The Role of Wages and Auditing during a Crackdown on Corruption in the City of Buenos Aires

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Abstract

We study the prices paid for basic inputs during a crackdown on corruption in the public hospitals of the city of Buenos Aires, