

# Lost in the Mail: A Field Experiment on Corruption

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**Abstract:** The ability to send and receive mail without it getting lost or stolen is an essential public service. If the mail sector works well, it reduces transaction costs and helps markets function more smoothly. If not, patterns of lost mail might help us understand the way the market is structured and the rationale behind corruption. Using an experimental design, we examine the mail sector in Peru and ask two questions. First, to what extent is mail lost? and Second, is there a systematic loss in mail by value of the mail being sent and characteristics of the recipient receiving the mail. We find that 18% of the mail in the study sent to Peru never arrived at its destination. Also, more valuable mail (mail that contained money) was 50% more likely to be lost, so lost mail cannot be attributed solely to poor service. Middle-income neighborhoods are the least likely to receive mail, followed by rich and poor neighborhoods. This suggests that the mailmen must think that middle-class areas either have more of an incentive to send valuables in the mail or that mailmen think they are less likely to be caught. The probability of loss tells us something about the implicit unsatisfied needs of different areas. The middle class must be perceived as needing a service to securely transfer money or lacking the alternatives to do so. Our study shows that crime is systematic and conforms with basic economic intuitions.

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# 1. Introduction

Economic reasoning suggests that neither the participation in illegal activities nor the diseconomies caused by criminal activities are expected to be uniformly distributed across the population (Becker, 1968). Several authors have provided evidence that the social and private benefits and costs associated with committing crime are important to determine its incidence (Erllich, 1973; Levitt, 1997; Glaeser, Scheinkman and Sacerdote, 1996; Jacob and Lefgren, 2003; Di Tella and Schargrodsky, 2003, 2005; Olken, 2007, Fisman and Miguel, 2007, Reinikka and Svensson, 2004; among others). Deterrence, the risk of being caught, and social norms all seem to be important factors in deciding whether to commit a crime or not.

Looking at the provision of public goods in developing countries, recent research shows that corruption is not only widespread but can create important inefficiencies and inequities (Bertrand, Djankov, Hanna, Mullainathan, 2006; Reinikka and Svensson, 2004). This paper shows that crime is also a problem for private firms trying to provide public services. We show that in the presence of moral hazard, private firms face significant level of corruption. Importantly, we show that the cost of crime is not equally shared by all citizens. The middle class suffers from corruption the most.

We use a unique field experiment that allows us to develop a behavioral measure of crime. The design measures which segments of the population are more likely to suffer from crime and whether this conforms with economic rationality broadly understood. Our study concentrates on the delivery of mail, and we do so for several reasons. First, the existence of a reliable mail sector is considered to be instrumental in the growth of electronic trade. Second, mail services are widely used by all segments of the population. Third, as we will describe, mail delivery is amenable to field experimentation with little or no intrusion. Fourth, mail delivery is a highly decentralized activity likely to suffer from moral hazard problems regardless of ownership.

For instance, sources of lost non-certified mail are nearly impossible to detect. Finally, crime in the mail sector is expected to be highly correlated with the expected gains and losses of committing a crime and less with social pathologies. That is, corruption in the mail sector is a crime of opportunity that can allow us to understand the economic motivation behind crime.

We develop a novel and simple empirical strategy to measure the probability that a piece of mail arrives at its destination. We send identical envelopes to different household in Lima, Peru from two American cities and record arrivals. The experiment includes a large population of volunteer households across neighborhoods of different socio-economic backgrounds. To better understand the motivation behind the commission of crime, we manipulated the contents, the sender of mail and the gender of the recipient. In particular, every household was sent four envelopes over the course of a year. Two envelopes had a sender with a foreign name and two had the last name of the sender and recipient matched. Finally, one of each of the two envelopes contained a small amount of money and the other did not. All these modifications were as subtle as possible and the order in which each different envelope was sent was random.

By manipulating the information made available to the person handling the mail, our design allows us to test several hypothesis behind the commission of crime. First, mail can be lost because the cost of delivery is larger than the cost of being caught shirking. Lost mail might be a reflection of apathy rather than crime. Therefore, comparing rates of lost mail containing money with those not containing money permits us to detect if crime is taking place. Second, if those handling mail behave strategically, one would expect that they will make use of information on the social distance between the recipient and the sender and the characteristics of the recipient. Therefore, comparing similar pieces of mail across subgroups can potentially reveal the expectations of those handling the mail.

