THE *REAL* STATE: INSIDE THE CONGO'S TRAFFIC POLICE AGENCY

Supplemental Study Documentation: Data Construction and Additional Design Information

Raúl Sánchez de la Sierra* **Kristof Titeca**† **Haoyang (Stan) Xie** ‡
Albert Malukisa Nkuku§ **Aimable A. Lameke**¶

10 July 2022

*University of Chicago and NBER. Email: raul@uchicago.edu
†Antwep University. Email: kristof.titeca@uantwerp.be
‡University of Chicago. Email: stanxie@uchicago.edu
§Université Catholique du Congo. albert.malukisa@ucc.ac.cd
¶Marakuja Kivu Research, Goma, Democratic Republic of the Congo. amanilamek@gmail.com

Data Construction

1. Algorithms to Aggregate Police Station Sources

A. *Resolved vs. Unresolved Files*

- **Step 1**: We determine if the file was resolved within the day. We apply the following algorithm:

  1. If either the amount of money paid to FCAs (as a fine) or JPOs (as a bribe) is non-missing, then the file is classified as resolved.
  2. Then, based on the initial bribe request and intervention data, we classify the remaining drivers:
     (a) if the initial offer value is positive:
        i. if the protection intervention is missing, then the file is not resolved.
        ii. if the protection intervention is non-missing, then the file is resolved.
     (b) if the initial offer value is either zero or missing:
        i. if the protection intervention is missing, then the file is not resolved.
        ii. if the protection intervention is non-missing, then the file is resolved.

- **Step 2**: For both resolved and unresolved cases, we impute the amount of money paid to FCAs or JPOs based on the amounts given by those recorded, applying the following algorithm:

  1. If the case is resolved, we code the amount of money missing to zero. This ensures that the data collectors entering paper forms meant that no amount was paid (rather than not having completed the entry).
  2. If the case is not resolved, and if there is no future information in subsequent days concerning the resolution of their case, we impute the missing amount paid to FCA using the average value over the police station, intersection and FCA source, and impute the missing amount paid to the JPO using the average value over the police station, intersection and JPO source.

B. *Dealing With Intersections that are Attached to Sample Police Stations but Are Outside the Experimental Sample*

The problem: In our context, a small set of intersection/teams outside of our study that are not observed in the street, nor are part of the experiment due to concerns for the safety of our observers, are nonetheless recorded in the police station as the origin intersection from which drivers are routinely being escorted to the police station. To address the challenge that we do not observe the amount of bribes collected by the teams at those intersections, we impute the street level bribe revenue for the agents at the few intersections that we are unable to observe in the street. The imputation applies to Table 1, Figure A6 and Figure A14.

The imputation: We assume that the unobserved intersections collect the street level bribe revenues at the same level as their co-intersections within the same police station. To conduct the imputation, we first sum the out-of-sample intersections to calculate the total number of relevant intersections for each police station.[1] Then, we calculate the ratio of the total number of relevant intersections in each police station to the in-sample intersections, for each police station and each day, henceforth *intersections ratio*.[2] Then, for each police station, and for each day, we multiply the (observed) average bribe revenue collected by the in-sample intersections of the study by the intersections ratio. This returns the sample adjusted estimate for the total bribes collected by all the agents of a station collected at their intersections.

C. *Presenting Descriptive Statistics When Some Team-Days Were Assigned to the Quota Reduction Encouragement*

In Table 1, we present the properties of the system. It is thus important that observations assigned to quota reduction *encouragement* do not factor in to the computation of the means presented in that table. For the intersection-day blocks assigned to the quota reduction *encouragement*, we impute the value using the mean of each intersection on the days without the quota reduction encouragement. We also use this strategy to exclude

[1] The average number of intersections each police station and each day is 1.9; the number is 3.3 counted out-of-sample intersections.

[2] The average intersections ratio for each police station and each day is around 2.2.

the quota reduction observations from the following tables and figures: Figure A6 and Figure A14. In all the rest, we simply exclude observations assigned to quota reduction *encouragement* when computing the mean.

D. *Aggregating Reports from the Four Observers in Each Police Station For Driver Interactions*

The problem: In each police station, we worked with four observers (two FCAs and two JPOs). The observers report on the same intersections; hence, if they made no omissions, the data collection strategy results in four data points per interaction. Since there are some omissions, the problem is complicated by varying intensities of duplication.

Another problem: Each day of data collection, in the evening, the forms were gathered in the project's office. The next day, two assistants entered the paper forms into a tablet using SurveyCTO. We applied this component to minimize the risk of data loss, but due to the conditions of data entry and the quantity of work, the quality of the data entered is reasonably low. For this reason, we also scanned all of the FCA and JPO reports (although 10% were ultimately lost). We thus have, in addition to the 4 sources entered in SurveyCTO (which may contain entry mistakes), the scans for a significant share of the original sources, resulting in 8 data points at times (4 of which are the entry of the first 4). We refer to *entered data* as the source of data that was entered in SurveyCTO during the study, and to *original scanned* as the original paper source scanned.

The algorithm to aggregate the police station sources is as follows:

- **Step 1**: Separately for each of *original scanned* and *entered data*,

    1. For *original scanned*:

        (a) We detect the potential duplicate-pairs, based on police station, intersection, date, arrival time for each car, and car type.

        (b) For the potential duplicate-pairs, we drop those (step by step):

            i. with more missing entries relating to the money paid to the FCA and JPO.

            ii. with more missing entries relating to the protector's rank information.

(c) Then, for the potential duplicates-pairs, we check whether they have different infractions. If they do, then they are treated differently; if they don't, then we drop one of them.

(d) Then for the potential duplicate-pairs that we cannot reduce to one observation after the steps above, we replace the numerical values, such as the amount of money paid to the FCA and JPO, using the mean within pairs.

2. For *entered data*:

   (a) We detect the potential duplicates, based on police station, intersection, date, arrival time for each car, and car type.

   (b) For the potential duplicate-pairs, drop those (step by step)

      i. with more missing entries relating to the money paid to the FCA and JPO.

      ii. with more missing entries relating to the protector's rank information.

   (c) Then, for the potential duplicates-pairs, we check whether they have different survey duration times, if yes, then they are treated differently; if no, we drop one of them.

   (d) Then, for the potential duplicate-pairs that we cannot reduce to one observation after the steps above, we replace the numerical values, such as the amount of money paid to the FCA and JPO using mean within pairs.

- **Step 2**: We append *entered data* and *original scanned* together

  1. We detect the potential duplicate-pairs, based on police station, intersection, date, arrival time for each car, and car type, then we drop the observations within each duplicate-pair if they are from *original scanned*, since *entered data* is of higher quality than *original scanned* when they are considered as the same data point.

  2. Then, we detect the potential duplicate-pairs, based on police station, intersection, date, hour, car type, the initial offer of each car, the amount of money paid to the FCA, the amount of money paid to the JPO and the amount of money paid purportedly as a fee for using the car pound (the "fourriere" in

French), then we drop the observations within each duplicate-pair if they are from *original scanned* using the same algorithm as above.

2. Verifying the True Quota Level Using Seven Different Sources

Sources: police station data (JPO and FCA sources), research coordinator general tracking sheet (which we called "tracking grade d'elite"), JPO research supervisor process tracking sheet, the street-level assistants' process tracking sheet (which we called "tracking assistants"), auditor's process tracking sheet, and daily records of the three daily supervision meeting.

Verification Algorithm: we take the mode of the quota level across these data sources, given the fact that most sources report the same quota level. The randomization implementation checks and experimental estimates of Equation 2 are robust to instead using the average, the weighted average, the median, or the maximum of the quota level.

3. Algorithms to Aggregate Observers' Street Sources

A. *Target Strategy*

Each street observer was assigned to track the behavior of a randomly selected agent attached to the intersection where the observer was deployed, whom they would follow and observe during the day (henceforth, the *target*). The observers were given instructions to observe a different agent whenever the *target* was nowhere to be found, and to indicate in their form that the agent being observed was a replacement. This new agent present at the intersection would be chosen randomly by the observer regardless of his membership to the team attached to the intersection. They would become a replacement for the *target*, only for the duration of time for which the *target* was absent. So if the *target* comes back to the intersection, the observer would have to switch back from observing the replacement agent, and start a new entry indicating they are recording the behavior of the *target*.

Due to minor data loss, we do not have access to the daily list of agents assigned to each observer by the supervisor. However, we included some questions related to the target status of the observed agent in the survey. The first indicator indicates if the observed officer is a *target* (henceforth, *target indicator*), and if not, the second indicator indicates why not (will be referred to as the *why replacement indicator*).

There are two deviations from this data collection protocol. First, these indicators were included in the survey from the third version of the survey design, which was deployed 8 days after the beginning of the study. Therefore, we do not have information on the indicators for the first 8 days. This represents around 19% of the raw data coming from the street observers survey. Second, around 28% of the raw data coming from the survey that did include the target status questions have missing values in the *target indicator*. In the following lines, we explain the cleaning process of this indicator.

In order to recover some information about the agents' target status with missing values in the *target indicator*, we use the following assumptions:

- First, in some cases the *target indicator* has a missing value but the *why replacement indicator* has a non-missing value. We use the responses of the latter variable to infer the values of the first variable. For example, we deduced that the agent was a replacement from a note saying "*This is the replacement agent*".

- Second, after the first 8 days, the majority of the observers who do not report the target status observed only one agent in the day (around 92%). Furthermore, most of the observers who observed only one agent in the day reported them to be a *target* (around 90%) and most of the observers who reported an agent as a replacement observed more than one agent in the day (around 60%). Based on this information, we determined that it is reasonable to assume that the observers who observed only one agent in a day were actually observing a *target*. Next, we use the same criteria to replace missing values in the first and second form designs (i.e., before the inclusion of the target variables in day 8).

- Third, for a specific observer and day, if two agents observed by the observer in the day have missing values in the *target indicator* and one does not belong to the police roster, then we assume that the other one must be the *target*. The main assumption is that a *target* could only be chosen from the pool of agents from the police roster.

- Finally, for a specific observer and day, if one of two agents observed by the observer in the day is a *target* and the other has a missing value in the *target indicator*, we assume that the latter agent is a *replacement*. The main assumption is that there should not be a case of more than one *target* being observed by the same observer.

- After implementing all of the changes that follow from these assumptions given the raw data, we are only left with very few missing values in the *target indicator* which we eventually drop when performing the aggregation process.

B. ***Aggregation***

We aggregate the data from the observed agent - intersection - day - hour level to the level of intersection - day - hour as follows. The estimated average behavior of an agent is given by:

$$\mathbb{E}(x_{piht}) = \mathbb{E}(x_{piht}|\text{present}) \Pr(\text{present}) + \mathbb{E}(x_{piht}|\text{not present}) \Pr(\text{not present})$$

where p is police, i is intersection, h is hour, t is day. $\mathbb{E}(x_{piht}|\text{present})$ is the behavior of a randomly selected agent (including *target* and random *replacement*), conditional on being present at intersection i. $\Pr(\text{present})$ is the probability that a randomly selected agent is present in intersection i at hour h in day t.

We do not observe $\mathbb{E}(x_{piht}|\text{not present})$, since the agents that were not present were not observed by the observers at intersection i. However, by assuming that $\mathbb{E}(x_{piht}|\text{not present}) = 0$, we can estimate a lower bound of $\mathbb{E}(x_{piht})$ (since agents not present at their intersection may not just be taking a break, they could be collecting bribes at other intersections and hence $\mathbb{E}(x_{piht}|\text{not present}) \geq 0$).

Since *targets* were randomly selected among the pool of agents attached to a given intersection irrespective of whether they were present or not, it follows that $E(x_{piht}) = E(x_{piht}|\text{target})$.

Therefore, we estimate $E(x_{piht}|\text{target}) = \mathbb{E}(x_{piht}|\text{target, present}) \Pr(\text{target, present})$ by analyzing the mean behavior of the targets that are present ($\mathbb{E}(x_{piht}|\text{target, present})$), and by estimating the probability that an agent is a target and present ($\Pr(\text{target, present})$).

We estimate $\Pr(\text{target, present})$ as follows:

O_1, O_2 denotes agents 1 and 2 who were observed by the observers, N denotes the total number of agents in intersection i at hour h in day t. $f(p)$ is a weighted average of

Table 1: Pr(target, present)

Number of observers	With replacement	Case	Pr(target, present)
One	One replacement	$O_1 \neq \emptyset$	$f(p)$
One	No replacement	$O_1 = \emptyset$	$f(p)$
Two	One replacement	$O_1 = \emptyset, O_2 \neq \emptyset$	$\frac{1}{N}$
Two	One replacement	$O_1 = O_2$	$\frac{1}{N}$
Two	One replacement	$O_1 = O_2 = \emptyset$	0
Two	One replacement	$O_1 \neq O_2 \neq \emptyset$	$f(p)$
Two	Two replacement	$O_1 = \emptyset, O_2 \neq \emptyset$	$\frac{1}{N}$
Two	Two replacement	$O_1 = O_2$	$\frac{1}{N}$
Two	Two replacement	$O_1 = O_2 = \emptyset$	0
Two	Two replacement	$O_1 \neq O_2 \neq \emptyset$	$f(p)$
Two	No replacement	$O_1 \neq O_2 \neq \emptyset$	$f(p)$

Notes: Each row presents one hypothetical case. The first column is the number of street observers for one specific intersection; the second column indicates whether any of the observers is replaced with another observer, and if yes how many observer(s) are replaced; the third column denotes the number of present observers; the fourth column gives the formula to solve Pr(target, present). See the details below.

p defined as $\sum_i^M p^i(1-p)^{n_i} \times s_i$ [3], i denotes the number of conjectural agents who are present, except for the observed agents.[4] n_i denotes the number of conjectural agents who are not present, except for the observed agents, which depends on the total number of agents N varying across different intersections and days.[5] s_i is the share of agents who are present for each conjectural i.[6] M denotes the number of terms appearing in the sum, which the total number of agents N constrains. i, n_i and s_i are all defined at the intersection - hour - day level.

We solve p explicitly for each case, setting Equation Pr(target, present) $= p$. We present the results in Table 2, and present two examples in Figure 2, visualizing the fixed points.[7]

Figure 1 presents the correlation between each of two of our three measures of p. In the left panel, we show the correlation between the p solved from $f(p) = p$ and the p

[3] $p^i(1-p)^{n_i}$ is the weight we assign to each conjectural case i in the weighted average formula $f(p)$

[4] for example, $i = 0$ if no agent is present except for the observed agents.

[5] for example, when i = 0 and N = 6, in the two replacement case with two observers, n_0 = 2

[6] for example, when i = 0 and N = 6, in the two replacement case with two observers, $s_0 = \frac{1}{3}$

[7] In some cases, we have multiple solutions, where we select p based on the minimum of the difference between each candidate p and the share of the target police who are present in each intersection-day-hour block. Our main results keep a similar significance level by selecting p from two other options: 1. the average of the share of target police who are present in intersection i at hour h in day t, across different days, or 2. the direct share of target police who are present in intersection i at hour h in day t.

measured by the average of the share of target police who are present in intersection i at hour h in day t.[8] In the right panel, we show the correlation between the p solved from $f(p) = p$ and the p measured by the direct share of target police who are present in intersection i at hour h in day t.[9]

Table 2: Solve Pr(target, present) $= p$

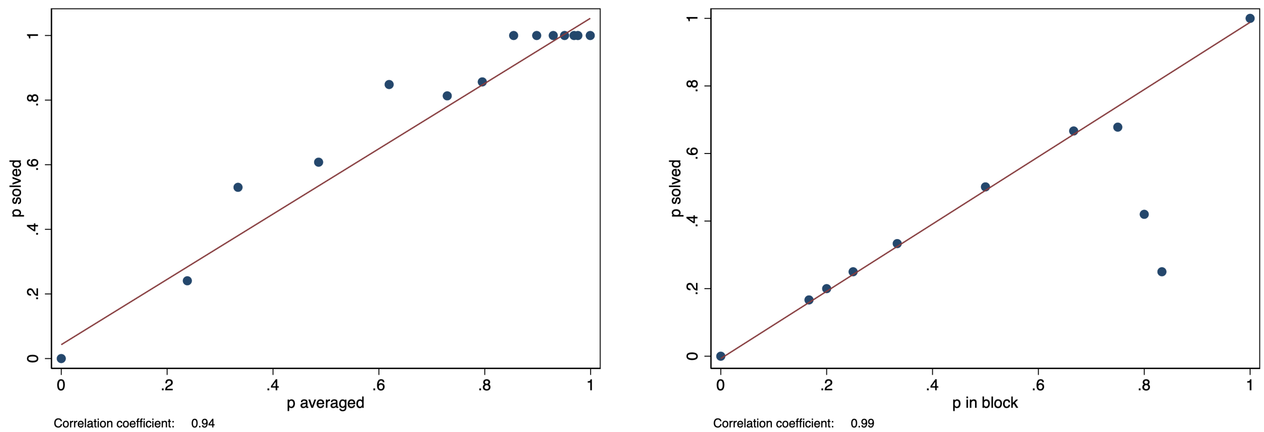
M	i	s_i	p
1	0	$s_0 = \frac{1}{2}$	$\frac{1}{2}$
1	0	$s_0 = \frac{2}{3}$	$\frac{2}{3}$
1	0	$s_0 = 1$	1
2	0,1	$s_0 = \frac{1}{2}, s_1 = \frac{3}{4}$	$\frac{2}{3}$
2	0,1	$s_0 = \frac{2}{3}, s_1 = 1$	1
2	0,1	$s_0 = \frac{3}{4}, s_1 = 1$	1
3	0,1,2	$s_0 = \frac{1}{3}, s_1 = \frac{1}{2}, s_2 = \frac{2}{3}$	$\frac{1}{3}$
3	0,1,2	$s_0 = \frac{1}{3}, s_1 = \frac{2}{3}, s_2 = 1$	$\frac{1}{2}$ or 1
3	0,1,2	$s_0 = \frac{2}{5}, s_1 = \frac{3}{5}, s_2 = \frac{4}{5}$	0.42
3	0,1,2	$s_0 = \frac{1}{2}, s_1 = \frac{3}{4}, s_2 = 1$	$\frac{2}{3}$ or 1
4	0,1,2,3	$s_0 = \frac{1}{4}, s_1 = \frac{1}{2}, s_2 = \frac{3}{4}, s_3 = 1$	0.22 or 1
4	0,1,2,3	$s_0 = \frac{1}{3}, s_1 = \frac{1}{2}, s_2 = \frac{2}{3}, s_3 = \frac{5}{6}$	0.25
4	0,1,2,3	$s_0 = \frac{2}{5}, s_1 = \frac{3}{5}, s_2 = \frac{4}{5}, s_3 = 1$	0.3 or 1
5	0,1,2,3,4	$s_0 = \frac{1}{5}, s_1 = \frac{2}{5}, s_2 = \frac{3}{5}, s_3 = \frac{4}{5}, s_4 = 1$	0.15 or 1
5	0,1,2,3,4	$s_0 = \frac{1}{3}, s_1 = \frac{1}{2}, s_2 = \frac{2}{3}, s_3 = \frac{5}{6}, s_4 = 1$	0.21 or 1
6	0,1,2,3,4,5	$s_0 = \frac{1}{6}, s_1 = \frac{1}{3}, s_2 = \frac{1}{2}, s_3 = \frac{2}{3}, s_4 = \frac{5}{6}, s_5 = 1$	0.12 or 1

Notes: This table solves p for each case described in Table 1, following the formula in Table 1. See the details above.

[8] Defined as p averaged.

[9] Defined as p in block.

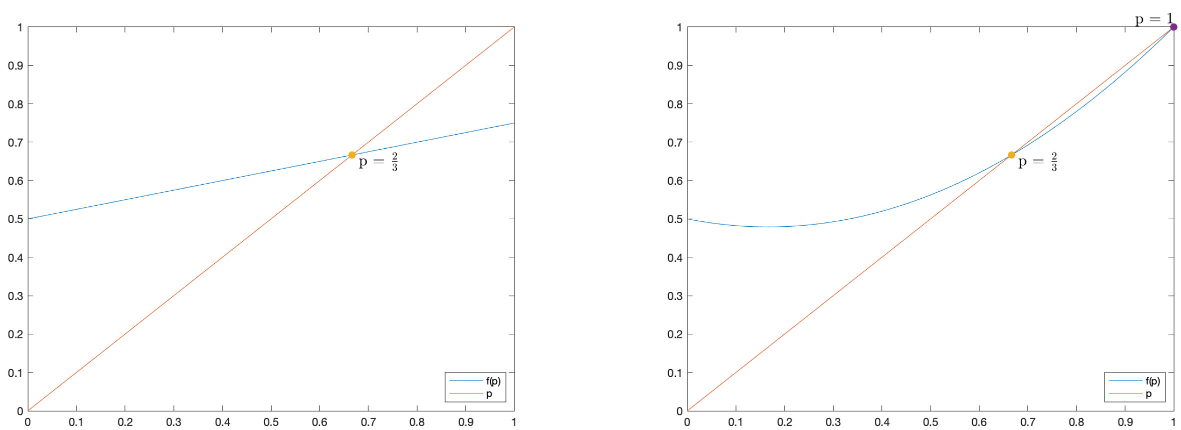
Figure 1: Correlation between different measures of p



Notes: This figure shows the correlation between p solved and p averaged (left panel), and the correlation between p solved and p in block (right panel), as a robustness check. p solved is the one that we use in Table 3.

Figure 2: Two examples: $f(p) = p$

$M = 2, i = 0,1, s_0 = \frac{1}{2}, s_1 = \frac{3}{4}$ $\qquad$ $M = 3, i = 0,1,2, s_0 = \frac{1}{2}, s_1 = \frac{3}{4}, s_2 = 1$



Notes: This figure shows two examples from 2, following the formula in Table 1. The left panel takes $M = 2, i = 0,1, s_0 = \frac{1}{2}, s_1 = \frac{3}{4}$, and solves $p = \frac{2}{3}$; the right panel takes $M = 3, i = 0,1,2, s_0 = \frac{1}{2}, s_1 = \frac{3}{4}, s_2 = 1$ and solves $p = \frac{2}{3}$ or 1, in which we take the p based on the minimum of the difference between the candidate p and the share of target police who are present in that intersection-day-hour block.

4. Hawthorne Effects, Collusion, Data Quality, Information Leakage

A. *Hawthorne effects*

We ensured that no agent was informed by our team, nor by any police authority, about the activities of street observers. While one major was informed by the study coordinator and gave his assent, no-one in the police force was otherwise informed of the presence of non police observers at intersections, in the police stations, or in minibuses. As a result, and based on the collaboration we had established with the battalion, we could confirm during and after the study that no agent was ever aware that they were being monitored by observers in the street.[10] Neither the JPOs (nor anyone else in the police station) were aware that they were being monitored by FCA agents.

We ensured that agents were not aware of the presence of the observers, which we can confirm from the independent access we had inside the police agency. First, we developed a smartphone survey that allowed us to record in real time the behavior of police agents. Using this application, the observers could record the data while seemingly texting.[11] Second, we randomly re-assigned the observers every day to a new intersection. This allowed us to reduce the risk that the observers' presence is noticed and that the observers developed ties with the police. Third, to reduce the risk faced by observers, instead of hiring civilians, we hired civil servants from the municipal transportation authority, whose presence was not considered suspicious at the intersection. The transportation authority is in charge of verifying the properties of traffic and sometimes the registration papers of drivers.[12] The observers blended in with the population of the intersections. These are generally crowded with traders, phone

[10]Because we had collaborated with the agency through other channels to collect the JPO data, we were informed about what happened at the police stations. Street observers' supervisors and street observers also played a central role in passing-up information about the atmosphere among police agents at the intersections.

[11]Taking notes on paper can catch the attention of the police agents and the security services.

[12]We agreed to pay a wage supplement to the division of transport officers in exchange for their time working. A general problem in the Congolese civil service, irrespective of the sector, are that a significant percentage of them are not on any salary lists - the so-called 'new units' (nouvelles unités). They earn their income through various ad-hoc activities - which supply bonuses - and hope to eventually become part of a salary list (Titeca and de Herdt, 2011). The agents we worked with were part of this category. We made sure that for the time engaged in this project, their regular activities (and sources of income) were not affected. We regularly consulted with their supervisor to ensure that their services were not being needed during our study.

credit sellers, food sellers, and drivers.

B. *Observers' Collusion*

To reduce the risk of collusion between observers and police agents, we hired three supervisors from our own networks in a different province of the country in order to independently monitor the observers. Every day, the supervisors were deployed to secretly monitor five intersections each.[13] Observers knew they were being observed: every day the scientific coordinator announced detected misbehavior from the previous day.[14] We further tackled the risk that supervisors and observers might collude. First, since social networks and repeated interactions can sustain collusion between supervisors and observers against the research team, we hired supervisors from other social networks (other kinship networks from regions in the extreme other end of the country). Second, to prevent new relationships between observers and supervisors from forming, we randomly reassigned the supervisors to different intersections every day. Supervisors' monitoring made it less likely that observers would collude with police agents.

C. *Data Quality*

To ensure that observers had incentives to gather true data, we developed a system of daily feedback and pay for performance.[15] This ensured that observers knew their work quality was also being monitored.[16]

[13]A tracking sheet allows the supervisor to record any irregularity.

[14]Observers were very motivated, for two reasons. First, at the beginning of the survey, there was one observer who shirked and was immediately replaced. Other observers were aware of this risk, which reinforced motivation in the teams. Second, observers wanted to please the scientific coordinator, who is in charge of a data collection firm and can offer future employment to good performers. As a result, observers were eager to collect good data and had developed a strong sense of duty in doing so.

[15]At the end of the day, the observers were required to upload the data for the day. In the evening, the scientific coordinator downloaded the data, and a graduate student in the United States went through the data, producing a data quality report, which included information on missing variables and specific questions about the data. The scientific coordinator then gathered such reports, and in the 6 am meeting the following day, he distributed reports for each observer.

[16]For minibus observers, we put in place a similar system for addressing measurement challenges. First, minibus observers were civilians hired from our own civilian networks from a distant province of the country in order to prevent collusion with the police. Second, they bought a daily ticket in the front seat of minibuses, where they were entering data on each intersection on a smartphone. Third, a minibus supervisor intercepted the minibuses along the way, and traveled behind the observer, often sitting at the back and observing their behavior. Fourth, every evening, the data collector was required to upload the data, and the same feedback mechanism was in place, in which a feedback document was sent to supervisors at 6am. This document was distributed to each data collector before the start of their day.

