

## MIT Open Access Articles

*The Simple Economics of Extortion: Evidence from Trucking in Aceh*

The MIT Faculty has made this article openly available. **Please share** how this access benefits you. Your story matters.

**Citation:** Olken, Benjamin A., and Patrick Barron. "The Simple Economics of Extortion: Evidence from Trucking in Aceh." *Journal of Political Economy* 117.3 (2009): 417-452. 2009 by The University of Chicago

**As Published:** <http://dx.doi.org/10.1086/599707>

**Publisher:** University of Chicago Press

**Persistent URL:** <http://hdl.handle.net/1721.1/61630>

**Version:** Final published version: final published article, as it appeared in a journal, conference proceedings, or other formally published context

**Terms of Use:** Article is made available in accordance with the publisher's policy and may be subject to US copyright law. Please refer to the publisher's site for terms of use.



# The Simple Economics of Extortion: Evidence from Trucking in Aceh

---

Benjamin A. Olken

*Massachusetts Institute of Technology and National Bureau of Economic Research*

Patrick Barron

*World Bank*

This paper tests whether the behavior of corrupt officials is consistent with standard industrial organization theory. We designed a study in which surveyors accompanied Indonesian truck drivers on 304 trips, during which they observed over 6,000 illegal payments to police, soldiers, and weigh station attendants. Using plausibly exogenous changes in the number of checkpoints, we show that market structure affects the level of illegal payments. We further show that corrupt officials use complex pricing schemes, including third-degree price discrimination and a menu of two-part tariffs. Our findings illustrate the importance of considering the market structure for bribes when designing anticorruption policy.

We thank David Abrams, Tim Bresnahan, Liran Einav, Amy Finkelstein, Asim Khwaja, Michael Kremer, Steve Levitt, Jesse Shapiro, Andrei Shleifer, Justin Wolfers, Elmar Wolfstetter, two anonymous referees, and numerous seminar participants for helpful comments. Special thanks are due to Yuhki Tajima for outstanding research assistance and to Scott Guggenheim for his support and assistance throughout the project. The field work would have been impossible without the dedication of Zejd Muhammad and numerous field surveyors. Kevin Evans and his team at the Aceh Rehabilitation and Reconstruction Board (BRR) provided assistance. We also thank the many people from the Aceh Monitoring Mission (AMM) who provided information on troop and police withdrawals and general assistance and support. This project was supported by World Bank trust funds from the Royal Netherlands Embassy in Jakarta and the British Department for International Development (DfID) and was conducted with the support of the BRR, the Decentralization Support Facility (DSF), and the World Bank. All views expressed are those of the authors and do not necessarily reflect the opinions of BRR, the Royal Netherlands Embassy, DfID, DSF, or the World Bank.

[*Journal of Political Economy*, 2009, vol. 117, no. 3]  
© 2009 by The University of Chicago. All rights reserved. 0022-3808/2009/11703-0002\$10.00

## I. Introduction

Most theoretical and empirical work on corruption focuses on a single transaction: potentially corrupt officials weigh the benefits from corruption against the expected punishments if they are caught and choose accordingly. However, the level of corruption may also be influenced by market forces. In this view, first articulated by Shleifer and Vishny (1993), corrupt officials behave like profit-maximizing firms, and the level of corruption is determined by the structure of the “market” for bribes, the elasticity of demand for the officials’ services, and the degree to which corrupt officials can coordinate with one another in setting prices.

This paper takes the market forces view of corruption seriously and examines the degree to which standard pricing theories from industrial organization are consistent with actual patterns of bribes and extortion payments. We study these questions in the context of bribes paid by truck drivers to police, soldiers, and weigh station attendants on their trips to and from the Indonesian province of Aceh.

To investigate these payments, we designed a study in which enumerators accompanied truck drivers on 304 trips to and from Aceh, directly observing more than 6,000 illegal payments. To the best of our knowledge, this represents the first large-scale survey that has ever directly observed bribes in the field.<sup>1</sup> On average, drivers spent about US\$40 per trip, or about 13 percent of the total cost of a trip, on bribes, extortion, and protection payments.

Using these data, we first examine how the bribes charged at checkpoints respond to changes in market structure. During the period we study, the Indonesian government withdrew over 30,000 police and military from Aceh province in accordance with a peace agreement signed earlier in the year to end a 30-year civil war between separatists and the Indonesian government. Since the troops and police that were withdrawn manned many of the checkpoints that extracted payments from truck drivers, this withdrawal represents a plausibly exogenous change in the market structure for illegal payments. Moreover, the roads to and from Aceh pass through two provinces, Aceh and North Sumatra, whereas the military withdrawal affected troops and police stationed only in Aceh province. We therefore examine how the bribes charged

<sup>1</sup> The only other data set consisting of observed bribe payments, as opposed to reported bribe payments, is the one used in the study by McMillan and Zoido (2004), which consists of videotapes the bribe giver (Vladimiro Montesinos Torres, the head of Peruvian intelligence under President Alberto Fujimori) took to help him maintain leverage over bribe recipients later on. Much of the other recent work with objective measures of corruption focuses on graft and tax evasion, not bribes (e.g., Di Tella and Schargrodsky 2003; Fisman and Wei 2004; Reinnika and Svensson 2004; Hsieh and Moretti 2006; Olken 2007; Yang, forthcoming), though this work suggests the presence of bribes.

in North Sumatra changed in response to the reduction in checkpoints in Aceh to examine how bribes respond to market forces.

We find that the average bribe paid in North Sumatra increased significantly in response to the reduction in the number of checkpoints in Aceh. Specifically, the elasticity of the average bribe paid at a checkpoint in North Sumatra province with respect to the expected total number of checkpoints encountered along a trip is between  $-0.54$  and  $-0.81$ . These results provide evidence for the Shleifer-Vishny view that the market structure has a substantial impact on the amount of bribes charged.

Second, since a driver needs to successfully pass all checkpoints on a route in order for the journey to be completed, the amount of surplus to be extracted by officials at checkpoints at the beginning of the trip may differ from the amount of surplus to be extracted at the end of the trip. If prices are not fully set in advance, this will translate into systematic differences in bribes paid at different points in the route. We first show that different officials have different amounts of bargaining power and, indeed, that prices are in part set through ex post bargaining rather than being fully determined ex ante. Then, taking advantage of the fact that our data include trips in both directions, we show that, consistent with the holdup theory, “downstream” checkpoints—that is, those that are closest to the final destination—receive higher bribes than “upstream” checkpoints—that is, those that are closer to the origin of the trip.

Third, we show that corrupt officials practice several types of price discrimination. Officials at checkpoints appear to practice third-degree price discrimination, charging higher prices to those drivers with observable characteristics that indicate a higher willingness to pay, such as those driving newer trucks or carrying valuable cargo. Moreover, officials at one weigh station have implemented a complex system of second-degree price discrimination, involving a coupon system whereby drivers self-select, before the trip starts, into one of multiple two-part tariffs. The fact that such types of price discrimination exist suggests that the illegal nature of the market does not prevent the emergence of quite sophisticated contracts.

The remainder of the paper is organized as follows. Section II describes the setting in more detail. Section III describes the data collection and presents descriptive statistics. Section IV examines the degree to which market structure affects the level of bribe payments. Section V examines price discrimination. Section VI presents conclusions.

## II. Setting

### A. *Trucking in Aceh*

The data in this study come from the two Indonesian provinces located at the northern tip of the island of Sumatra, the province of Nanggroe Aceh Darussalam (hereafter referred to as Aceh) and the province of North Sumatra. Aceh was the site of the December 2004 tsunami, which killed an estimated 167,000 people. It was also the site of a 30-year civil war between the separatist Free Aceh Movement (GAM in Indonesian) and the Indonesian government, which ended with the signing of a peace agreement in August 2005.

This study focuses on the two major long-distance transportation routes in Aceh, shown in figure 1. The first route runs along the western coast from the Acehnese city of Meulaboh to Medan, the capital of North Sumatra province and the largest city on the island of Sumatra. A typical truck takes about 35 hours to complete this 637-kilometer journey. The second route runs along the northeastern coast from the capital of Aceh province, Banda Aceh, to Medan. A typical truck takes about 24 hours to complete this 560-kilometer journey. These two routes represent the primary means of transporting goods to and from Aceh. Since the tsunami washed out the west coast road north of Meulaboh, the two routes are essentially not connected.<sup>2</sup> As is visible in the figure, both the Meulaboh route and the Banda Aceh route have portions in Aceh province and portions in North Sumatra province.

Illegal payments along these routes take two main forms—payments at checkpoints and payments at weigh stations. Checkpoints are set up by police and the military. They serve a security function, particularly in conflict areas, but also exist as a rent-extraction tool. In addition, two weigh stations operated by the provincial transportation department are located on each route (see fig. 1). Officially, a truck entering a weigh station weighing more than 5 percent above the maximum limit is supposed to be ticketed and to immediately unload its excess cargo, and the driver is meant to appear in court to have a fine determined.<sup>3</sup> In practice, almost all drivers pay a bribe to avoid this fine.

In addition to payments made along the route, most trucks make a

<sup>2</sup> For the Banda Aceh route, there are no alternative land routes; for the Meulaboh route, an alternative road through the center of the province exists, but it is of very low quality, containing unpaved sections that can be traversed only in the dry season (approximately March–September).

<sup>3</sup> One of the four weigh stations, at Seumedam in Aceh province on the Banda Aceh–Medan road, was part of a pilot program launched by the national government to reduce corruption at weigh stations. As part of this pilot program, the official tolerance was increased substantially (to between 50 and 70 percent over the legal limit), but attendants were given incentives to issue tickets (*tilang*) for trucks exceeding the threshold rather than to accept bribes. See Foster (2005) for more details.

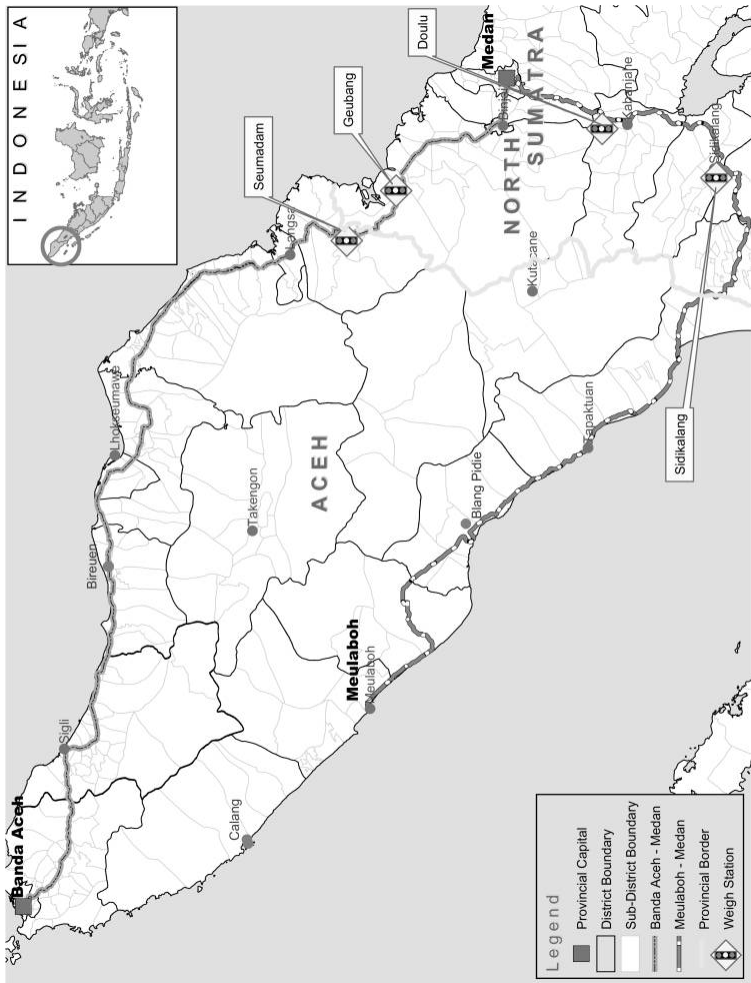


FIG. 1.—Routes

regular monthly payment to a criminal organization for protection purposes; those firms that do not run the risk of their trucks being hijacked and the cargo stolen. Trucks also pay police and/or the military in order to travel as part of a protected convoy.<sup>4</sup>

### *B. Military Presence in Aceh*

Intermittent military conflicts between the Indonesian Army and the separatist GAM occurred from the mid-1970s until the signing of the peace agreement in August 2005. At the time the peace agreement was signed, 55,480 police and military were in Aceh. These were divided among three primary groups: the army (TNI), the militarized police (Brimob), and the regular police force (Polri).