The experiments show first that the mail service in Peru is highly ineffi-

cient. The overall rate of mail lost is 18%.<sup>1</sup> The loss rate, however, hides the fact that mail containing money is lost 21% of the time while mail containing no money is lost 14% of the time. That is, we find evidence of shirking as well as crime. The quality of service is not independent of socio-economic status. Mail without money is lost 18% of the time when sent to a poor neighborhood but only 10% of the time when sent to a relatively richer neighborhood. Given the geographical distribution of post offices, this cannot be attributed to a lack of manpower.

Economic rationality suggests that crime levels will be higher in those population that have more to gain from using conventional mail service. That is, all things constant, populations standing to benefit from sending mail but lacking safe alternatives will be more likely to risk sending valuables through conventional mail. In equilibrium, these population will be able to tolerate higher levels of mail crime.

The experiments reveal some interesting patterns of behavior. The difference in lost mail with and without money is independent of neighborhood income when the sender is a foreigner. When the sender is a family member instead, the difference in mail loss with and without money is highly dependent on neighborhood income. The relationship is non-linear. The difference in low-income neighborhoods is 1%, while the difference is 15.7% in middle-income neighborhoods and 10.6% in richer neighborhoods. This pattern of behavior is consistent with the belief that middle-income neighborhoods stand to gain the most given their available income and options. It is also consistent with the belief that poorer people are unlikely to remit valuables. Finally, while the patterns of loss depend on the gender of the recipient, the non-linear relationship between neighborhood income and lost mail with valuables persists. The pattern is more pronounced among men.

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<sup>1</sup>Compared to the less than 0.5% of mail reported lost in the U.S. or the U.K., this is very large. Note that loss rates in the U.S. and the U.K. are for *reported* mail lost. This will underestimate the problem if not all mail lost is reported. Our experimental measure is for all mail lost that should have arrived at a destination.

Women seem to receive worse service in poor neighborhoods relative to men, but a better service relative to men in richer neighborhoods.

The results contribute to the literature on the economic reasons behind crime. They show that subtle changes in the information made available can have large and meaningful economic effects. The observed behavior is consistent with strategic thinking. Mail is lost whenever it is more likely to contain valuable contents. But, service is also worse among the poor. The emerging picture is of an agent that commits a crime whenever it is more likely to yield benefits and that adjusts service depending on the recipient. All things constant, mail sent to a woman in a poorer neighborhood is more likely to be lost than that sent to a man.<sup>2</sup>

Our approach has several advantages. First, by randomly assigning treatments to different populations, it provides the necessary counterfactuals to test the presence of strategic behavior. Second, the study avoids potential biases due to experimenter effects by using an existing service that likely suffers from moral hazard problems. Third, by using a widely used service and careful selection of the sample, our study overcomes the criticisms of lack of external validity. Finally, our study provides a behavioral measure of crime that avoids common measurement problems and underreporting.

Our research also speaks to the problems that developing countries face when trying to solve inefficiencies through privatization of public services. Private firms suffer the same asymmetries of information that governments do. Improvements in quality might be difficult to obtain. Moreover, the fact that subtle changes in the characteristics of envelopes generate adjustments in behavior suggests that mechanisms based on random checks (Becker and Stigler, 1974) might be too difficult or costly to implement. For instance, the presence of electronic devices to monitor behavior might be easy to detect, thus triggering good behavior on the part of the worker. Finally, our research

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<sup>2</sup>As mentioned above, difference in mail loss with or without money in poorer neighborhoods is negligible. It is unlikely that the gender differences in mail received are due to expectations on containing valuable contents.

presents new evidence that crime is not shared equally. The middle class is taxed more heavily by corruption.

## 2. Experimental Design

The experiment provides a behavioral measure of crime. We send envelopes from the United States to Peru through the normal mail services in both countries (U.S. Postal Service and Serpost, respectively). We use a list of residential addresses in Peru that are geographically representative of poor, middle, and high income neighborhoods. A resident of each address is the recipient of the envelope and reports to us if the envelope arrives or not.

The 2 x 2 design we employ allows us to address our research questions by varying the contents of the envelope and the sender’s name. The contents of the envelope either contains two \$1 bills folded in half or no money. The sender’s name is either a foreign name (i.e. J. Tucker, M. Scott) or the same family name as the recipient (i.e. M. Sosa, L. Cordova).<sup>3</sup> The design is outlined in Table 1 and includes the number of envelopes sent in each treatment.