D. *Tackling Leakage of Data Collection Activities*

Strict measures were taken to control the flow of information. Table 3 describes who was informed of each activity. First, actors were only informed about their own subset of the data collection. For example, the FCA agents were not aware of the operations with the JPOs, at the intersections, or in minibuses. Similarly, the agents were not aware data collection took place with the JPOs and with the FCA agents. Also, the police commanders, the JPOs, and the FCA agents were unaware of data gathering activity at the intersection level. Second, for each part of the data collection, we ensured that the actor had the necessary authorization. In some cases (division of transport and FCA agents) this involved presenting their operations as being part of their daily job. In other cases this involved contacting the relevant actor within the police hierarchy.

Actors of different operations were trained in separated workshops.

First, surveyors, minibus observers' surveyors and street-level observers' observers were trained.

Second, FCA agents received their instructions in a training that they alone attended.

Third, all the supervisors (including street-level assistants and the auditor) were trained together.

Fourth, the agents were trained in the morning, from 6:30 to 7:30, in their respective intersections in the presence of their commander, in order to provide a diary. Agents were instructed to write, in randomly selected days (so that we could control for any effect of this activity on their behavior), a diary of their activity at the intersections. Agents were compensated for this effort each Friday, in which small payments were made as compensation for their effort. The agents did not take the task seriously and it was clear from the start that the data would be unusable and that the collection would have no impact on the agents' behavior. The quality of these diaries was so low that they could not be used. An example of those forms is presented in Figure 3.[17]

Fifth, JPOs and commanders were trained separately from the FCAs. This separation was established to prevent information leakage and Hawthorne effects. In training, actors were informed separately that we were conducting a scientific study. Moreover, we

[17]The magnitude and p-value of the coefficients in all the regressions of the study are unchanged by whether we include controls for whether the team-day was assigned to diary collection, and whether it was a Friday – the day in which such compensation was made.

Table 3: Data Collection System–Information Leakage Management

	(Police) Agents	Agents' team leader	Station JPOs	Station FCA Agent	Station Commander	Minibus Driver	Minibus Observer	Street Observer	Sup. Street	Sup. Minibus	Sup. FCA Agent	Sup. JPOs	Street-Level Assistants	Audito
(Police) Agents														
Agents' Team Leader	**yes**/**yes**													
JPOs	/	/												
Station FCA Agent	/	/	/											
Station Commander	/	**yes**/	**yes**/	/										
Minibus Driver	/	/	/	/	/									
Minibus Observer	/	/	/	/	/	**yes**/**yes**								
Street Observer	**yes**/	**yes**/	/	/	/	/	/							
Sup. Observer	/	**yes**/	/	/	/	/	/	**yes**/**yes**						
Sup. Minibus	/	/	/	/	/	**yes**/	**yes**/**yes**	/	/					
Sup. FCA Agent	/	/	/	**yes**/	/	/	/	/	/	/				
Sup. JPOs	/	/	**yes**/	/	**yes**/**yes**	/	/	/	/	/	/			
Street-Level Assistants	**yes**/**yes**	**yes**/**yes**	**yes**/	/	**yes**/**yes**	/	/	**yes**/**yes**	/	/	/	**yes**/		
Auditor	**yes**/**yes**	**yes**/**yes**	**yes**/**yes**	/	**yes**/	/	/	**yes**/	/	/	/	**yes**/**yes**	**yes**/**yes**	

Notes: This table shows the allocation of the information about the different research components across the different actors. The table reports whether the actor on the left was informed of the activity of the actor on top.

informed them about their compensation and their tasks, and instructed them on how to complete the forms (JPOs, FCA agents) or how to handle the smartphones.

5. Data Collection Management Details

The scientific coordinator met daily at 6am with the street-level assistants, the operations coordinator, the Fine Collection Agency (FCA) agents' supervisors and the Judicial Police Officers' (JPO) supervisors and at 7pm with the intersection supervisors, the minibus supervisor, the street-level assistants and the auditor. For security reasons, both meetings took place at a location which was not communicated to any observer, FCA agent, or member of the police force.