As a result of the peace agreement, 31,690 military and police personnel were withdrawn from Aceh in four waves, from September 2005 to January 2006. Since there was no longer personnel to staff many of the checkpoints after the troops withdrew, the withdrawal provides a source of plausibly exogenous variation in the number of checkpoints and, hence, in the market structure for bribes. These withdrawals affected only checkpoints in Aceh province; there was no change in the allocation of troops or police in North Sumatra province during this time. We obtained data on army withdrawals from each district from the EU-led Aceh Monitoring Mission (AMM) and data on police and militarized police withdrawals from the provincial police command in Banda Aceh.<sup>5</sup>

## **III. Data**

### *A. Data Collection*

We collected data on bribes by having locally recruited Acehese surveyors accompany drivers on their regular routes. Data were collected between November 2005 and July 2006 and so encompass the third and

<sup>4</sup> Convoys were run by the army, the militarized police (Brimob), and the military police for a fee of between 300,000 and 600,000 rupiah (US\$32–\$64). Convoys supposedly provided protection from GAM rebels, although the rebels were no longer active by the time our survey began. Convoys were used by trucks traveling from Banda Aceh to Medan (many of which were carrying scrap metal of questionable legal status) and by trucks traveling in both directions on the Medan–Meulaboh route (until March 2006). The results in the paper are similar if we restrict the data to the period in which all trucks on the Meulaboh route used convoys.

<sup>5</sup> The AMM data are broken down by AMM's 12 subregions, whereas the police data are available for each of Aceh's 21 districts. When we use the AMM data at the district level, we allocate troops in each AMM subregion to districts in the same proportions in which police are allocated to those districts. Conducting all the analysis at the AMM subregion level rather than the district level does not substantively change the results.

fourth waves of the military withdrawal as well as a substantial postperiod. Surveyors recorded the time, location, and amount paid at every checkpoint and weigh station.<sup>6</sup> At each checkpoint, they noted the organization manning the checkpoint (police, army, etc.), the number of officers visible, and whether any officers were visibly carrying a gun. They also recorded detailed information about other expenditures, the weight of the truck reported at the weigh stations, and characteristics about the truck and the driver. Drivers were aware of the surveyor, but since truck drivers usually have at least one assistant anyway, the surveyors blended in and those manning the checkpoints were, to the best of our knowledge, unaware of their presence.

Owing to the clandestine nature of the survey and the military occupation under way when the survey began, we could not obtain a strictly random sample of trucks operating on the routes. Instead, we sought out several cooperative firms on each route that agreed to let our surveyors accompany their drivers. Within firms, enumerators accompanied whichever driver was next departing, provided that the driver gave permission, that the surveyor had not ridden with that driver in the previous month, that the truck was transporting cargo rather than traveling empty, and that no other surveyor was departing with the same firm on the same day. The survey is therefore approximately representative of the trips undertaken by these particular firms but is not necessarily representative of all trucks traveling on the route.<sup>7</sup>

There are advantages and disadvantages of obtaining data by direct observation. In interviews, drivers usually cannot remember the precise locations of checkpoints or even the total number of checkpoints. Drivers may also exaggerate bribe payments in the hopes of extracting more money from their bosses.<sup>8</sup> Direct observation ameliorates these problems but raises concerns about Hawthorne effects: that is, drivers may

<sup>6</sup> In most cases, the surveyor directly observed the amount paid. This occurred when the payment was in-kind (e.g., one or two packets of cigarettes), when the driver counted out the money in front of the surveyor, or when the driver gave the money to his assistant, who in turn gave it to the officer. In those cases in which the actual transaction was not directly observed, the surveyor asked the driver for the amount paid.

<sup>7</sup> For the Meulaboh road, we expect that we have a roughly random sample of trips, since there are few firms and they do not appear to be differentiated in terms of the goods they transport. For the Banda Aceh road, certain types of goods, such as timber, are carried by special trucks and hence are not included in our survey. In addition to excluding empty trucks, which pay few bribes, our survey also did not include humanitarian aid to tsunami victims, which was often sent in special convoys and was typically exempt from bribe payments. We focused on non-tsunami, nonempty trucks in order to maximize our statistical power to detect changes in bribe payments.

<sup>8</sup> In fact, we compared the amount of bribes we observed on 40 trips between January 25, 2006, and February 20, 2006, with 12 interviews we conducted around the same time with drivers who had just completed their trips, and we found that on average the bribes drivers reported in interviews were more than double the amount of the bribes we recorded by direct observation.



change their bribe decisions because they are observed. Several reasons, however, suggest that Hawthorne effects will have a minimal impact on this study. First, the truck driver is the residual claimant for all bribe payments: the driver receives a flat payment for all expenses on the road, including bribes, and keeps whatever remains. Under all circumstances, he has a strong incentive to minimize bribe payments. Second, there is no stigma or risk associated with making these types of illegal payments since they are completely common and well known. Most important, any Hawthorne effects would be constant, affecting the *levels* of our reported bribe payments, but not affecting our analysis of the differences in bribe payments across checkpoints, trips, or routes.

The survey was kept entirely secret until April 4, 2006, when the preliminary time-series results for the Banda Aceh–Medan route were released at a joint Aceh Reconstruction and Rehabilitation Agency (BRR)–World Bank press conference in Banda Aceh.<sup>9</sup> The press conference generated substantial media attention in Aceh province: the results and reaction to the study were the lead story of the Aceh provincial newspaper, *Serambi*, for 4 days, including a reporter's own exposé of bribes on the Meulaboh road. In our data, the number of checkpoints in Aceh province fell by more than 25 percent starting about 2 weeks after the press conference took place, suggesting that publicizing corruption may play an important role in reducing it (Ferraz and Finan 2008).<sup>10</sup> Despite the publicity, surveyors were able to continue collecting data unobserved.

### B. Descriptive Statistics

Summary statistics are presented in table 1. The table indicates that the average marginal cost of a one-way trip was approximately Rp. 3 million (US\$325).<sup>11</sup> Of these costs, fuel represents the largest component (about 53 percent). The remainder is attributable to loading and unloading

<sup>9</sup> As we show below, the main results are robust to limiting the sample to the pre–press conference period (i.e., before April 4, 2006).

<sup>10</sup> To estimate the impact of the press conference, we restricted the data to a 3-month period before and after the press conference and ran a regression of the number of checkpoints on a time trend and a post–press conference dummy. The results suggest that the number of checkpoints fell by 3.5 on the Meulaboh road and 1.2 on the Banda Aceh road following the press conference, although the results are sensitive to specification (results available on request). Qualitative evidence confirms that there was indeed a police crackdown 2 weeks after the press conference: on April 19, 2006 (2 weeks after the press conference), *Serambi* reported that the Aceh police conducted a raid to shut down a checkpoint illegally collecting bribes in Aceh Timur district (*Serambi*, April 22, 2008).

<sup>11</sup> All prices have been normalized to October 2006 prices using monthly consumer price index data, though doing so does not meaningfully change any of the results since annual inflation rates over the period averaged only 6 percent.

TABLE 1  
SUMMARY STATISTICS

	Both Roads (1)	Meulaboh Road (2)	Banda Aceh Road (3)
Total expenditures during trip (rupiah)	2,901,345 (725,003)	2,932,687 (561,736)	2,863,637 (883,308)
Bribes, extortion, and protection payments	361,323 (182,563)	415,263 (180,928)	296,427 (162,896)
Payments at checkpoints	131,876 (106,386)	201,671 (85,203)	47,905 (57,293)
Payments at weigh stations	79,195 (79,405)	61,461 (43,090)	100,531 (104,277)
Convoy fees	131,404 (176,689)	152,131 (147,927)	106,468 (203,875)
Coupons/protection fees	18,848 (57,593)	. . .	41,524 (79,937)
Fuel	1,553,712 (477,207)	1,434,608 (222,493)	1,697,010 (637,442)
Salary for truck driver and assistant	275,058 (124,685)	325,514 (139,233)	214,353 (65,132)
Loading and unloading of cargo	421,408 (336,904)	471,182 (298,246)	361,523 (370,621)
Food, lodging, etc.	148,872 (70,807)	124,649 (59,067)	178,016 (72,956)
Other	140,971 (194,728)	161,471 (236,202)	116,308 (124,755)
Number of checkpoints	20 (13)	27 (12)	11 (6)
Average payment at checkpoint	6,262 (3,809)	7,769 (1,780)	4,421 (4,722)
Number of trips	282	154	128

NOTE.—Standard deviations are in parentheses. Summary statistics include only those trips for which salary information was available. All figures are in October 2006 rupiah (US\$1.00 = Rp. 9,200).

of cargo (14 percent), illegal payments (13 percent), salaries (10 percent), and food and lodging (5 percent).

The magnitude and composition of illegal payments vary substantially across the two routes, as can be seen by comparing columns 2 and 3 of table 1. Checkpoints were much more important on the Meulaboh road: the average Meulaboh trip stopped at more than double the number of checkpoints (27 vs. 11) and paid nearly four times as much at checkpoints (US\$23 vs. US\$5) as the average Banda Aceh trip. Conversely, weigh station payments appear much more substantial on the Banda Aceh route than on the Meulaboh route.

### 1. Checkpoints

Transactions at checkpoints work as follows. The officer manning the checkpoint flags down trucks (or, anticipating this, in 30 percent of

cases, drivers stop on their own). The driver offers the officer a payment of Rp. 5,000–Rp. 10,000 (US\$0.55–\$1.10). On the Banda Aceh route, these payments are in cash; on the Meulaboh route, they often take the form of one or two packets of cigarettes. The officer usually accepts the offer; in only 13 percent of cases does he reject the offer and try to bargain for more. If no payment is made, the officer may chase the truck down and harass the driver, either physically (drivers have reported being beaten for failing to pay bribes or for offering too little), by delaying the truck, or by finding a violation and issuing a ticket, which requires the driver to come to court and lose several days of work.