**Table 1**  
Experimental Design

Sender Last Name	Contents of Envelope	
	Money	No Money
Foreign	n=136	n=131
Family	n=135	n=139

To get a valid estimate of crime, it is important that the envelope look like something that would normally be sent in the mail. So, we chose an opaque solid-colored envelope and card (of the same color). The envelope looks like one that would be sent for a birthday. Keeping with that idea, on the inside of each card, we handwrite “Happy Birthday” or “Feliz Cumpleanos” –

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<sup>3</sup>In South America, including Peru, everyone has two last names. The first is the last name from the father and the second is the last name of the mother. We use the first last name.

depending on the return addressee's name – and sign Josh or Mike or Marco or Luis. If the card is stolen or opened, we want it to seem like it was actually sent by the person whose name appears on the front of the card.

Because the envelope is opaque, the greeting inside the card cannot be seen. If the card contains money, this also cannot be seen, even if held up to the light. One can, however, feel that there is something in the envelope because the folded two \$1 bills make a very subtle bump. It is impossible to determine what exactly is in the envelope.<sup>4</sup> But, there is a hint that the envelope contains something other than the card. We chose this subtle manipulation so that anyone thinking of stealing the envelope would need to be looking for signs that the envelope contained something that might be worth stealing.

All envelopes have handwritten addresses, stamps for postage and an airmail stamp on the front of the envelope. There are two return addresses in Atlanta and two in Washington, DC. The envelopes are glued shut, making it impossible to steam open, reseal and deliver. Envelopes are mailed from one of two locations. Envelopes with a return address from Atlanta were mailed from the main post office in downtown Atlanta, and envelopes with a return address of Washington DC were mailed from a post office mailbox in Washington DC. The color of the envelope, the return address and the handwriting on the envelope are randomized across the four treatments.<sup>5</sup> Envelopes were sent in November 2006, June-August 2007, and December 2007.

Mailboxes in Peru are secure and not exposed to theft from people passing by on the street. Typically there is a mail slot that places the mail inside the locked residence or in a box inside a locked gate. Mail is not left in post

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<sup>4</sup>We could very well have placed folded pieces of paper in the envelope instead of money, but we want the envelopes and contents to be realistic, especially in the case the envelope got lost.

<sup>5</sup>We did this to insure that each envelope sent to a household by a different person was indeed handwritten by a different person.

boxes on the streets as is the case in the U.S.

To find recipient addresses, we used a snowball method to recruit people willing to receive the cards and report for us. Initially, we recruited people from GRADE, a well-known and respected research institute in Lima, Peru. The institute conducts economic research and hosts people from a variety of demographic and income groups. The people from GRADE suggested names of friends and family who would participate. The important design element for us was that the addresses where mail was sent were geographically diverse. So, even though the mail recipients may know one another, the addresses are dispersed across locations. To minimize the number of addresses in the study for any post office, no more than three households were within a 1-kilometer radius of each other.

Recipients of the mail reported the arrival or non-arrival of each envelope and kept any money if an envelope with money arrived. They were instructed to not ask the mailman about the card or go to the post office to enquire. To compensate recipients for their time and help, at the end of the experiment, we conducted a lottery with cash prizes for recipients who reported. Recipients knew of the lottery before we began sending envelopes. We conducted a follow-up survey in December 2007 to verify mail receipt responses and collect more individual data on mail recipients. All previous responses were confirmed.<sup>6</sup>

### 3. Results

We would like to know the patterns of mail loss geographically and across various demographic characteristics. First, though, we turn to a description of the sample.

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<sup>6</sup>We asked the recipient if they received an envelope during a certain period of time and asked the recipient to report the return address and color of the envelope. Recipients were able to correctly confirm reports from 4-5 months earlier. This gives us confidence that the reported data is accurate.

Table 2 shows descriptive statistics on the individual and geographical characteristics of the mail recipients. The sample is split roughly half and half between male and female recipients. The distribution of residents across low, middle and high-income neighborhoods is not evenly distribution, with more people living in middle-income neighborhoods.<sup>7</sup> Most recipients have a university education, are married or living with their partner and have a family member that lives in the United States. This latter result is important as it makes receipt of a card from the United States not seem strange and also attests to the degree of mail that could potentially come from the United States.