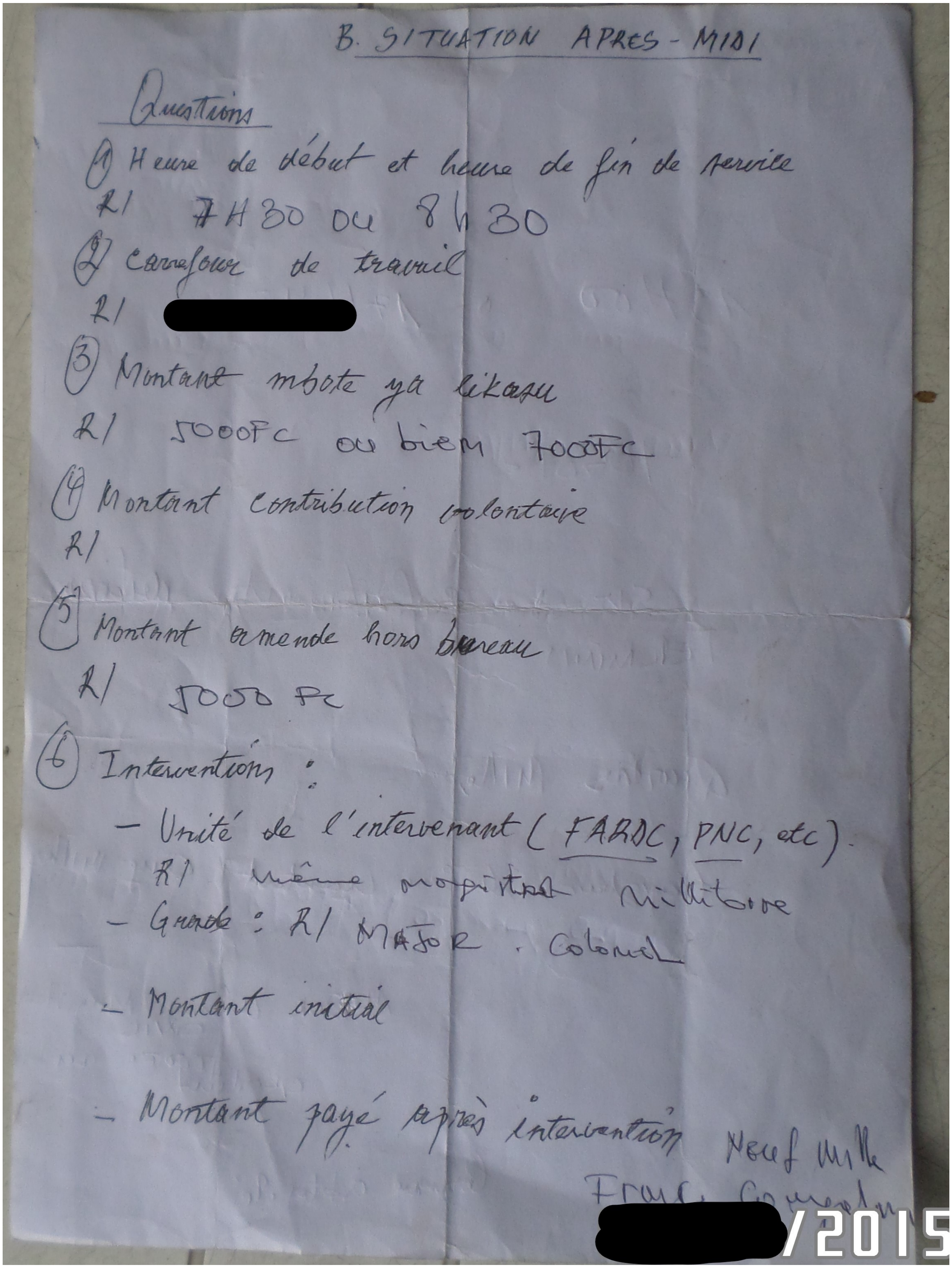
A. *Morning Meeting*

The JPOs and FCA agents' supervisors shared the data they had received the day before from the police stations with the scientific coordinator. The scientific coordinator communicated the feedback to them about the data that he had received from them the previous day and that they were to communicate to the JPOs and FCA agents. One PI communicated the quota reduction assignments for that day to the scientific coordinator every morning, who then communicated it to the supervisors of the JPOs. The PIs pointed out problems or mistakes in the data of the previous day and discussed operational challenges. All other actors handed over their daily data in the evening. At 7am the data collection activities began.

B. *Activities in the Day*

First, the JPOs' supervisors were dispatched to the police stations where a quota reduction had been assigned on that day, and compensated the commander for the income lost due to the quota reduction. This was done before the commander communicated (by phone) the level of the quota to the police agents. The JPOs and FCA agents' supervisors then visited all their assigned police stations to meet with the JPO and FCA agents, provide feedback on the data collected the previous day, and gather the data. Supervisors would call the FCA agents (and different supervisors would call the JPO agents) to meet

Figure 3: Example of an Agent Diary


B. SITUATION APRES-MIDI

Questions

1) Heure de début et heure de fin de service

R/ 7H30 ou 8h30

2) Carrefour de travail

R/ [redacted]

3) Montant mbote ya likasu

R/ 5000FC ou biem 7000FC

4) Montant contribution volontaire

R/

5) Montant amende hors bureau

R/ 5000 Fc

6) Interventions :

– Unité de l'intervenant (FARDC, PNC, etc).

R/ même magistrat militaire

– Grade : R/ MAJOR . Colonel

– Montant initial

– Montant payé après intervention Neuf mille Francs Congolais

[redacted]/2015

Notes: Example of an agent diary, 2015th.

them outside of the station where no other actor would be able to see them. The JPOs and FCA agents did their work according to their daily routine. To reduce suspicions, FCA agents and JPOs noted down on paper during the day what they were observing, copied this data into forms at night at home and then gave the data to their supervisors. The JPOs and FCA agents were compensated for their work. Once a week, they received the equivalent of 5 USD per day of work.

Second, the auditor visited all the stations, and verified that the supervisors had distributed the funds.

Third, each night, the street-level observers' supervisors received the list of assignments of observers to intersections, which the supervisors shared with surveyors in the morning around 6 am prior to dispatching them.

Fourth, the minibus supervisor met all the minibus surveyors. In that meeting, the scientific coordinator read the documents that he had received from all the supervisors and took notes about the quality of the data, in order to provide feedback back to the data collectors.

C. *Evening Meeting*

Supervisors of the JPOs, FCAs, minibus observers, and street observers met the scientific coordinator in the research coordination office. The difficulties faced in the day were discussed. The street-level assistants handed in the data that had been collected by talking to the agents, and the street-level observers' supervisors were informed of the allocation of the surveyors at the intersections the next day. Records of all meeting notes were kept.

6. Verifying if the Researchers Administered the Encouragement

Sources: randomization assignment calendar, auditor's process tracking sheet, commanders' process tracking sheet, complete financial records, our complete list of receipts of payments made by anyone in the research team, the JPOs' process tracking sheets, project process files.

Verification Algorithm: We combine these sources in the following seven steps.

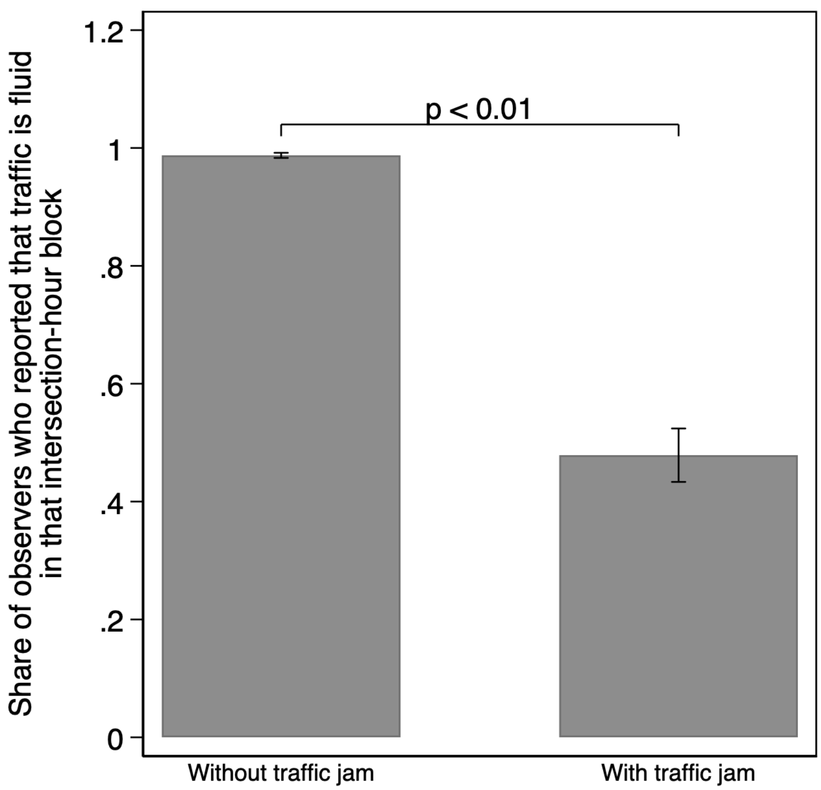
- **Step 1**: We open the quota reduction assignment from the randomization calendar.
- **Step 2**: We create an administration indicator, IMPL Quota, taking value one if the quota reduction is administered. At this step, the variable has only missing observations. For observations before July 4th (the latest date of commanders' process tracking completion):
  1. We assign IMPL Quota to 1 if the commanders' process tracking sheet records the correct payment made to reduce the quota, and the quota reduction assignment is 1 in the randomization calendar
  2. We assign IMPL Quota to 0 if the commanders' process tracking sheet did *not* record any amount of money paid to reduce the quota *and* the quota reduction assignment is 0 in the calendar
- **Step 3**: For observations with missing IMPL Quota only, we assign IMPL Quota to 1 if the receipts and finance accounting *both* indicate that the quota encouragement was administered.
- **Step 4**: For observations with missing IMPL Quota only, we assign IMPL Quota to 1 if the auditor's process tracking sheet verified that the quota reduction encouragement was administered.
- **Step 5**: If assignment is 0 and IMPL Quota is missing, we assign IMPL Quota to 0.
- **Step 6**: If the money to reduce the quota in the project process files is non-missing, then IMPL Quota should be 1. We verify this is true. It is true for all observations.
- **Step 7**: We separately analyze the observations that still have missing values for IMPL Quota.
  1. For those that have at least one non-missing source above (4 observations), we check case by case and assign them to the corresponding IMPL Quota (all take value 1)
  2. For those that are missing all sources described above (9 observations), we assign IMPL Quota to 0.

