 |
| Cost (Log) | 0.08 | 0.05 | 0.08 |
| | 0.50 | 0.66 | 0.47 |
| Constant | 2.75+ | 3.16+ | 2.64+ |
| | 0.09 | 0.06 | 0.09 |
| Fixed effects | Yes | Yes | Yes |
| lnsig2u | -2.60 | -2.99 | -14.48 |
| Constant | 0.87 | 0.94 | 1.00 |
| Observations | 594 | 594 | 594 |

Notes: P-values (+ 0.10 * 0.05 ** 0.01 *** 0.001). Source: Author based on UNPS 2013-2016. Model 1-Region, 2-Terrain and 3-Year effects. MI estimation could not allow all three effects in the same specification.

*Table 4: Robustness check of the effect of contracting out on road maintenance quality with transformed population values and capital city values removed from analysis*

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Contracting out (ref=No) | -1.72* | -1.55* | -1.56* | -1.54* |
| | 0.01 | 0.02 | 0.02 | 0.02 |
| Medium population | 0.36 | | | |
| | 0.45 | | | |
| High population | 1.05+ | | | |
| | 0.09 | | | |
| Total road length (km) | 0.01* | 0.01* | 0.01* | 0.01* |
| | 0.01 | 0.01 | 0.01 | 0.01 |
| Usual Transport to road (ref= Walking) | 0.30 | 0.12 | 0.11 | 0.12 |
| | 0.74 | 0.90 | 0.90 | 0.89 |
| **Frequency of repairs (Ref=Routine manual)** | | | | |
| *Routine-mechanized* | 1.51* | 1.53* | 1.51* | 1.52* |
| | 0.04 | 0.04 | 0.04 | 0.04 |
| *Regular-manual* | 0.72 | 0.65 | 0.68 | 0.65 |
| | 0.31 | 0.35 | 0.33 | 0.35 |
| *Regular-mechanized* | 1.53+ | 1.53+ | 1.53+ | 1.53+ |
| | 0.05 | 0.06 | 0.05 | 0.06 |
| *Other* | 0.34 | 0.22 | 0.24 | 0.23 |
| | 0.70 | 0.80 | 0.78 | 0.79 |
| Length of road maintained (km) | -0.02* | -0.02* | -0.02* | -0.02* |
| | 0.03 | 0.03 | 0.03 | 0.03 |
| Cost (log) | 0.29* | 0.3* | 0.28* | 0.29* |
| | 0.02 | 0.01 | 0.02 | 0.01 |
| Centered population | | 0.00 | | |

| | | | | |
|---|---|---|---|---|
| | | 0.71 | | |
| Log population | | | 0.28 | |
| | | | 0.41 | |
| Pop | | | | 0.00 |
| | | | | 0.72 |
| cut1 | -0.85 | -1.69 | -0.32 | -1.55 |
| | 0.72 | 0.45 | 0.91 | 0.48 |
| cut2 | 6.05* | 5.18* | 6.51* | 5.25* |
| | 0.03 | 0.04 | 0.04 | 0.04 |
| sigma2_u | 4.37 | 4.23 | 4.11 | 4.27 |
| | 0.11 | 0.11 | 0.12 | 0.11 |
| Observations | 288 | 282 | 282 | 278 |
| Wald chi2 | 37.29 | 39.09 | 37.22 | 35.41 |
| Prob>chi2 | 0.11 | 0.06 | 0.09 | 0.10 |

Notes: P-values (+ 0.10 * 0.05 ** 0.01 *** 0.001). Source: Author based on UNPS 2013-2016. Model 4 removes values on the capital (Kampala) from the analysis.

## 5. Discussion and conclusion

This paper examines the effect of contracting out of road servicing to private sector on the quality of road maintenance using panel data on Uganda. The main result indicates a negative relationship between contracting out and quality of road maintenance service. By focusing on how contracting out affects road service quality, this study adds to the literature that predominantly explored the relationship between costs and contracting out (Petersen, Hjelmar, & Vrangbæk, 2018). While this paper follows Blom-Hansen (2003), and Petersen and Houlberg (2017), the results are not comparable because prior studies considered costs as a major dependent variable and quality as the independent variable. Contrary to Blom-Hansen (2003), and Petersen and Houlberg (2017), economies of scale could not be assessed in this study due to differences in specification of the outcome variable. Nonetheless, since these prior papers studied road maintenance and use panel data, they could be useful for explaining and discussing the results of this paper. For instance, the larger coefficients in models 2, 4 and 5 of Table 2 suggest the importance of adding fixed time and time invariant regional effects as suggested by Petersen and Houlberg (2016). Indeed the increase in the coefficient of contracting out implies that there were time constant differences between the LGs. Because road investments are prone to selection bias, controlling for these differences using the year, region and terrain as I have done in Table 2 shows that this bias has been mitigated or reduced (see Petersen and Houlberg 2016).