**Table 2**  
Descriptive Statistics of Sample

	Percent	Std Dev	# Obs
Male Recipients	48.4		280
Low Income	35.9		208
Middle Income	39.2		227
High Income	24.9		144
Age (mean)	37.2	10.1	496
University Education	62.4		500
Married or Cohabiting	48.4		496
Family size (mean)	4.1	1.5	496
Family in U.S.	51.6		496

An important component of our experimental design, in addition to a diverse and representative distribution of individual mail recipient characteristics, is that the distribution of recipient addresses is geographically disperse across neighborhoods and post offices and is representative of metropolitan Lima. Figure 1 shows the geographical distribution of residents in our study. The residents cover the majority of the city. There are fewer residents in

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<sup>7</sup>Low-income neighborhoods are ones where the percent of the population living below the poverty line is 30% or higher. Middle-income neighborhoods are those where the percentage is between 10-30%, and high-income neighborhoods are those where the percentage is less than 10%.

some of the peri-urban areas of the city, but the addresses are nicely distributed across neighborhoods. This gives us observations across most areas of Lima and confidence that our results apply to the larger city-wide mail sector.

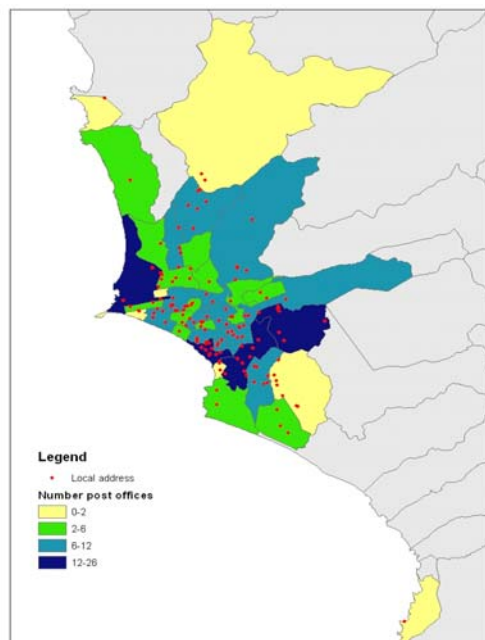


Figure 1: Distribution of Addresses Across Lima, Peru

Turning to loss rates, we see that mail service in Lima is inefficient and subject to crime. Table 3 shows loss rates overall and by income groups. Overall, 18% of all envelopes sent through the mail never arrived at their destination. Envelopes with money were less likely to arrive than envelopes without money, so it does not appear that mail loss is solely due to bad service. This hints more of criminal activity. Over 21% of envelopes with money did not arrive, whereas 14.8% of envelopes without money did not arrive. This 50% increase in loss is statistically significant (one-side p-value=0.023).

**Table 3**  
Loss Rates  
Overall and by Income Groups (in percent)

	Percent	# Obs
Overall	18.1	98
Money	21.4	58
No Money	14.8	40
Low Income	18.9	
Middle Income	20.4	
High Income	13.5	

	Low Income	Middle Income	High Income
Money	19.8	25.7	16.9
No Money	18.0	15.3	10.0
Foreign Sender Name	18.9	18.3	16.4
Family Sender Name	18.9	22.4	10.3
Male Recipient	14.3	20.0	20.4
Female Recipient	21.8	20.8	1.9

How was mail lost across our four treatments? Table 4 shows loss rates by the contents of the envelope and the sender's last name. Again, envelopes with money were more likely to be lost than those without money, whether or not the sender's last name was foreign or a family name. The difference between money and no money envelopes for envelopes with a foreign sender is not significantly different, but the almost 10 percentage point difference for envelopes with a family last name is (one-sided p-value=0.023). Indeed, the most loss happened for envelopes with money sent by a family member. Almost one-quarter of those envelopes never arrived.

**Table 4**  
Loss Rates

Sender Last Name	Contents of Envelope	
	Money	No Money
Foreign	19.8	16.0
Family	23.0	13.7

Across low, middle and high-income neighborhoods, mail is lost at different rates. Table 3 shows that residents in middle-income neighborhoods lose mail at the highest rate, 20.4%, and those in high-income neighborhoods lose mail at the lowest rate, 13.5%. The difference between low and middle-income neighborhoods compared to high-income neighborhoods is significantly different.<sup>8</sup>

One might wonder if these loss rates can be attributed to Serpost, the Peruvian mail service, or to the U.S. Postal Service. The results in Table 3 suggest that lost mail is happening on the Peruvian side. While it may be reasonable to think that envelopes with money might be lost on the U.S. side, it is highly unlikely that the significantly different loss rates we see across low, middle and high-income neighborhoods is due to the U.S. Postal Service. Such loss rates cannot be rationalized by crime of envelopes with money without knowledge of neighborhoods in Lima.