7. Validating the Experimental Results With Alternative Aggregation and Measurements

A. *Alternative Measurement of Traffic Jams in Street Observers Data*

In this section, we replicate our main result on the properties of traffic using alternative traffic measures from street observers throughout the day. Street observers reported whether there was a traffic jam or, instead, traffic was fluid (including no traffic). We first show the distribution of the mean number of reports of a traffic jam against fluid traffic. Figure 3 shows that a traffic jam is half as likely to occur as fluid traffic.

Figure 3: Alternative Measures from Street Observers



Notes. In this figure, the mean of the corresponding variable is reported for intersection-hour blocks in which no observer reported observing a traffic jam (left bar) and intersection-hour blocks in which at least one observer reported one (right bar). The variable analyzed is the share of observers who report, in each intersection-hour block, that traffic is fluid. Throughout the study, there were always two observers for each intersection-hour block. Error bars indicate 95% confidence intervals. p is the p-value obtained from a two-sample t-test of the equality of means. **Source:** street observers' records of events.

Table 4 estimates Equation 2 using the traffic jam and traffic fluid variables as dependent variables. Since most days have at least one hour block in which traffic is fluid, to elicit the effect of the quota on whether traffic is fluid, we cannot use an indicator for whether at least one hour block has fluid traffic, as there would be no variation to explain. Instead, to compare the effect on traffic jams and on traffic fluid, we separately estimate Equation 2 using the maximum (minimum) number of observers who, in each hour block, report traffic to be jammed, or instead, fluid in Panel A (and Panel B, respectively). Panel A shows that a one-driver increase in the quota increases the maximum number of observers who report a traffic jam in an hour block by 0.04, but the equivalent number for reporting that traffic is fluid is already 100%. This shows that, each day, there is at least one hour in which everyone reports traffic to be fluid, hence the quota can only induce variation in the maximum number of observers who report traffic to be congested. Panel B shows that a one driver increase in the quota decreases the minimum number of observers who report traffic to be fluid by 4%, mirroring its effect on the maximum number who report a traffic jam. Its effect on the minimum number of observers who report a traffic jam is unsurprisingly zero, since each day there is at least one hour block for which none of them report a traffic jam (typically in the morning), hence the minimum leaves no variation left to explain. Taken together, Panel A and Panel B can be interpreted as follows: while traffic jams do not predominate the reports across hours in the day, the quota increases their prevalence, and decreases the tendency of observers to report that traffic is fluid.

B. *Alternative Measurement of Traffic Jams with Independent Source: Minibuses*

Here, we cross-validate our main result on the properties of traffic using mobile observers traveling in minibuses throughout the day.

In preparation for a follow-up experiment concerning collusion between police agents and drivers, we also hired observers in 10 minibuses during the 33 days of this study. The data collection process extended for 2 additional months beyond the study described in this paper. Observers travelled through some of the study intersections 5-10 times per day on average. We use this data for robustness.

The data quality of this source for the purpose of this study is limited for three reasons. First, since drivers circulate through only some intersections and during only some times

Table 4: The Quota Causes Traffic Jams (Alternative Measures)

Panel A. Raw traffic report (max across hours)

	Dep. var:	
	Traffic jam	Traffic fluid
	(1)	(2)
Quota level	0.037**	0.001
	(0.017)	(0.002)
First-stage F-statistic	84.82	84.82
Randomization block FE	Yes	Yes
Day FE	Yes	Yes
Dep. var. mean (no encouragement)	0.43	0.99
Dep. var. mean (encouragement)	0.38	0.99
Observations	322	322

Panel B. Raw traffic report (min across hours)

	Dep. var:	
	Traffic jam	Traffic fluid
	(1)	(2)
Quota level	0.001	-0.043**
	(0.001)	(0.017)
First-stage F-statistic	84.82	84.82
Randomization block FE	Yes	Yes
Day FE	Yes	Yes
Dep. var. mean (no encouragement)	0.00	0.47
Dep. var. mean (encouragement)	0.00	0.57
Observations	322	322

Notes: In this table, we estimate $\hat{\beta}_Q^{2SLS}$ in Equation 2, to analyze the quota effect on the occurrence of traffic jams and fluid traffic. Traffic jam and traffic fluid were measured and constructed as follows. The observers completed a questionnaire every hour, answering whether there were traffic jams or not (traffic fluid). Using the street observers reports of whether a traffic jam occurred in a given intersection-hour. We construct indicators taking value 1 if at least one of the observers posted to a given intersection (there are two observers at each intersection through the working hours of the day) reported there to be one traffic jam or fluid in the corresponding intersection-hour. We then sum these intersection-hour indicators at the intersection - day level. In Panel A, the dependent variable is the daily maximum of the recorded occurrence of traffic jams across hour blocks in column (1) and the daily maximum of the recorded occurrences of fluid traffic across hour blocks in column (2). In Panel B, we take the minimum. We report the 2SLS coefficient, as well as the effective F-statistic of the first stage following (Olea and Pflueger, 2013). We include randomization block (team of agents/intersection) fixed effects (Randomization block FE) and the day fixed effects (Day FE) in all columns. Dep. var. mean (no encouragement) and Dep. var. mean (encouragement) report the mean of the dependent variable for the regression sample without and with the quota reduction *encouragement*. The experimental sample covers 337 teams of agents/intersections-day observations, which are also the units of assignment, 327 of which have non-missing quota level. Observations for which the dependent variable are missing are dropped. There is no selection of data missing on treatment assignment. **Source:** street observers' records of events.

during the day, these data miss a large number of agent-driver interactions and traffic properties, resulting in an imbalanced panel.