These payments appear closer to outright extortion (or, perhaps less pejoratively, to a toll) than to bribes paid to avoid a fine. In fact, out of the 5,387 checkpoint transactions in which we observed money changing hands, on only 21 occasions—that is, less than 0.5 percent of all transactions—did the officer even mention a specific violation. Instead, in most cases, the driver simply handed over the payment without discussion and continued on his way.<sup>12</sup>

An interesting question is whether drivers know the “going price” for each checkpoint or simply make the same offer everywhere. A decomposition of variance of checkpoint payments shows that the majority of the variance comes within trips rather than between trips (the within-trip standard deviation of log bribes is 0.83, whereas the between-trip standard deviation is 0.32). This suggests that drivers tailor their offers to each checkpoint. Moreover, across all trips, the variation between checkpoints is larger than the variation within checkpoints (standard deviation of 0.68 between checkpoints compared to only 0.58 within checkpoints). These facts suggest that drivers vary their offers checkpoint by checkpoint in systematically similar ways.

## 2. Weigh Stations

In equilibrium, almost all trucks operate overweight: in our data, 84 percent of trucks weighed more than 5 percent above the limit, and 42 percent weighed more than 50 percent above the limit. At weigh stations, however, only 3 percent of these trucks received a ticket; instead, the remaining truck drivers paid a bribe at the weigh station to avoid penalties.

From an efficiency perspective, a key question is the relationship between the weight of the truck and the bribe paid. To examine this, figure 2 plots locally weighted Fan (1992) regressions for each weigh

<sup>12</sup> Of course, the fact that no violation was stated does not mean that, in the off-equilibrium path where the driver refused to pay, the officer would not at that point state a violation. Nevertheless, the fact that the transactions are so routine as to not require mentioning a violation is remarkable.

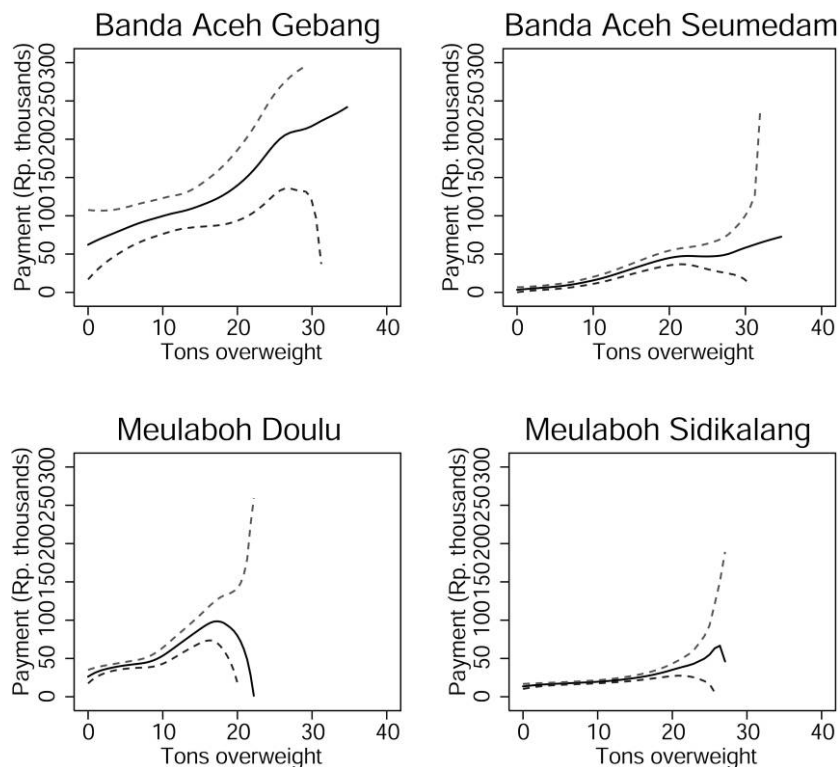


FIG. 2.—Payments at weigh stations. Each graph shows the results of a nonparametric Fan (1992) locally weighted regression, where the dependent variable is the amount of bribe paid at the weigh station and the independent variable is the number of tons the truck is overweight. The bandwidth is equal to one-third of the range of the independent variable. Bootstrapped 95 percent confidence intervals are shown in dashes, where bootstrapping is clustered by trip. When the dashed lines are not shown, it indicates that the 95 percent confidence interval exceeds the y-axis of the graph.

station, where the dependent variable is the total bribe paid at the weigh station and the independent variable is the number of tons the truck is overweight. Figure 2 shows that, at all four weigh stations, bribes increase in the amount the truck is overweight.<sup>13</sup> On average, drivers pay Rp. 3,345 (US\$0.36) for each additional ton overweight. This positive relationship means that, although official fines are almost never levied, weigh stations at least create some marginal disincentive for being overweight. However, the slope is not nearly as convex as the official

<sup>13</sup> Separate linear regressions for each weigh station of the total bribe on the number of tons the truck is overweight confirm that the slope is positive and statistically significant ( $p < 0.01$ ) for all four weigh stations.

fine and likely not as steep or convex as would be socially optimal.<sup>14</sup> There also exists evidence of outright extortion: two-thirds of trucks that were not overweight at all also paid bribes at weigh stations (results not reported).

#### IV. Does Market Structure Matter? Evidence from Checkpoints

##### A. Theoretical Framework

We first present a very simple theoretical framework to demonstrate how the number and location of checkpoints may affect the bribes charged at each checkpoint. The idea is to model checkpoints as a chain of vertical monopolies. To illustrate the potential for double marginalization in such a situation (as in Spengler [1950], Bresnahan and Reiss [1985], and Shleifer and Vishny [1993]), we first discuss the case in which checkpoints announce a fixed, posted price. We then relax the assumption of full commitment to illustrate the potential for increasing holdup by downstream checkpoints (following Grossman and Hart [1986], Hart and Moore [1990], and Blanchard and Kremer [1997]).

##### 1. Model with Fixed Prices

Suppose that there are  $n$  identical checkpoints arrayed throughout the road. Each checkpoint announces, in advance, a price  $p$  for the truck to pass. The demand for trucking depends on the total price to pass all checkpoints,  $q(\sum_j p_j)$ . Given this demand function, each checkpoint  $i$  maximizes

$$p_i q\left(p_i + \sum_{j \neq i} p_j\right). \quad (1)$$

The first-order condition is

$$p_i q'\left(p_i + \sum_{j \neq i} p_j\right) = -q\left(p_i + \sum_{j \neq i} p_j\right). \quad (2)$$

In equilibrium, symmetry implies that  $p_i = p_j = p$ . Define the total price  $P = np$ . Then, in equilibrium, equation (2) implies that

$$\frac{q'(P)P}{q(P)} = -n; \quad (3)$$

that is, the total price is set so that the elasticity of demand  $\epsilon(P)$  is equal to  $-n$ .

<sup>14</sup> The standard engineering estimate is that the damage a truck does to a road is proportional to the fourth power of the truck's weight (American Association of State Highway Officials 1961).

Under the usual assumption that the elasticity of demand is increasing in absolute value in the price (e.g., with a linear demand curve), the total price to pass through the road is increasing in the number of checkpoints, that is,  $\partial P/\partial n > 0$ .<sup>15</sup> Moreover, if  $q(P)$  is not too convex, the price charged per checkpoint is decreasing in the number of checkpoints, that is,  $\partial p_i/\partial n < 0$ .<sup>16</sup> Thus, the elasticity of the total price paid along the route ( $P$ ) with respect to the number of checkpoints ( $n$ ) is between zero and one, and the elasticity of the average price paid per checkpoint ( $p_i$ ) with respect to  $n$  is between minus one and zero.

By contrast, if the prices were set by a central authority rather than by decentralized checkpoint officers, then equation (3) becomes the standard monopoly result

$$\frac{q'(P)P}{q(P)} = -1. \quad (4)$$

In this case, the total cost of passing through the road does not depend on the number of checkpoints. Since the total price  $P$  is constant, the elasticity of the price charged per checkpoint,  $p_i = P/n$ , with respect to the number of checkpoints is exactly equal to minus one. The difference arises because when prices are decentralized, the person setting the price at each checkpoint does not internalize the effect of his price on the revenues at the other checkpoints; whereas when prices are set centrally, the centralized price setter sets the total price  $P$  equal to the monopoly price no matter how many checkpoints there are.<sup>17</sup>

## 2. Bargaining and Holdup

The previous model assumed that prices could be fully committed to in advance. If, however, there is some amount of ex post bargaining over bribes, then as in a chain of Leontief production technologies (Blanchard and Kremer 1997), the downstream producers—in our case, the checkpoints at the end of the journey—will be able to extract more

<sup>15</sup> The assumption that the elasticity of demand is increasing in absolute value in the price is required to generate a finite equilibrium price in any monopoly pricing model with zero marginal cost, such as the model considered here. Details of this and all subsequent proofs are in the working paper version of the paper (Olken and Barron 2007).

<sup>16</sup> For example, it is sufficient that  $q''(P)P/q'(P) > -1$ , which is clearly satisfied by any demand function in which  $q''(P) \leq 0$ , including linear demand.

<sup>17</sup> This simple model, taken literally, implies a high equilibrium elasticity of demand, but this need not hold more generally. Suppose, e.g., that higher bribes increase the possibility of a political backlash in which all checkpoints are closed. This translates into price setters maximizing a weighted sum of consumer surplus and their own profits, lower bribes, and a lower equilibrium elasticity of demand. Similar comparative statics would still obtain, however, since a centralized officer would internalize the full effect of corruption on political backlash (or consumer surplus) whereas decentralized officers would not.

of the surplus than the upstream producers, the checkpoints at the beginning of the journey.

To see the intuition, consider the case with two checkpoints and no commitment over prices. In this case, the driver and the officer Nash bargain over the bribe to be paid to pass the checkpoint. Suppose that if the driver reaches the final destination, the trip is worth one; if there is no agreement at a checkpoint, the officer confiscates the cargo and both the driver and the officer earn zero. We assume that the officer has relative bargaining power  $\alpha$ , which we assume is identical across both checkpoints.

At the second checkpoint, the surplus from agreement is one. Nash bargaining with weight  $\alpha$  for the officer implies that the bribe at the second checkpoint,  $b_2$ , is equal to  $\alpha$ . At the first checkpoint, however, in anticipation of the bribe to be paid at the second checkpoint, the surplus from agreement is no longer one; the surplus is now  $1 - \alpha$ , since if agreement is reached at checkpoint 1, then the driver will still have to pay  $\alpha$  at the second checkpoint. Given that the surplus from agreement is  $1 - \alpha$ , the bribe at the first checkpoint is  $b_1 = \alpha(1 - \alpha)$ . Note that  $b_1 < b_2$ ; more generally, no matter how many checkpoints there are, the key prediction of this model is that the bribes are increasing as the driver gets closer to the end, so that  $b_j < b_k$  if  $j < k$ .<sup>18</sup>

Overall, the theory has two sets of predictions that will be explored in the empirical work below. First, subsection B will explore the degree to which the overall price level responds endogenously to changes in market structure. Then, subsection C will explore the degree to which prices are set through ex post bargaining and, to the extent that there is some ex post bargaining over prices, whether this results in higher prices at checkpoints later in the route.

### B. *Empirical Evidence on the Impact of Changes in Market Structure*

To examine how prices respond to changes in market structure, we use the fact that the staggered withdrawal of military and police from Aceh province generates plausibly exogenous variation in the number of checkpoints. In subsection 1 we present the main results, which examine how prices on the portion of the roads in North Sumatra province responded to the reduction in checkpoints on the portion of the roads in Aceh province. In subsection 2 we present results from an alternative empirical approach that exploits the differential timing of the with-

<sup>18</sup> The working paper version (Olken and Barron 2007) demonstrates this claim formally. It also shows formally that if prices contain a fixed component and a component determined by ex post bargaining, then the double marginalization results of Sec. IV.A.1 and the holdup results in this subsection both hold in a single model.

drawal in different districts in Aceh, which allows us to look at changes within Aceh as well.

### 1. Changes in Bribes Paid in North Sumatra in Response to Reductions in Checkpoints in Aceh

We begin by examining how officials in North Sumatra province responded to the reduction in checkpoints in Aceh province. Since the military withdrawal was restricted to Aceh, it did not affect the military or police environment in North Sumatra. In the absence of other time trends, changes in prices paid at checkpoints in North Sumatra can therefore be attributed to the military withdrawal from the portion of the route running through Aceh province.

During the period covered by our data collection, the number of checkpoints in Aceh province on the Meulaboh route fell from an average of above 30 at the beginning of the sample to just 2.5 at the end of the sample. This is shown in the leftmost graphs of figure 3, which plot the number of checkpoints over time for both routes (dots indicate checkpoints in Aceh province; crosses indicate checkpoints in North Sumatra province, which remain roughly constant over the period). By contrast, on the Banda Aceh route, most checkpoints in Aceh province had already disappeared before our data collection began, so declines were more muted.<sup>19</sup> We therefore focus our analysis on the Meulaboh route and report additional difference-in-difference specifications that exploit the difference in the magnitude of the reduction between the Meulaboh and Banda Aceh routes to control for time trends.

The center panel of figure 3 shows changes in average bribes at checkpoints on both routes. The graphs show an increase in average prices on the Meulaboh route, coincident with the dramatic reduction of checkpoints on that route; if anything, there appear to have been declines in average prices on the Banda Aceh route. Similarly, the rightmost panel shows that total payments in North Sumatra rise on the Meulaboh route, whereas if anything, total payments fall slightly on the Banda Aceh route. These results suggest that prices on the North Sumatra portion of the Meulaboh route increased in response to the reduction in checkpoints on the Aceh portion of the route, as the model of endogenous price responses would predict.

<sup>19</sup> Specifically, on the Meulaboh road, checkpoints in Aceh province declined from 30.6 in the first 2 months to just 2.5 in the last 2 months; checkpoints in North Sumatra province increased from 11.9 to 12.5. On the Banda Aceh road, checkpoints in Aceh province declined from 8.5 to 2.4 over the same period; checkpoints in North Sumatra province declined from 7.8 to 6.9.



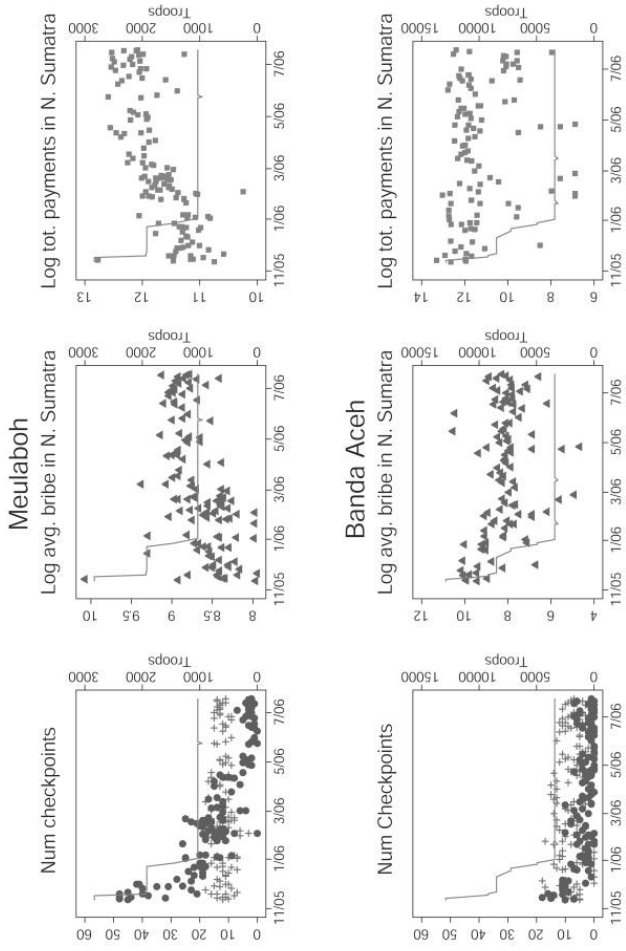


FIG. 3.—Impact of troop withdrawals. Each observation is a trip. Dots in the left column show the number of checkpoints encountered on the trip in Aceh province; crosses in the left column show the number of checkpoints encountered on the trip in North Sumatra province. Triangles in the center column show average prices paid at checkpoints in North Sumatra province on the trip. Boxes in the right column show the log of total payments made in North Sumatra province, including payments at weigh stations. The top panel shows trips on the Meulaboh road; the bottom panel shows trips on the Banda Aceh road. The solid line indicates the number of troops and police stationed in Aceh province at the time the trip began in the districts through which the trip passes.

To econometrically estimate this relationship, we estimate the following regression:

$$\text{LogPrice}_{ci} = \alpha_c + X'_i\gamma + \beta\text{LogExpectedPosts}_i + \epsilon_{ci}. \quad (5)$$

Each observation is a bribe paid at a checkpoint, and only checkpoints in North Sumatra province are included. The key coefficient is  $\beta$ , the elasticity of prices at checkpoints with respect to the number of checkpoints. The variable  $\text{LogPrice}_{ci}$  is the log bribe paid at checkpoint  $c$  on trip  $i$ , and  $\text{LogExpectedPosts}_i$  is the log expected number of checkpoints encountered on trip  $i$ . The expected number of checkpoints is calculated using data from other trips on the route over a 2-week period, with the number of checkpoints in North Sumatra held constant to isolate variation from Aceh province.<sup>20</sup>

Control variables  $X$  include six dummies for the type of cargo, log driver's monthly salary, truck age and age squared, and number of tons the truck is overweight; the impact of these characteristics will be explored in more detail in Section V.A.<sup>21</sup> We include checkpoint  $\times$  direction of travel fixed effects ( $\alpha_c$ ) to control flexibly for heterogeneity in checkpoints and to capture the fact that not all checkpoints operate every day.<sup>22</sup> Following Cameron, Gelbach, and Miller (2006), we cluster standard errors simultaneously on two dimensions, checkpoint and trip. We estimate versions of equation (5) in which we include only trips on the Meulaboh route, where the main reductions in checkpoints took place. We also estimate versions including Banda Aceh trips plus either a common cubic time polynomial or common month fixed effects to control for unobserved time trends.

One potential concern with equation (5) is that, because it is estimated at the checkpoint level, it might not detect changes due to the entry or exit of checkpoints, as well as changes in the amounts paid at weigh stations. We therefore estimate an alternative specification that

<sup>20</sup> Specifically, for each trip we calculate the average number of checkpoints in Aceh province for all other trips on the route during a 2-week window. We add the average number of checkpoints on the route in North Sumatra province, computed over the entire 8-month period. This expectation therefore (a) uses only variation in checkpoints coming from the changes in Aceh province and (b) excludes any idiosyncratic factors from the particular trip in question. Alternatively, using the actual number of checkpoints instead of the expected number of checkpoints produces very similar results. Instrumenting for the actual number of checkpoints with the expected number of checkpoints produces similar results for cols. 1–4 of table 2 below and slightly larger coefficients for cols. 5–6.

<sup>21</sup> We have also examined specifications including checkpoint characteristics (the number of officers manning the checkpoint and whether any officers at the checkpoint carried a gun) to capture potential changes in how checkpoints in North Sumatra operate. Including these controls does not affect the results (available on request).

<sup>22</sup> Specifically, we have information on the subdistrict (*kecamatan*) where each checkpoint was located and the organization (military, police, etc.) manning the checkpoint. We approximate a checkpoint fixed effect with a subdistrict  $\times$  organization fixed effect.

focuses on the *total* amount paid at checkpoints and weigh stations in North Sumatra, that is,

$$\text{LogPayments}_i = \alpha + X_i'\gamma + \beta\text{LogExpectedPosts}_i + \epsilon_i. \quad (6)$$

In this specification, each observation is a single trip, and  $\text{Log Payments}_i$  is the log of total illegal payments (checkpoints and weigh stations) in North Sumatra province on trip  $i$ . Newey-West robust standard errors are computed, allowing for serial correlation with up to 10 lags. Control variables and specifications are otherwise identical to equation (5).

The mapping between the estimated coefficients  $\beta$  and the alternative pricing structures discussed in the theory section is the same for both equations. If pricing at checkpoints does not depend on market structure, then  $\beta = 0$ . If pricing does depend on market structure and is fully centralized, the amount charged at each remaining checkpoint would increase enough to fully offset the lost revenues from the checkpoints that were eliminated, so  $\beta = -1$ . If pricing depends on market structure and is decentralized, the amount charged at each remaining checkpoint should increase, though not enough to fully offset the lost revenues from the checkpoints that were eliminated, so  $-1 < \beta < 0$ .<sup>23</sup>

Panel A of table 2 presents the checkpoint-level results from estimating equation (5), and panel B presents the aggregate time-series results from estimating equation (6). Column 1 presents ordinary least squares (OLS) estimates for the Meulaboh route without controls  $X$ . Panel A shows that the elasticity of the average bribe in North Sumatra with respect to the expected number of checkpoints on the route is  $-0.545$ , and panel B shows that the elasticity of the total payments in North Sumatra with respect to the expected number of checkpoints on the route is  $-0.736$ . The reason that the latter elasticity is slightly larger is likely that panel A includes only checkpoints, whereas panel B includes weigh stations as well as checkpoints. Column 2 adds controls for the trip, which do not noticeably affect the results. In column 3, we restrict attention to the period before the press conference, yielding estimates of  $-0.684$  and  $-0.643$ . In column 4, to verify that the results are in fact related to the military withdrawals, we instrument for the log expected

<sup>23</sup> To see that the predictions are the same for both specifications, note that the total payments in North Sumatra,  $P_i$ , are equal to  $(P/n)n_i$ , where  $P$  is the total amount paid,  $n$  is the total number of checkpoints, and  $n_i$  is the number of checkpoints in North Sumatra. Since  $n_i$  is not changing in response to the military withdrawal,

$$\log(P_i) = \log\left(\frac{P}{n}n_i\right) = \log\left(\frac{P}{n}\right) + c,$$

so the predictions for changes in  $\log(P_i)$  in (6) are the same as for  $\log(P/n)$  in (5).

TABLE 2  
IMPACT OF NUMBER OF CHECKPOINTS IN ACEH ON BRIBES IN NORTH SUMATRA

	Meulaboh OLS (1)	Meulaboh OLS (2)	Meulaboh (Pre-Press Conference) OLS (3)	Meulaboh IV (4)	Both Routes OLS (5)	Both Routes OLS (6)
A. Log Payment at Checkpoint						
Log expected checkpoints on route	-.545*** (.157)	-.580*** (.167)	-.684*** (.257)	-.788*** (.217)	-.701*** (.202)	-.787*** (.203)
Truck controls	No	Yes	Yes	Yes	Yes	Yes
Common time effects	None	None	None	None	Cubic	Month FE
Observations	1,941	1,720	1,069	1,720	2,369	2,369
Test elasticity = 0	.00	.00	.01	.00	.00	.00
Test elasticity = -1	.00	.01	.22	.33	.14	.29
B. Log Total Payments						
Log expected checkpoints on route	-.736*** (.064)	-.695*** (.069)	-.643*** (.237)	-.782*** (.131)	-1.107** (.444)	-1.026** (.405)
Truck controls	No	Yes	Yes	Yes	Yes	Yes
Common time effects	None	None	None	None	Cubic	Month FE
Observations	161	144	90	144	249	249
Test elasticity = 0	.00	.00	.01	.00	.01	.01
Test elasticity = -1	.00	.00	.14	.10	.81	.95

NOTE.—Panel A presents the results from estimating eq. (5), where each observation is a payment at a checkpoint, the dependent variable is the log payment at the checkpoint, the sample is limited to North Sumatra province only, all specifications include checkpoint × direction of travel fixed effects, and robust standard errors are in parentheses, adjusted simultaneously for clustering at the checkpoint and trip levels. Panel B presents the results from estimating eq. (6), where each observation is a trip, the dependent variable is log total payments in North Sumatra province, and robust Newey-West standard errors allowing for up to 10 lags are included in parentheses. In both specifications, truck controls are dummies for six types of contents, log driver’s monthly salary, truck age and truck age squared, and number of tons truck is overweight; these characteristics are examined in more detail in table 6. The instrument in col. 4 is the log number of troops remaining in Aceh in the districts covered by the Meulaboh route; the first-stage *F*-statistic for the excluded instruments based on the panel B specification is 43.11. Log expected checkpoints uses only variation from Aceh province; the details of how this variable is constructed are in the text. Columns 5 and 6 are the difference-in-difference specifications, including both routes and a common cubic in time (col. 5) or common month fixed effects (col. 6). Note that cols. 5 and 6 of panel B also includes a route dummy.

\* Significant at 10 percent.  
\*\* Significant at 5 percent.  
\*\*\* Significant at 1 percent.

number of checkpoints with the log number of troops remaining in Aceh, yielding estimates of  $-0.788$  and  $-0.782$ .<sup>24</sup>

To control for potentially unobserved time trends, columns 5 and 6 present difference-in-difference specifications, exploiting the fact that

<sup>24</sup> If we estimate the first stage with one observation per trip (equivalent to panel B), the *F*-statistic on the excluded instruments is 43.11. This suggests that weak instruments are not a problem in this context (Staiger and Stock 1997).

there were larger reductions in checkpoints on the Meulaboh route than on the Banda Aceh route. Specifically, column 5 includes observations from both routes plus a common cubic polynomial of the trip date. Column 6 is similar, with common month fixed effects instead of the time polynomial.<sup>25</sup> The resulting elasticities are  $-0.701$  and  $-0.787$  for average payments at checkpoints and  $-1.107$  and  $-1.026$  for total payments. This difference-in-difference strategy provides further evidence that prices respond endogenously to the withdrawals.

The estimates in all specifications are statistically significantly different from zero, confirming that prices charged in North Sumatra increase as the number of checkpoints on the route in Aceh declines. Prices thus respond to changes in market structure in a way consistent with economic theory. The point estimates are not statistically distinguishable from minus one in most specifications, so we cannot determine whether the price setting is decentralized or centralized.

The estimates suggest that the magnitude of endogenous price responses is substantial. For example, consider how the impact of the military withdrawal would have differed if prices had not responded endogenously. Preliminary interviews in March 2005 found that truck drivers stopped at an average of 90 checkpoints along the two routes, whereas in the post-withdrawal period, truck drivers stopped at an average of 18 checkpoints. When we applied the estimate from column 1, panel A, of table 2 that the elasticity of the average price at a checkpoint with respect to the total number of checkpoints is  $-0.55$ , the 80 percent reduction in the number of checkpoints reduced the cost of payments at checkpoints by only 51 percent.<sup>26</sup> Had prices been exogenous, the cost of payments would have fallen by 80 percent. Endogenous price responses therefore offset about 36 percent of the potential reduction in corruption from removing checkpoints.

One potential concern is that this empirical strategy does not rule out differential time trends across the two routes. For example, although we have no evidence that this is the case, it is possible that the recovery efforts from the 2004 tsunami proceeded at a different pace in the Meulaboh area than in the Banda Aceh area, creating differential

<sup>25</sup> Naturally, in panel B we also include a dummy for which route the trip was on; such a dummy is not necessary in panel A because it already includes checkpoint fixed effects, which implicitly capture the route fixed effect.

<sup>26</sup> To see this, note that we can transform eq. (5) to be

$$\text{LogTotalPayments}_i = (\beta + 1)\text{LogTotalCheckpoints}_i.$$

Thus, the relationship between the log of total payments on the route and the log of the total number of checkpoints on the route is equal to  $-0.55 + 1 = 0.45$ . This, combined with the 80 percent ( $-1.6$  in log units) reduction in checkpoints, yields the estimate in the text. Since  $-0.55$  is the smallest of all the estimates in table 2, choosing a different point estimate would yield an even smaller reduction in payments and a larger impact of endogenous price responses.

changes in willingness to pay for transport on the two routes and potentially biasing the estimates. Although this empirical strategy cannot definitely rule out such a possibility, the analysis in the next subsection addresses this concern with an alternative identification strategy that looks within Aceh province and relies on changes in the location of checkpoints.

## 2. An Alternative Empirical Approach: Changes within Individual Districts

An alternative empirical approach is to examine how the cost of passing through each district in Aceh changed as troops were withdrawn, taking advantage of the fact that the withdrawal of troops occurred at different times in different districts.<sup>27</sup> The key advantage of this approach is that, since each trip passes through 10 districts, we can include trip fixed effects. This allows us to control completely flexibly for separate time trends on each route, as well as for unobservable characteristics of each truck and driver. However, since trip fixed effects absorb the overall general equilibrium changes in the prices estimated above, this analysis tells us only how the allocation of bribes within a trip shifted as a result of the military withdrawal rather than the impact on the overall bribe level.

To examine this, we estimate the following regression:

$$\text{LogPayments}_{di} = \alpha + \alpha_d + \beta \text{LogExpectedPosts}_{di} + \epsilon_{di}, \quad (7)$$

where  $\text{LogPayments}_{di}$  is the log of the total amount of payments made by driver  $i$  to pass through district  $d$ ,  $\text{LogExpectedPosts}_{di}$  is the log expected number of checkpoints in district (*kabupaten*)  $d$  encountered during trip  $i$  (calculated analogously to  $\text{LogExpectedPosts}_i$  in eqq. [5] and [6] above),  $\alpha$  is a trip fixed effect, and  $\alpha_d$  is a set of district  $\times$  direction of travel fixed effects. Each observation is now a district  $\times$  trip, and since each trip passes through 10 districts, there are 10 observations for each trip.<sup>28</sup>

Since the regression in (7) examines the relationship between total payments in a district and the expected number of checkpoints *in that district*, the interpretation of the estimated  $\beta$  in (7) differs from that in equations (5) and (6). In this case, price setting that does not depend on market structure translates into  $\beta = 1$ , since the total cost of passing

<sup>27</sup> Districts are the key subprovincial administrative units in Indonesia, and both the police and the army are organized district by district. District borders are shown as solid black lines in fig. 1.

<sup>28</sup> Note, however, that the log-log form drops district  $\times$  trip observations with no checkpoints. We have reestimated this equation in levels and find qualitatively similar effects, suggesting that dropping the zeros does not substantially affect the results.

TABLE 3  
IMPACT OF NUMBER OF CHECKPOINTS ON TOTAL PAYMENTS IN DISTRICT

	Meulaboh OLS (1)	Meulaboh IV (Troops) (2)	Both Routes OLS (3)	Both Routes IV (Troops) (4)
Log expected check- points in district	.663*** (.081)	1.522*** (.390)	.586*** (.082)	.786** (.359)
Observations	1,090	1,026	1,435	1,363
Test elasticity = 0	.00	.00	.00	.03
Test elasticity = 1	.00	.18	.00	.55

NOTE.—This table presents the results from estimating eq. (7), where there is one observation for each district encountered on each trip, the dependent variable is the log of total amount paid in bribes in the district, and trip fixed effects and district  $\times$  direction of travel fixed effects are included. The instrument in cols. 2 and 4 is the log number of troops remaining in the district. Robust standard errors are in parentheses, adjusted simultaneously for clustering at the district  $\times$  quarter and trip levels.

\* Significant at 10 percent.

\*\* Significant at 5 percent.

\*\*\* Significant at 1 percent.

through a district is proportional to the number of checkpoints in the district. Centralized price setting within districts—for example, by the district police or army commander—translates into  $\beta = 0$ , since the commander would adjust each checkpoint's price so that the cost of passing through the district remains constant. Decentralized price setting within districts translates into  $0 < \beta < 1$ .<sup>29</sup>

The results are presented in table 3. Column 1 of table 3 presents the results from estimating equation (7) using OLS and data from the Meulaboh route, with fixed effects for each trip and for each district  $\times$  direction of travel. Column 2 presents the results from reestimating equation (7) instrumenting for  $\text{LogPosts}_{di}$  with the log number of troops remaining in the district.<sup>30</sup> Columns 3 and 4 repeat the estimation using data from both routes. Standard errors are clustered simultaneously on two dimensions, district  $\times$  quarter and trip.<sup>31</sup>

<sup>29</sup> Note that, given the inclusion of trip fixed effects, we would also obtain  $\beta = 1$  if pricing was decentralized but depended only on the total number of checkpoints on the entire route, not on the number of checkpoints within each district. This would be the case if all trips traveled the entire route from Meulaboh or Banda Aceh to Medan. The decentralized predictions in this section therefore hold only if there are some trips that travel on a subsection of the route, so the elasticity of demand to pass through a district depends on the total price in that district.

<sup>30</sup> In col. 2, the first-stage estimate is that the elasticity of the number of checkpoints in the district with respect to the number of troops in the district is 0.48, with an  $F$ -statistic of 1.80; in col. 4, the first-stage estimate is 0.52, with an  $F$ -statistic of 4.55. These first-stage  $F$ -statistics are much lower than in table 2, since we are now trying to predict the pattern of withdrawals district by district rather than the overall withdrawal of checkpoints.

<sup>31</sup> Note that we cannot cluster by district since there are only 10 districts in cols. 1 and 2, so the asymptotics would not be valid. An alternative approach is to treat the data as a time series within each district and use Newey-West (1987) standard errors. Computing these standard errors allowing for autocorrelation with up to 10 lags produces standard errors similar to those shown in the tables.

Both the OLS and instrumental variable (IV) estimates (0.663 and 1.522, respectively, on the Meulaboh route and 0.586 and 0.786, respectively, using data for both routes) are statistically distinguishable from zero. Moreover, the OLS estimates of 0.663 and 0.586 are significantly different from one. This not only means that prices respond endogenously to the *total* number of checkpoints on the road, but also suggests that they adjust to take into account the number of checkpoints in their particular portion of the road. This provides further evidence rejecting centralized price setting in favor of decentralized price setting and, more generally, further evidence that market structure affects equilibrium price levels.

### C. Empirical Evidence on Sequential Bargaining

#### 1. Bargaining versus Fixed Prices

An important theoretical question is whether bribes are fixed in advance of the trip or are instead determined in part through a bilateral bargaining process at the checkpoint. To test for bargaining, we examine whether the prices paid at the checkpoints vary with two objective factors that would presumably increase the bargaining power of the officer at the checkpoint.

First, we examine the price impact of the officer at the checkpoint brandishing a gun. Holding a gun increases the officer's bargaining power for a variety of reasons: it signals his willingness (or, perhaps, taste) to inflict physical punishment, it can be used to beat people, and it could be used to shoot a truck that drove away from the checkpoint. Second, we examine the number of officers visible at the checkpoint. Having more officers allows a given officer to spend time harassing a truck driver without worrying that he will be unable to stop another truck in the meantime. Having more officers as backup may also increase the confidence of the officer bargaining with the truck driver.