The results corroborate those in Rho (2013) who finds that contracting out does not lead to more resources available for instructional functions in school districts. The result in contracting out also corroborates findings in Camp and Gaes (2002), O'Toole and Meier (2014), Purse (2009) and Thompson (2011). There are several possible explanations for the negative relationship between contracting out on road maintenance quality. First is the contrary argument that instead of raising efficiency as claimed in some prior papers, contracting out may reduce the spending, which then lowers the service quality, as both governments and contractors have the tendencies to save costs in order to profit more from the outsourcing. This is likely to be the case in developing countries with poor bureaucracy and weak legal institution. Secondly, contracting could be synonymous with bloated bureaucracy (O'Toole Jr & Meier, 2004; Rho, 2013), which adversely affects service quality due to delays in processing contracts or participating parties not honoring the contracts due to poor legal enforcement of the contracts. Contracting requires "a strong relational element which most governments in developing countries are unable to guarantee (Batley & Mcloughlin, 2010). Since majority of the contractual arrangements in developing countries are funded through donors, government's power and state capacity could have been undermined, hence giving contractors the leeway to save on costs. An example is Afganistan (Zivetz, 2006 cited in Bartely and Mcloughlin, 2010:142) which suggests poor contractual management by the local government, thereby leading to a poor quality public good. In fact, it is suggested that contractual arrangements may not be the best alternative to financial service delivery constraints in fragile countries (Bartely and Mcloughlin, 2010:143). It remains to be established whether Uganda has become vulnerable in the days of post conflict. Bartely's suggestion could be extended to a regional outlook, as Uganda belongs to a fragile region that is prone to civil strife emanating from neighboring countries i.e. borderline districts or those that have recently recovered from conflict such as majority districts in Northern Uganda and Kasese district in the Southwest. In fact, positive significant coefficients in regional effects of Tables A1 and A2 of the appendix affirm this explanation.

This paper, however, has several limitations. For instance, it is difficult to know if the variable in the data set asks for quality of service arising from the use of contractors for that survey year or the complete contractual period. Given that contracts are usually lengthy[6], the respondent (head of service in LG) may have referred to quality at the initial assessment of the contract. Contractual performance is usually impressive at the onset

[6] 3 years maximum for Uganda's case according to stakeholder interview with UNRA. Besides, insignificant year effects (see Appendix A1 for full set of results) may signal that contracts often last several years.

because contractors are often intentionally efficient but will deteriorate subsequently (see Lindholst, Helby Petersen, & Houlberg 2018b). Moreover, taking road quality itself also possesses further limitations as pointed by Petersen and Houlberg (2016). Cracks and potholes may delay appearance in the first year depending of course on the quality of construction. This means that road quality is as result of maintenance in previous years (Petersen & Houlberg, 2016).

Another limitation of the study is the lack of variables on contractors. Accounting for contractor effects such as information of contractor's prior performance, financial muscle, expertise, education may change the results in Table 2 (see Rho 2013). According to stakeholder interviews, local contractors are drawn to maintenance works while private contractors- rehabilitation works. The differentiating factor between the two types of contractors is the financial muscle, high in the latter type.

Therefore, future studies on contacting out in technical fields such as road maintenance should ensure adequate data on costs and transaction costs for purposes of comparability with prior studies. If indeed quality of service is selected as the outcome variable, an index of quality indicators is recommended, see Stolt et al. (2011) and Mouwen and Rietvel (2013) for a replicable social and technical service example respectively.

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# Appendix

*Table A1: Effect of contracting out on quality of road maintenance, full estimation results*