Second, the drivers are mobile, and constantly make decisions on where to drive. The existence of a report at a given intersection, which depends on whether the driver chose to drive through the intersection, is thus endogenous to any variables affecting their beliefs about traffic jams at that intersection. It is thus likely that the data is affected by selection bias.

Third, minibus drivers are part of a collusive agreement with agents, and are thus almost never harassed. They instead always pay the toll fee, *mbote ya likasu*. For this reason, the source is not designed to measure the effect of the quota on driver tracasserie – which is driven by unprotected drivers. We use this data extensively in a separate study for analyzing the driver-agent relationship.

Reports of traffic jams from minibus observers and from street observers correlate strongly. [18] Table 5 shows the analysis of Table 2 using the data recorded by the observers in minibuses. The table shows that the effect of the quota level on traffic jams replicates. Though Column (1) is not very significant, the coefficient in Column (2) is close to its correspondent coefficient in Table 2 and is even stronger.

This source is subject to large measurement error, arising from the fact that the drivers only cross the study intersections a few times per day, and only for a subset of the intersections. Furthermore, the decision to drive through an intersection, even though it is on a predetermined line, is in principle, endogenous. Therefore, this data must be interpreted with caution.

C. *Alternative Aggregation of Agents' Behavior: Experimental Results with Different p*

We replicate the paper's Table 3 Panel A using different versions of estimated p in Table 6. Panel A uses p averaged and Panel B uses p in block, defined in Section 3 part B.

[18] The correlation coefficients between minibus and street are 0.42 for daily occurrence of traffic jams, and 0.29 for an indicator of daily taking value one if at least one traffic jam was recorded in the day. p-values are both smaller than 0.01.

Table 5: Replicating the Traffic Jam Analysis: The Observers in Minibuses

	Dep. var: Traffic jams (minibus)	
	#	0/1
	(1)	(2)
Quota level	0.0769	0.0357**
	(0.0608)	(0.0154)
First-stage *F*-statistic	62.79	62.79
Randomization block FE	Yes	Yes
Day FE	Yes	Yes
Dep. var. mean (no encouragement)	1.70	0.59
Dep. var. mean (encouragement)	1.74	0.57
Observations	266	266

Notes: In this table, we estimate $\hat{\beta}_Q^{2SLS}$ in Equation 2 to analyze the local average treatment effect of a one-unit increase in the quota on the traffic jams. Using the minibus observers' reports of whether a traffic jam occurred in a given intersection-hour, we construct indicators taking value 1 if the observer reported there to be one traffic jam in the corresponding intersection-hour. We then sum these intersection-hour indicators at the intersection - day level. In column (1) the dependent variable is the daily number of recorded traffic jams, and in column (2) the dependent variable is an indicator taking value one if at least one traffic jam was recorded in the day. We report the 2SLS coefficient, as well as the effective F-statistic of the first stage following (Olea and Pflueger, 2013). We include randomization block (team of agents/intersection) fixed effects (Randomization block FE) and the day fixed effects (Day FE) in all columns. Dep. var. mean (no encouragement) and Dep. var. mean (encouragement) report the mean of the dependent variable for the regression sample without and with the quota reduction *encouragement*. The experimental sample covers 337 teams of agents/intersections-day observations, which are also the units of assignment, 327 of which have non-missing quota level. Observations for which the dependent variable are missing are dropped. There is no selection of data missing on treatment assignment. **Source:** minibus observers' records of events.

Table 6: The Effect of the Quota on Agents' Behavior

A. Agent's Behavior (p averaged)

	Dep. var:			
	Attempted escorts #			Time away
	All	Successful	Failed	from Int. (minutes)
	(1)	(2)	(3)	(4)
Quota level	1.001***	0.512*	0.489***	3.863**
	(0.362)	(0.271)	(0.183)	(1.946)
Randomization block FE	Yes	Yes	Yes	Yes
Day FE	Yes	Yes	Yes	Yes
Dep. var. mean (no encouragement)	10.75	7.10	3.65	43.76
Dep. var. mean (encouragement)	8.58	6.04	2.54	34.32
Observations	319	319	319	319

B. Agent's Behavior (p in block)

	Dep. var:			
	Attempted escorts #			Time away
	All	Successful	Failed	from Int. (minutes)
	(1)	(2)	(3)	(4)
Quota level	1.042***	0.528*	0.514***	4.104*
	(0.379)	(0.285)	(0.194)	(2.102)
Randomization block FE	Yes	Yes	Yes	Yes
Day FE	Yes	Yes	Yes	Yes
Dep. var. mean (no encouragement)	11.48	7.57	3.91	47.16
Dep. var. mean (encouragement)	9.16	6.44	2.72	36.75
Observations	319	319	319	319
R-squared	0.37	0.38	0.17	0.38

Notes: This table analyzes the effect of the quota on the attempted escorts and time spent away from intersections, replicating Table 3 for p averaged and p in block respectively. We estimate $\hat{\beta}_Q^{2SLS}$ in Equation 2. "Attempted escort" is an interaction between a driver and an agent in which the agent escorts the driver to the police station (successful), or in which the agent is seen harassing the driver trying to get hold of the vehicle, but in which they fail to escort the driver (failed). Failed escorts are the ones in which the driver escapes, or in which the driver makes a bribe payment to the agent that is neither a toll fee nor a voluntary contribution. "Time away from Int." is the gap between the timestamp at which the agent is seen interacting with a driver for an escort to the police station and the timestamp of the agent's next interaction at the intersection. The dependent variables across column (1) through column (4) are the daily number of all attempted escorts per intersection, the daily number of successful attempted escorts per intersection, the daily number of failed attempted escorts per intersection and the daily total minutes away from intersections per agent due to escorts. We report the 2SLS coefficient, as well as the effective F-statistic of the first stage following (Olea and Pflueger, 2013). We include randomization block (team of agents/intersection) fixed effects (Randomization block FE) and the day fixed effects (Day FE) in all columns. Dep. var. mean (no encouragement) and Dep. var. mean (encouragement) report the mean of the dependent variable for the regression sample without and with the quota reduction *encouragement*. The experimental sample covers 337 teams of agents/intersections-day observations, which are also the units of assignment, 327 of which have non-missing quota level. Observations for which the dependent variable are missing are dropped. There is no selection of data missing on treatment assignment. **Source:** street observers' records of events.

References

Olea, J. L. M., and C. Pflueger (2013): "A robust test for weak instruments," *Journal of Business & Economic Statistics*, 31(3), 358–369.

Titeca, K., and T. de Herdt (2011): "Real governance beyond the 'failed state': Negotiating education in the Democratic Republic of the Congo," *African Affairs*, 110(439), 213–231.