To test for bargaining, we estimate the following regression:

$$\text{LogPrice}_{ci} = \alpha_i + \alpha_c + \text{Gun}_{ci} + \text{NumOfficers}_{ci} + \epsilon_{ci}. \quad (8)$$

As in equation (5), each observation is a checkpoint on a particular trip. Note that it includes fixed effects for the trip ( $\alpha_i$ ) and fixed effects for the checkpoint  $\times$  direction of travel  $\times$  month ( $\alpha_c$ ), and we include all the data (i.e., data from both routes and both provinces). We adjust standard errors for clustering at the checkpoint level. We are thus examining whether, with characteristics of the checkpoint, time trends, and the trip held constant, greater bargaining power on the part of the officer manning the checkpoint leads to higher prices.

The results, presented in table 4, support the idea that increases in



TABLE 4  
BARGAINING VERSUS FIXED PRICES

	LOG PAYMENT		NEGOTIATE DUMMY	
	(1)	(2)	(3)	(4)
Gun visible	.166** (.066)	.154** (.070)	.042** (.018)	.047*** (.018)
Gun visible at subsequent checkpoint		.016 (.024)		.016 (.018)
Number of officers at checkpoint	.047*** (.010)	.050*** (.009)	.017*** (.004)	.016*** (.005)
Number of officers at subsequent checkpoint		-.003 (.007)		-.003 (.004)
Observations	5,260	4,968	5,281	4,989
Mean dependent variable	8.49	8.50	.13	.13

NOTE.—This table presents the results from estimating eq. (8), where there is one observation for each payment at a checkpoint, and trip fixed effects and checkpoint  $\times$  direction  $\times$  month interval fixed effects are included. Robust standard errors are in parentheses, adjusted for clustering at the checkpoint level.

\* Significant at 10 percent.

\*\* Significant at 5 percent.

\*\*\* Significant at 1 percent.

the observable bargaining power of the officer lead to higher bribes paid. Column 1 of table 4 indicates that if the officer has a gun visible, average payments increase by about 17 percent. Each additional person visible at the checkpoint increases payments by about 5 percent.

One potential concern is that having a gun or having more officers present at the checkpoint indicates a worse security situation, in which case the higher payment is commensurate with the greater amount of security services received rather than with increased bargaining power on the part of the officers at the checkpoint. To test this, in column 2 of table 4 we include the gun and number of officers variables for the subsequent checkpoint encountered on the trip. If these variables capture the overall security situation, which presumably varies continuously along the route, the effect of these variables at the subsequent checkpoint should be similar to the effect at the current checkpoint. As shown in column 2, however, the presence of a gun or the number of officers at the subsequent checkpoint has no effect on the bribe paid at the current checkpoint, suggesting that these variables capture bargaining strength rather than the overall security situation.

Another possibility is that these differential prices reflect higher prices set ex ante rather than the result of bargaining per se. We therefore examine negotiation directly. In 87 percent of cases, the driver simply hands over an amount, which is accepted with no discussion; active negotiation occurs in only 13 percent of cases. Column 3 of table 4 shows that the officer having a gun and the number of officers at the checkpoint not only increase the price but also increase the probability of active negotiation. For example, the officer having a gun increases

the probability of negotiations by 4 percentage points, or 45 percent above the baseline level. In a full information bargaining model, of course, these characteristics should affect the equilibrium price, but not necessarily the number of rounds of bargaining. The fact that these characteristics affect negotiation in addition to the equilibrium price suggests some uncertainty as to their impact on the officer's bargaining power, which is resolved through negotiation. Column 4 of table 4 shows that the variables at the subsequent checkpoint do not affect negotiation, confirming again that these variables are not capturing general trends about the security situation. Combined, these results suggest that bribes are set at least in part through bilateral bargaining.

## 2. Sequential Bargaining and Increasing Prices

Given the presence of bargaining, we can test the implication of Section IV.A.2 that prices should increase later in the trip. To do so, we take advantage of the fact that we observe trips in both directions on both routes. We therefore examine the dynamics of payments along a trip, conditioning out trip fixed effects and checkpoint fixed effects.

Specifically, we assign each checkpoint a percentile score based on the order in which they are encountered, from 0 (the first checkpoint) to 1 (the last checkpoint). We average across all trips each month to obtain the mean percentile score for each checkpoint—that is, at what point in the trip that checkpoint is usually encountered—for each direction of travel. Each checkpoint therefore has two mean percentile scores each given month: one for when the trip is going from point A to point B and one for when the trip is going from point B to point A.<sup>32</sup>

We estimate the following regression at the checkpoint-trip level:

$$\text{LogPrice}_{ci} = \alpha_i + \alpha_c + \beta \text{MeanPercentile}_{ci} + \epsilon_{ci}, \quad (9)$$

where  $\alpha_i$  is a trip fixed effect and  $\alpha_c$  is a checkpoint  $\times$  month fixed effect. A positive coefficient  $\beta$  indicates that the price is increasing as the trip progresses. We estimate equation (9) separately for each route, clustering standard errors at the checkpoint level. We also present the results nonparametrically. To do this, we first estimate (9) with  $\text{LogPrice}$  as the dependent variable and with only the fixed effects  $\alpha_i$  and  $\alpha_c$  as independent variables. We then perform a nonparametric Fan regression of the residuals from that regression on  $\text{MeanPercentile}_{ci}$ .

Figure 4 shows the nonparametric Fan regression, and table 5 presents

<sup>32</sup> By allowing the percentile for each checkpoint to vary month by month, we ensure that we are not confounding the direction of travel effect with the change in composition of posts due to the military withdrawal, though in practice computing the percentiles for the whole sample, rather than month by month, produces similar results.

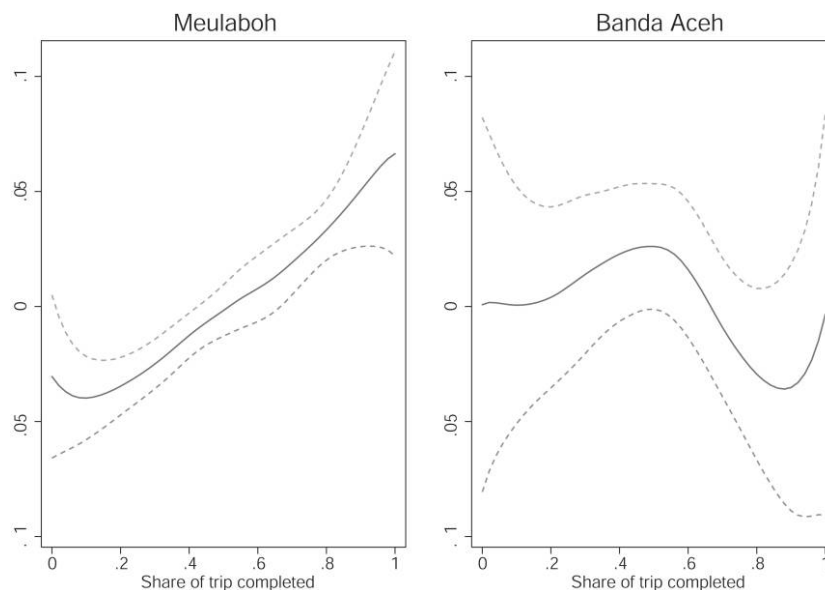


FIG. 4.—Payments by percentile of trip. Each graph shows the results of a nonparametric Fan (1992) locally weighted regression, where the dependent variable is log payment at checkpoint, after removing checkpoint  $\times$  month fixed effects and trip fixed effects, and the independent variable is the average percentile of the trip at which the checkpoint is encountered. The bandwidth is equal to one-third of the range of the independent variable. Dependent variable is log bribe paid at checkpoint. Bootstrapped 95 percent confidence intervals are shown in dashes, where bootstrapping is clustered by trip.

the regression results from estimating equation (9). In both sets of results, the data from the Meulaboh route show prices clearly increasing along the route, with prices increasing 16 percent from the beginning to the end of the trip. This is consistent with the model outlined above, in which there is less surplus early in the route for checkpoints to extract.

The evidence from the Banda Aceh route is less conclusive, with no clear pattern emerging; the point estimate in table 5 is negative but the confidence intervals are wide; the nonparametric regressions in figure 4 show a pattern that increases and then decreases. One reason the model may not apply as well here is that the route from Banda Aceh to Medan runs through several other cities (Lhokseumawe and Langsa, both visible on fig. 1), whereas there are no major intermediate destinations on the Meulaboh road. If officials cannot determine whether a truck is going all the way from Banda Aceh to Medan or stopping at an intermediate destination, the upward slope prediction may be much less clear.<sup>33</sup>

<sup>33</sup> Another potential reason is that there are fewer checkpoints on the Banda Aceh

TABLE 5  
SEQUENTIAL BARGAINING AND INCREASING PRICES

	Meulaboh (1)	Banda Aceh (2)
Mean percentile	.145*** (.045)	-.178 (.225)
Observations	4,190	1,089

NOTE.—This table presents the results from estimating eq. (9), where there is one observation for each payment at a checkpoint, and trip fixed effects and checkpoint  $\times$  month interval fixed effects are included. Robust standard errors are in parentheses, adjusted for clustering at the checkpoint level.

\* Significant at 10 percent.  
\*\* Significant at 5 percent.  
\*\*\* Significant at 1 percent.

Using the model, we can use the estimated slope on payments along the route to back out the implied relative bargaining power of the officer and driver. The model implies that the slope with respect to the percentile (i.e., what we estimate in [9]) will be equal to  $-N \log(1 - \alpha)$ , where  $N$  is the number of checkpoints.<sup>34</sup> If we take the model seriously, the estimates from the Meulaboh route imply that bargaining power of the officers at the checkpoints is extremely low: the implied  $\alpha$  is only 0.005. This very low bargaining power of officers at checkpoints is consistent with the small size of average payments (between US\$0.55 and US\$1.10), but why it is so low remains a puzzle.

## V. Can Corrupt Officials Price Discriminate?

The analysis above suggests that corrupt officials respond to market forces in determining the level of bribes. However, this does not necessarily imply that corrupt officials are just like firms in the marketplace. In particular, the fact that corruption is illegal means that there may be very substantial restrictions on the types of contracts that corrupt officials can offer. This section examines whether the fact that bribes are illegal is sufficient to preclude price discrimination.

route. Since  $N$  is much smaller, the predicted slope on the percentile of the checkpoint's location, equal to  $N \log(1 - \alpha)$ , should also be much smaller (see n. 34 below).

<sup>34</sup>To see this, note that the theory predicts  $b_n = \alpha(1 - \alpha)^{N-n}$ , where  $n$  indexes the checkpoint number and  $N$  indexes the total number of checkpoints. Taking logs, we get

$$\log b_n = -n \log(1 - \alpha) + k,$$

which implies that

$$\log b_n = -N \log(1 - \alpha) \frac{n}{N} + k,$$

where  $n/N$  is the checkpoint's percentile.