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Contracting out(ref=No) | -1.20* | -1.55** | -1.20* | -1.55* | -1.58** |
| | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 |
| Population | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 0.51 | 0.66 | 0.52 | 0.71 | 0.51 |
| Total road length (km) | 0.01* | 0.01* | 0.01* | 0.01* | 0.01* |
| | 0.03 | 0.02 | 0.02 | 0.01 | 0.03 |
| Usual Transport to road | 0.04 | 0.12 | 0.04 | 0.12 | 0.09 |
| | 0.95 | 0.88 | 0.96 | 0.90 | 0.92 |
| Frequency of repairs (ref=routine manual) | | | | | |
| *Routine-mechanized* | -0.29 | 1.53* | -0.29 | 1.53* | 1.26+ |
| | 0.64 | 0.05 | 0.61 | 0.04 | 0.08 |
| *Regular-manual* | 0.38 | 0.65 | 0.38 | 0.65 | 0.64 |
| | 0.54 | 0.33 | 0.57 | 0.35 | 0.37 |
| *Regular-mechanized* | 0.52 | 1.53+ | 0.52 | 1.53+ | 1.64* |
| | 0.43 | 0.07 | 0.44 | 0.06 | 0.03 |
| *Other* | -0.69 | 0.22 | -0.69 | 0.22 | 0.50 |
| | 0.28 | 0.77 | 0.33 | 0.80 | 0.54 |
| Length of road maintained(KMs) | -0.02* | -0.02+ | -0.02** | -0.02* | -0.01* |
| | 0.01 | 0.05 | 0.00 | 0.03 | 0.02 |
| Cost (log) | 0.28* | 0.3* | 0.28* | 0.3* | 0.25* |
| | 0.03 | 0.04 | 0.01 | 0.01 | 0.03 |
| Year1 | | -0.35 | | -0.35 | -0.28 |
| | | 0.34 | | 0.33 | 0.43 |
| **Region (ref= Central1)** | | | | | |
| *Central 2* | | 1.61+ | | 1.61 | |
| | | 0.10 | | 0.10 | |
| *Busoga* | | 1.88 | | 1.88 | |
| | | 0.15 | | 0.14 | |
| *Kampala* | | -2.82 | | -2.82** | -2.79*** |
| | | 0.18 | | 0.00 | 0.00 |
| *Lango* | | -0.28 | | -0.28 | |
| | | 0.81 | | 0.83 | |
| *Acholi* | | 2.34 | | 2.34+ | |
| | | 0.22 | | 0.10 | |
| *Tooro* | | 0.28 | | 0.28 | |
| | | 0.86 | | 0.83 | |
| *Bunyoro* | | 0.20 | | 0.20 | |
| | | 0.91 | | 0.85 | |
| *Bukedi* | | 1.32 | | 1.32 | |
| | | 0.40 | | 0.46 | |
| *Elgon* | | 1.00 | | 1.00 | |
| | | 0.63 | | 0.70 | |
| *Karamoja* | | 3.95* | | 3.95* | 3.67** |
| | | 0.01 | | 0.01 | 0.01 |
| *Teso* | | 4.19** | | 4.19** | 3.79*** |
| | | 0.00 | | 0.00 | 0.00 |
| *Kigezi* | | -0.91 | | -0.91 | |
| | | 0.51 | | 0.26 | |
| *Ankole* | | -0.59 | | -0.59 | |

| | | | | | |
|---|---|---|---|---|---|
| | | 0.57 | | 0.47 | |
| *WestNile* | | 3.55** | | 3.55** | 3.21** |
| | | 0.01 | | 0.01 | 0.00 |
| **Terrain (ref= Island)** | | | | | |
| *Mountain* | | -0.64 | | -0.64 | -1.45 |
| | | 0.68 | | 0.64 | 0.22 |
| *Normal terrain* | | -0.51 | | -0.51 | -0.81 |
| | | 0.57 | | 0.55 | 0.25 |
| cut1 | -1.38 | -0.16 | -1.38 | -0.16 | -1.31 |
| | 0.37 | 0.94 | 0.29 | 0.93 | 0.45 |
| cut2 | 4.66* | 6.70** | 4.66** | 6.70** | 5.44* |
| | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 |
| sigma2_u | 4.51$^{+}$ | 4.23 | 4.51$^{+}$ | 4.23 | 4.58$^{+}$ |
| | 0.07 | 0.10 | 0.06 | 0.11 | 0.07 |
| Observations | 282.00 | 282.00 | 282.00 | 282.00 | 282.00 |
| Wald chi2 | 13.51 | 9.91 | 18.92 | 39.09 | 29.72 |
| Prob>chi2 | 0.00 | 0.00 | 0.04 | 0.06 | 0.03 |

Notes: P-values (+ 0.10 * 0.05 ** 0.01 *** 0.001). Source: Authors

*Table A2: Full estimation -Robustness check of the effect of contracting out on road maintenance quality with transformed population values and capital city values removed from analysis*