Conditioning on the contents of the envelopes, mail with money is significantly more likely to be lost than without money in middle-income neighborhoods. The loss rate in poor neighborhoods is around 18% but does not change much for envelopes with money. High-income neighborhoods have an almost 7 percentage point increase for envelopes with money, but this is not significantly different. This pattern of loss is consistent with an equilibrium model of crime where the poor are not expected to be sending valuables by mail. The loss rate in poor neighborhoods seems to be more a reflection of poor service. However, loss rates in middle-income neighborhoods are consistent with a population that would have valuable items sent through the mail and do not have alternatives. And, indeed, the loss of valuable mail is significantly higher. High-income neighborhoods do experience loss, but it would seem that search is lower as the rich probably have alternatives for sending valuables.

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<sup>8</sup>One-sided ttests yield p-values of 0.098 comparing low to high-income loss rates and 0.045 comparing middle to high-income loss rates.

The pattern of loss across neighborhoods is primarily driven by envelopes where the sender's last name is the same as the family. Table 3 illustrates this. This result is important because it suggests that those handling the mail attribute similar probability of being caught when disposing of mail sent by non-family members. Since other factors do not seem to be as important when the mail is sent by a foreigner, this comparison gives a measure of the effect of adding money to the envelope (7%).

Across the gender of the recipient, women suffer larger losses in poor neighborhoods and men suffer larger losses in rich neighborhoods. The loss rate for women in poor neighborhoods is 50% higher than that for men, and the loss rate for men in high-income neighborhoods is ten times higher than that for women. It is important to note that there are more women in poor neighborhoods than men and more men in high income neighborhoods than women. Since we do not find other significant treatment effects that could explain the differential treatment of men and women in poor neighborhoods, we conclude that those handling the mail perceive that mishandling female's mail carries less risk.

**Table 5**  
Loss Rates  
by Money and Income Groups (in percent)

	Envelope with Money		
	Low Income	Middle Income	High Income
Foreign Sender Name	21.7	21.1	17.1
Family Sender Name	18.1	30.2	13.9
Male Recipient	17.6	27.1	22.7
Female Recipient	21.4	24.6	3.7

	Envelopes with No Money		
	Low Income	Middle Income	High Income
Foreign Sender Name	14.6	14.9	16.7
Family Sender Name	17.1	14.5	3.3
Male Recipient	12.1	12.8	16.7
Female Recipient	18.4	16.4	0.0

Table 5 allows us to calculate a difference-in-difference estimate of the effect of income on crime. The presence of money in envelopes sent by a family member increases the rate of mail lost by 15.7 percentage points in middle-income neighborhoods but only by 1 percentage point in poor neighborhoods. In other words, people are 14.7 percentage points more likely to keep envelopes sent to middle-income neighborhoods when there is suspicion of valuable content. A comparison of the richer neighborhoods and poorer neighborhoods give a smaller estimate (9.3). This reduction can be explained by either the perceived existence of safe alternatives in richer neighborhoods or a perceived larger risk of being caught. The first reason would imply that those in richer neighborhoods are less likely to send valuables in the mail, all things constant, and the second implies that those delivering mail will perceive a smaller return of committing a crime. Note that income does not seem to play a role for mail sent by foreigners.

## 4. Conclusions

Using a novel behavioral measure of crime, we examine corruption in the mail sector in Lima, Peru. We hypothesize that the very nature of mail delivery gives an opportunity to those who handle the mail to “lose” mail if it is beneficial to do so. Our design allows us to differentiate poor service from targeted crime and to investigate what information is pertinent in crime and who suffers the most from it.

We send identical envelopes from the United States to Peru and vary the value of the envelope and the information on who is sending it. Half of the envelopes sent contained money and half did not. Also, half were sent from a person who shares the same last name as the recipient and half were sent from a foreigner. Roughly half of the mail recipients were women, and mail recipients lived in poor, middle, and high-income neighborhoods. The difference in loss rates for envelopes with and without money inform us on poor service relative to crime, and the difference in loss rates from family members and foreigners inform us on the strategy of crime. Characteristics of the mail recipients tell us who suffers from crime.

We have several key findings. First, loss rates are very high. Over 18% of all mail sent never arrived at its destination. Second, this high loss rate is partially explained by poor service. Envelopes containing money were 50% more likely to be lost than those without money. So, lost mail is not random. Third, when the sender’s last name matched the recipient’s last name, the mail was almost twice as likely to be lost if it contained money. Clearly, those who handle the mail are looking for clues that might suggest that an envelope holds something of value. Fourth, middle-income neighborhoods suffer the highest loss rates and high-income neighborhoods suffer the lowest. This result (and the previous) lends support for the crime occurring in Peru rather than the U.S. since it would require the U.S. Postal Service to know which neighborhoods were rich or poor. Finally, women in low-income neighborhoods lose more mail than men, and men in high-income neighborhoods lose

more mail than women. This result suggests that the poor handling of mail for women in poor neighborhoods carries little risk for the mail carrier.

Put together our results suggest a model of crime where those who handle the mail are looking for items of value to steal. Our experiment tests an equilibrium effect of crime, rather than shocking the system to change patterns of crime. The story that emerges is threefold. There is less crime in poor neighborhoods because there is likely nothing of value to steal. There is more crime in middle-income neighborhoods because there is likely something to steal and there are few alternatives to the conventional mail service. And, there is the lowest crime in high-income neighborhoods since the rich have valuables to steal but they have secure alternatives to send items.

Crime of opportunity certainly exists in the mail sector in Peru, and it interacts with expectations of items of value being sent through the mail and the risk of being caught. All income groups suffer from lost mail, but it is the lower and middle income groups that suffer the most.

We conclude by noting that private firms providing public services face incentives problems due to moral hazard the same way the government does. The nature of the good seems to as important as the nature of ownership. The sophistication in criminal activity found in our study suggest that inexpensive, reliable alternatives and affordable monitoring might be difficult to obtain. This suggests that incentives problems prevent market development as well as improvements in governance.

## 5. References

- Becker, Gary (1968), "Crime and Punishment: An Economic Approach," *The Journal of Political Economy*, 76, 169-217.
- Becker, Gary and George J. Stigler (1976), "Law Enforcement, Malfeasance and the Compensation of Enforcers" *Journal of Legal Studies*, 3, pp. 1-18, 1974.
- Bertrand, Marianne, Simeon Djankov, Rema Hanna, Sendhil Mullainathan (2006), "Obtaining a Driving License in India: An Experimental Approach to Studying Corruption," NBER Working Paper.
- Di Tella, Rafael and Ernesto Schargrodsky (2003) "The Role of Wages and Auditing during a Crackdown on Corruption in the City of Buenos Aires," *Journal of Law and Economics*, 46(1), 269-92.
- Di Tella, Rafael and Ernesto Schargrodsky (2004) "Do Police Reduce Crime? Estimates Using the Allocation of Police Forces after a Terrorist Attack," *American Economic Review*, 94(1), 115-33.
- Erllich, I. "Participation in Illegitimate Activities: A Theoretical and Empirical Investigation," *Journal of Political Economy*, 81, pp. 521-565, 1973.
- Fisman, R. and E. Miguel, "Corruption, Norms, and Legal Enforcement: Evidence from Diplomatic Parking Tickets," *Journal of Political Economy*, 115, pp. 1020-1048, 2007.
- Glaeser, Edward L., Sacerdote, Bruce, and Scheinkman, Jose´ A. (1996) "Crime and Social Interactions." *Quarterly Journal of Economics*, 111, 507-48.
- Jacob, B. and L. Lefgren (2003) "Are Idle Hands the Devil's Workshop? Incapacitation, Concentration, and Juvenile Crime," *American Economic Review*, 93, pp. 1560-1577.
- Levitt, Steven (1997), "Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime," *American Economic Review*, 87(3), 270-290.
- Olken, Benjamin (2007) "Monitoring Corruption: Evidence from a Field

Experiment in Indonesia,” *Journal of Political Economy*, 115(2), 200-249.

Reinikka, Ritva, and Jakob Svensson (2005) “Fighting Corruption to Improve Schooling: Evidence from a Newspaper Campaign in Uganda.” *Journal of the European Economic Association*, 3, 259-267.

Reinikka, Ritva and Jakob Svensson (2004) “Local Capture: Evidence from a Central Government Transfer Program in Uganda,” *Quarterly Journal of Economics*, 119, pp. 679-05, 2004.