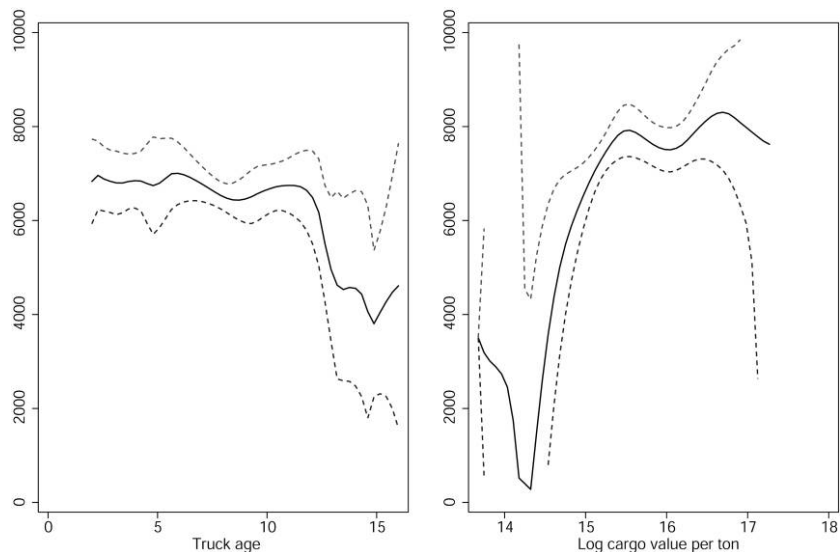


FIG. 5.—Price discrimination on observable characteristics. Each graph shows the results of a nonparametric Fan (1992) locally weighted regression, with the bandwidth equal to one-fifth of the range of the independent variable. The dependent variable is the price paid at the checkpoint, and the independent variable is shown in the  $x$ -axis (truck age in the left panel and log cargo value per ton in the right panel). Bootstrapped 95 percent confidence intervals are shown in dashes, where bootstrapping is clustered by trip. When the dashed lines are not shown, it indicates that the 95 percent confidence interval exceeds the  $y$ -axis of the graph.

#### A. Price Discrimination Based on Observable Characteristics

If there are observable characteristics that are correlated with differential willingness to pay, profit-maximizing officials will charge different bribes on the basis of those characteristics. To test for this type of third-degree price discrimination, we examine the correlation between bribes and observable characteristics of trucks that we would predict, a priori, to be correlated with differential willingness to pay.

Figure 5 presents the results of nonparametric Fan regressions of bribes on two such characteristics: the age of the truck and the average cargo value per ton. Figure 5 reveals that trucks older than about 12 years pay substantially lower prices, though this accounts for only about 6 percent of the trucks in our data. Trucks with low-value cargo also pay substantially less; prices fall off precipitously below about Rp. 5,500,000 per ton (US\$600, or 15.5 on the log scale shown in the figure, which is the 43rd percentile in the value distribution).

To verify the patterns shown in figure 5, we estimate a price discrimination equation. We include checkpoint fixed effects interacted with

month fixed effects to take into account the fact that different trucks carrying different cargo may have traveled on different routes or at different times. Specifically, we estimate the following equation:

$$\text{LogPrice}_{ci} = \alpha_c + X_i'\beta + \epsilon_{ci}, \quad (10)$$

where each observation is a bribe at a checkpoint,  $X_i'$  are characteristics of truck  $i$ , and  $\alpha_c$  are checkpoint  $\times$  direction of travel  $\times$  month fixed effects. We include data from both provinces and both routes. Standard errors are simultaneously clustered at both checkpoint level and trip level.

The results are reported in table 6. Since the cargo value was available for only a subset of trips, in column 1 we use dummy variables for different cargo types (which were available for all trips), and in column 2 we instead include the cargo value (which limits the sample to those trips with cargo value data). The results in column 2 confirm that trucks with higher cargo value pay more. The point estimates also suggest a concave relationship between truck age and payment, with trucks over 5 years old paying less, though the quadratic term is not statistically significant. The results for types of cargo indicate higher payments for steel, which is often of questionable legality, and lower payments for manufactured goods. A joint  $F$ -test of all truck characteristics shows that these characteristics are jointly significant at the 1 percent level. These results are consistent with those of Svensson (2003), who also found that firms with higher ability to pay do in fact pay higher bribes.

The social welfare consequences of price discrimination at checkpoints depend on whether the total amount of corruption is affected by the ability to price discriminate. If the total amount of corrupt revenue from bribes at checkpoints is fixed (e.g., through some type of political constraint), allowing third-degree price discrimination unambiguously reduces the deadweight loss from corruption (Baumol and Bradford 1970). This is analogous to the Ramsey tax problem: with third-degree price discrimination, officers can extract a greater share of the revenue from those truckers whose demand is less elastic. If, however, officials are not subject to a revenue constraint, then the welfare effects of third-degree price discrimination are theoretically ambiguous and depend on the specific shape of the demand curves (Schmalensee 1981).

Table 6 also includes characteristics of the driver, such as age, education, years of experience, and so forth. These driver characteristics are jointly statistically significant, with a  $p$ -value of 0.01. Two results in particular stand out. First, more frequent drivers—that is, those drivers who average more trips per month—pay lower bribes. One explanation is that frequent drivers are willing to invest more in learning the true

TABLE 6  
PRICE DISCRIMINATION

	LOG PAYMENT	
	(1)	(2)
Contents of truck:		
Steel	.387*** (.144)	
Construction materials	-.063 (.059)	
Food	.025 (.039)	
Agricultural produce	.106 (.073)	
Manufactured goods	-.210*** (.074)	
Empty bottles	-.037 (.529)	
Log cargo value per ton		.072** (.036)
Truck characteristics:		
Truck age	.050** (.025)	.028 (.031)
Truck age squared (years)	-.002 (.002)	-.001 (.002)
Tons overweight	-.001 (.003)	.006** (.003)
Driver characteristics:		
Age	.006 (.004)	.001 (.004)
Years of education	.002 (.004)	-.011 (.007)
Speaks Acehnese	-.029 (.039)	.045 (.045)
Years of experience	-.003 (.003)	.003 (.004)
Average trips per month	-.049*** (.015)	-.007 (.031)
Log monthly salary	.090** (.042)	.026 (.057)
Observations	4,510	2,079
<i>F</i> -statistic on joint test of all contents/truck characteristics	24.61	2.90
<i>p</i> -value of joint test of all contents/truck characteristics	.00	.41
<i>F</i> -statistic on joint test of all driver characteristics	17.70	8.12
<i>p</i> -value of joint test of all driver characteristics	.01	.23

NOTE.—This table presents the results from estimating eq. (10), where there is one observation for each payment at a checkpoint, and checkpoint  $\times$  direction  $\times$  month fixed effects and hour of day fixed effects are included. Robust standard errors are in parentheses, adjusted simultaneously for clustering at both the checkpoint and trip levels.

\* Significant at 10 percent.

\*\* Significant at 5 percent.

\*\*\* Significant at 1 percent.

reservation price of each checkpoint.<sup>35</sup> Second, drivers with higher salaries pay more. One potential explanation is an income effect: drivers with more income are willing to pay more not to spend the time and hassle (and potential risks) to obtain a low price. These factors suggest that in addition to price discrimination, drivers have some flexibility in the degree to which they invest in obtaining a lower price.

### *B. Weigh Stations and Second-Degree Price Discrimination*

A second type of price discrimination can occur when there is asymmetric information between firms and customers. In this context, for example, there may be unobserved heterogeneity in the fixed cost for each trip and, thus, truck drivers' willingness to pay to be overweight. In such a situation, officials at weigh stations could potentially introduce a nonlinear pricing scheme to extract additional revenue from drivers with a higher willingness to pay to be overweight. These nonlinear pricing schemes should feature quantity discounts, so that the marginal bribe required for each additional ton overweight decreases as the number of tons overweight increases (Maskin and Riley 1984).

An example of this type of second-degree price discrimination can be found at the Gebang weigh station, located in North Sumatra province on the Banda Aceh–Medan route, where officials have set up the bribe schedule as a menu of two-part tariffs. If trucks simply arrive at the weigh station, they pay a high marginal cost for being overweight: regressions indicate that they pay approximately Rp. 11,000 (US\$1.20) per ton overweight for each ton over 10 tons overweight plus a fixed fee of approximately Rp. 170,000 (US\$18.50). However, if before they leave Medan they purchase a date-stamped coupon from a criminal organization for about Rp. 150,000 (US\$16.30), at the weigh station they can turn in the coupon and pay a flat fee of Rp. 50,000 (US\$5.50) to the weigh station attendants, regardless of how overweight they are. Facing this schedule, drivers more than 16 tons overweight should prefer the high fixed fee, low marginal cost scheme.

Figure 6 shows nonparametric locally weighted regression estimates of the bribes truck drivers pay at Gebang (including the price of the coupon), separately depending on whether they have purchased the coupon or not. The patterns visible in figure 6 confirm the existence of two very different pricing schedules with a break-even line around 16 tons.

<sup>35</sup> The fact that frequent drivers pay less suggests that checkpoints and drivers may be engaged in a repeated game, which might help explain the low level of bribes. If so, prices should change right before checkpoints are withdrawn, since in the final period repeated games would break down. We found no evidence, however, that prices change systematically before checkpoints are withdrawn.



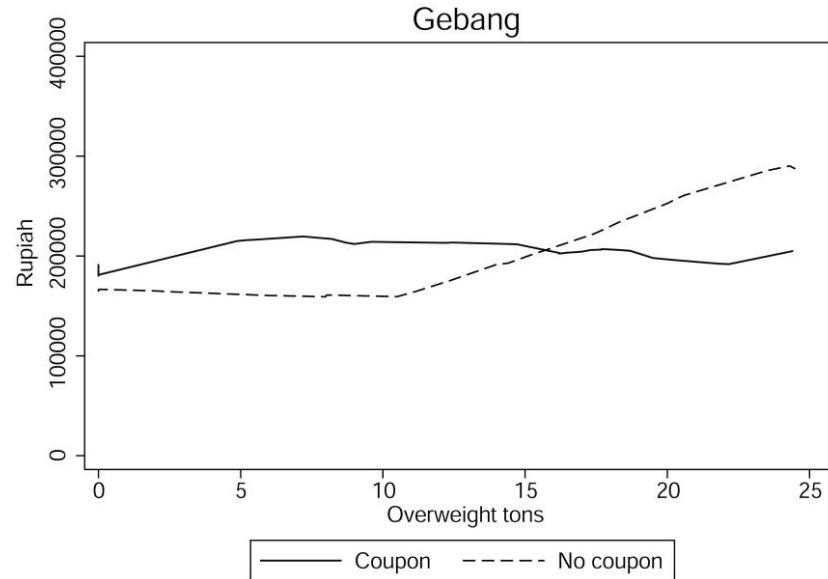


FIG. 6.—Payments at Gebang weigh station. The figure shows the results of two locally weighted Fan regressions of the total amount paid at the Gebang checkpoint and (if applicable) in purchasing the coupon on the amount overweight. The solid line shows the total amount paid for those who purchased the coupon, and the dashed line shows the total amount paid for those who did not purchase the coupon. We cannot reject that the slope of the coupon line is zero but can reject that the slope of the no coupon line is zero and can reject that the two slopes are equal at the 95 percent level. Note that this regression drops one observation that was more than 30 tons overweight and all observations from one surveyor who did not record whether the truck had paid the coupon or not.