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Contracting out (ref=No) | -1.72* | -1.55* | -1.56* | -1.54* |
| | 0.01 | 0.02 | 0.02 | 0.02 |
| Medium population | 0.36 | | | |
| | 0.45 | | | |
| High population | 1.05$^{+}$ | | | |
| | 0.09 | | | |
| Total road length (km) | 0.01* | 0.01* | 0.01* | 0.01* |
| | 0.01 | 0.01 | 0.01 | 0.01 |
| Usual Transport to Road (ref=walking) | 0.30 | 0.12 | 0.11 | 0.12 |
| | 0.74 | 0.90 | 0.90 | 0.89 |
| **Frequency of repairs (ref=Routine manual)** | | | | |
| *Routine-mechanized* | 1.51* | 1.53* | 1.51* | 1.52* |
| | 0.04 | 0.04 | 0.04 | 0.04 |
| *Regular-manual* | 0.72 | 0.65 | 0.68 | 0.65 |
| | 0.31 | 0.35 | 0.33 | 0.35 |
| *Regular-mechanized* | 1.53$^{+}$ | 1.53$^{+}$ | 1.53$^{+}$ | 1.53$^{+}$ |
| | 0.05 | 0.06 | 0.05 | 0.06 |
| *Other* | 0.34 | 0.22 | 0.24 | 0.23 |
| | 0.70 | 0.80 | 0.78 | 0.79 |
| Length of road maintained (km) | -0.02* | -0.02* | -0.02* | -0.02* |
| | 0.03 | 0.03 | 0.03 | 0.03 |
| Cost (log) | 0.29* | 0.3* | 0.28* | 0.29* |
| | 0.02 | 0.01 | 0.02 | 0.01 |
| Centered population | | 0.00 | | |
| | | 0.71 | | |
| Log population | | | 0.28 | |
| | | | 0.41 | |
| Pop | | | | 0.00 |

| | | | | |
|---|---|---|---|---|
| | | | | 0.72 |
| Year1 | -0.32 | -0.35 | -0.36 | -0.35 |
| | 0.38 | 0.33 | 0.31 | 0.33 |
| **Region (ref= Central 1)** | | | | |
| *Central 2* | 1.45 | 1.61 | 1.53 | 1.60 |
| | 0.14 | 0.10 | 0.12 | 0.11 |
| *Busoga* | 0.85 | 1.88 | 1.81 | 1.86 |
| | 0.55 | 0.14 | 0.15 | 0.14 |
| *Kampala* | -2.96** | -2.82** | -2.77** | |
| | 0.00 | 0.00 | 0.00 | |
| *Lango* | -0.20 | -0.28 | -0.14 | -0.27 |
| | 0.88 | 0.83 | 0.92 | 0.84 |
| *Acholi* | 2.14 | 2.34+ | 2.34+ | 2.32+ |
| | 0.11 | 0.10 | 0.09 | 0.10 |
| *Tooro* | 0.07 | 0.28 | 0.28 | 0.27 |
| | 0.96 | 0.83 | 0.83 | 0.84 |
| *Bunyoro* | -0.08 | 0.20 | 0.26 | 0.20 |
| | 0.94 | 0.85 | 0.81 | 0.86 |
| *Bukedi* | 1.22 | 1.32 | 1.35 | 1.32 |
| | 0.44 | 0.46 | 0.44 | 0.45 |
| *Elgon* | 1.40 | 1.00 | 1.35 | 1.00 |
| | 0.59 | 0.70 | 0.62 | 0.69 |
| *Karamoja* | 4.05* | 3.95* | 3.97* | 3.93* |
| | 0.01 | 0.01 | 0.01 | 0.01 |
| *Teso* | 3.83** | 4.19** | 4.16** | 4.17** |
| | 0.00 | 0.00 | 0.00 | 0.00 |
| *Kigezi* | -0.66 | -0.91 | -0.79 | -0.88 |
| | 0.43 | 0.26 | 0.34 | 0.27 |
| *Ankole* | -0.57 | -0.59 | -0.55 | -0.57 |
| | 0.49 | 0.47 | 0.50 | 0.48 |
| *WestNile* | 3.58** | 3.55** | 3.61** | 3.53** |
| | 0.01 | 0.01 | 0.01 | 0.01 |
| **Terrain (ref= Island)** | | | | |
| *Mountain* | -0.31 | -0.64 | -0.62 | -0.63 |
| | 0.83 | 0.64 | 0.65 | 0.65 |
| *Normal terrain* | 0.01 | -0.51 | -0.43 | -0.49 |
| | 0.99 | 0.55 | 0.61 | 0.57 |
| cut1 | -0.85 | -1.69 | -0.32 | -1.55 |
| | 0.72 | 0.45 | 0.91 | 0.48 |
| cut2 | 6.05* | 5.18* | 6.51* | 5.25* |
| | 0.03 | 0.04 | 0.04 | 0.04 |
| sigma2_u | 4.37 | 4.23 | 4.11 | 4.27 |
| | 0.11 | 0.11 | 0.12 | 0.11 |
| Observations | 288 | 282 | 282 | 278 |
| Wald chi2 | 37.29 | 39.09 | 37.22 | 35.41 |
| Prob>chi2 | 0.11 | 0.06 | 0.09 | 0.10 |

Notes: P-values (+ 0.10 * 0.05 ** 0.01 *** 0.001). Source: Authors