Table 7 investigates which trucks select into which fee schedule. Column 1 of table 7 shows, quite surprisingly, that while heavier trucks are more likely to select into the high fixed cost, low marginal cost fee schedule, this effect is not statistically significant and is relatively small in magnitude: moving from not being overweight at all to being 25 tons overweight, close to the maximum reported, is associated with only an 8-percentage-point higher probability of choosing the high fixed cost, low marginal cost schedule. However, column 2 indicates that those with higher unobserved fixed costs (in the forms of higher salaries for drivers) are much more likely to select into the high fixed cost, low marginal cost fee schedule. Moreover, those drivers who get paid more also tend to carry heavier loads, so that in column 3, when we instrument for truck weight with the log of the driver's salary, we now get a much larger (and statistically significant) coefficient on truck weight.<sup>36</sup>

<sup>36</sup> Of course, the driver's salary is by no means a perfect instrument; rather, the point

TABLE 7  
WHO SELECTS INTO A HIGH FIXED COST CONTRACT?

	OLS (1)	OLS (2)	IV (3)
Tons overweight	.003 (.010)		.039** (.019)
Log driver's monthly salary		.305** (.119)	
Constant	.495*** (.138)	-4.018** (1.760)	.074 (.210)
Observations	47	47	47
$R^2$	.00	.09	

NOTE.—This table reports the result of a linear probability model that estimates  $\text{Coupon}_i = \alpha + X_i'\beta + \epsilon_i$ , where  $\text{Coupon}_i$  is a dummy for whether a given trip  $i$  purchased the coupon and thus selected into the flat-price system. Each observation is a trip, and the sample is restricted to all trips on the Medan-Banda Aceh route headed in the direction of Banda Aceh, since coupons are for sale only on this route and only for this direction of travel. Columns 1 and 2 are estimated as linear probability models using OLS; col. 3 is estimated as a linear probability IV model using two-stage least squares, where the instrument is the log driver's monthly salary. Nonlinear probit and IV probit models produce qualitatively similar results. Robust standard errors are in parentheses. All columns drop two outliers: the highest observation on weight and the highest observation on salary. Including these observations strengthens the statistical significance of the results in cols. 2 and 3.

\* Significant at 10 percent.

\*\* Significant at 5 percent.

\*\*\* Significant at 1 percent.

One way to reconcile all these results is to assume that drivers have some uncertainty about the amount their truck weighs. Since they have to decide whether or not to buy the date-stamped coupon before they depart, they decide on the basis of whether they are generally overweight. This would explain why factors that predict whether they are overweight—such as the driver's salary—have more predictive power than the actual weight of the truck. This uncertainty could also explain why there are two two-part tariffs rather than a single nonlinear tariff; in the presence of ex ante uncertainty about the weight of the truck and risk-averse truck drivers, this system of multiple two-part tariffs can produce more revenue than a single nonlinear tariff (Clay, Sibley, and Srinagesh 1992; Miravete 2005).<sup>37</sup>

This type of second-degree price discrimination, while it may be revenue maximizing for corrupt officials, exacerbates the inefficiencies caused by corruption. In particular, quantity discounts decrease social efficiency by moving from a linear bribe schedule to a concave bribe schedule—the opposite of the true social costs from driving overweight.

The pricing scheme of the Gebang weigh station is, in a sense, a possibility result: it demonstrates that very sophisticated pricing con-

is that we have demonstrated a characteristic that is related to a fixed cost of a trip and correlated with both a driver being overweight on average and his decision to purchase the coupon.

<sup>37</sup> Another possible reason for the geographic separation is that it requires the use of a physical coupon. This coupon could allow upper-level bureaucrats to obtain data on the number of trucks paying bribes, which they could use to extract bribe revenue from weigh station attendants on a per-truck basis rather than a fixed-fee basis.

tracts can emerge for corrupt activity. Just because this type of two-part contract occurs at Gebang, however, does not mean that it will emerge everywhere; in fact, an interesting question is why this system occurs only at the Gebang weigh station and only heading toward Aceh.<sup>38</sup> Understanding the precise circumstances that enable these complex arrangements to evolve is an important direction for future work.

## VI. Conclusion

This paper examines the degree to which corrupt officials behave like firms. We accompanied truck drivers on 304 trips transporting goods to and from the Indonesian province of Aceh. During these trips, we observed a total of more than 6,000 bribes and other illegal payments to police, military officers, and officials at weigh stations, or about 20 such payments per trip. Total illegal payments averaged about 13 percent of the cost of each trip, more than the total wages received for the trip by the truck driver and his assistant.

Using these data, we showed that the patterns of bribes paid conform to predictions of standard models of pricing behavior from industrial organization. During the period under study, the military staged a staggered withdrawal from Aceh province as part of a peace agreement with the GAM rebel group. We document that this withdrawal led to a dramatic reduction in the number of checkpoints at which trucks in Aceh had to stop to pay bribes. We show that average bribes paid at checkpoints on the remainder of the route increased in response.

We also use our direct observation of bribe payments to examine how bribes are negotiated. Although in most cases the truck driver's initial offer is accepted without discussion, the equilibrium amount paid nevertheless reflects the relative bargaining power of the two parties. Factors that increase the bargaining power of the officer manning the checkpoint, such as whether he is brandishing a gun and the number of officers who are visible and could provide backup if trouble arose, increase the equilibrium payment. Given the presence of bargaining, we then show that bribes paid per checkpoint increase as the trip nears its destination, consistent with *ex post* holdup along a chain of monopolies.

Even though corruption is illegal, complex systems can evolve in order to achieve greater levels of price discrimination. We document the existence of price discrimination on the basis of observable characteristics,

<sup>38</sup> One potential reason that it has not emerged at the Seumedam weigh station is that, as discussed above, Seumedam received intense scrutiny as part of a pilot project, so operating these more complex bribe contracts may not be feasible. Moreover, in all trips except those from Medan to Banda Aceh, most trucks travel as part of an organized convoy. As a result, virtually all other trucks have already paid a fixed fee for the journey, which may make offering the type of contracts offered at Gebang more difficult.

such as the age of the truck and the cargo being carried, so that trucks with characteristics that indicate higher willingness to pay are indeed charged higher bribes. Moreover, we show that at one of the four weigh stations on the route, a criminal organization appears to have partnered with weigh station officials to introduce a menu of two-part tariffs. This suggests that the barriers posed by the fact that corruption is illegal are not sufficient to prevent complex pricing schemes involving multiple transactions.

The results here have several implications for anticorruption policy. First, the endogenous price responses documented here imply that decentralized corruption can result in higher bribes charged than if corruption was centralized. If that is the case, tackling corruption at the top of an organization could actually lead to increases in bribes if the number of bribe takers on the ground remains the same but their coordination system is undermined. Second, we show empirically that endogenous price change responses can substantially offset the gains from reducing the number of corrupt bureaucrats. In cases in which corruption was centralized, these gains could be completely offset by endogenous price responses.

Although the economic mechanisms identified in this paper are likely to be general, the degree of centralization or decentralization of bribes will clearly vary according to the context. For example, a pilot survey conducted by the authors in March 2005 on the road between Jakarta, the capital of Indonesia, and Bandung, the capital of nearby West Java province, found that—in contrast to Aceh—the vast majority of extortion payments made by truck drivers on the Bandung–Jakarta route were in the form of routine monthly payments to police officials and affiliated criminal organizations, with relatively little collected at checkpoints. One interpretation of this phenomenon is that the corrupt officials in West Java had managed to centralize collection of bribes precisely in order to overcome the double marginalization problem discussed in this paper. Understanding the circumstances that allow corruption to be coordinated in this way is an important direction for future research.

## References

- American Association of State Highway Officials. 1961. "Road Test Report 5: Pavement Research." Special Report no. 61, Highway Res. Bd., Washington, DC.
- Baumol, W. J., and D. F. Bradford. 1970. "Optimal Departures from Marginal Cost Pricing." *A.E.R.* 60 (3): 265–83.
- Blanchard, O., and M. Kremer. 1997. "Disorganization." *Q.J.E.* 112 (4): 1091–1126.

- Bresnahan, T. F., and P. C. Reiss. 1985. "Dealer and Manufacturer Margins." *Rand J. Econ.* 16 (2): 253–68.
- Cameron, A. C., J. B. Gelbach, and D. L. Miller. 2006. "Robust Inference with Multi-way Clustering." Technical Working Paper no. 327, NBER, Cambridge, MA.
- Clay, K. B., D. S. Sibley, and P. Srinagesh. 1992. "Ex Post vs. Ex Ante Pricing: Optional Calling Plans and Tapered Tariffs." *J. Regulatory Econ.* 4 (2): 115–38.
- Di Tella, R., and E. Schargrodsky. 2003. "The Role of Wages and Auditing during a Crackdown on Corruption in the City of Buenos Aires." *J. Law and Econ.* 46 (1): 269–92.
- Fan, J. 1992. "Design-Adaptive Nonparametric Regression." *J. American Statist. Assoc.* 87 (420): 998–1004.
- Ferraz, C., and F. Finan. 2008. "Exposing Corrupt Politicians: The Effects of Brazil's Publicly Released Audits on Electoral Outcomes." *Q.J.E.* 123 (2): 703–45.
- Fisman, R., and S.-J. Wei. 2004. "Tax Rates and Tax Evasion: Evidence from 'Missing Imports' in China." *J.P.E.* 112 (2): 471–500.
- Foster, D. 2005. "Sumatra Region Roads Project: Technical Assistance on Road Traffic Safety and Vehicle Weights and Dimension, Enforcement Component." Report, World Bank, Washington, DC.
- Grossman, S. J., and O. D. Hart. 1986. "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration." *J.P.E.* 94 (4): 691–719.
- Hart, O. D., and J. Moore. 1990. "Property Rights and the Nature of the Firm." *J.P.E.* 98 (6): 1119–58.
- Hsieh, C.-T., and E. Moretti. 2006. "Did Iraq Cheat the United Nations? Underpricing, Bribes, and the Oil for Food Program." *Q.J.E.* 121 (4): 1211–48.
- Maskin, E., and J. Riley. 1984. "Monopoly with Incomplete Information." *Rand J. Econ.* 15 (2): 171–96.
- McMillan, J., and P. Zoido. 2004. "How to Subvert Democracy: Montesinos in Peru." *J. Econ. Perspectives* 18 (4): 69–92.
- Miravete, E. J. 2005. "The Welfare Performance of Sequential Pricing Mechanisms." *Internat. Econ. Rev.* 46 (4): 1321–60.
- Newey, W. K., and K. D. West. 1987. "A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix." *Econometrica* 55 (3): 703–8.
- Olken, B. A. 2007. "Monitoring Corruption: Evidence from a Field Experiment in Indonesia." *J.P.E.* 115 (2): 200–249.
- Olken, B. A., and P. Barron. 2007. "The Simple Economics of Extortion: Evidence from Trucking in Aceh." Working Paper no. 13145, NBER, Cambridge, MA.
- Reinnika, R., and J. Svensson. 2004. "Local Capture: Evidence from a Central Government Transfer Program in Uganda." *Q.J.E.* 119 (2): 679–705.
- Schmalensee, R. 1981. "Output and Welfare Implications of Monopolistic Third-Degree Price Discrimination." *A.E.R.* 71 (1): 242–47.
- Shleifer, A., and R. W. Vishny. 1993. "Corruption." *Q.J.E.* 108 (3): 599–617.
- Spengler, J. J. 1950. "Vertical Integration and Antitrust Policy." *J.P.E.* 58 (4): 347–52.
- Staiger, D., and J. H. Stock. 1997. "Instrumental Variables Regression with Weak Instruments." *Econometrica* 65 (3): 557–86.
- Svensson, J. 2003. "Who Must Pay Bribes and How Much? Evidence from a Cross Section of Firms." *Q.J.E.* 118 (3): 207–23.
- Yang, D. Forthcoming. "Integrity for Hire: An Analysis of a Widespread Customs Reform." *J. Law and Econ.*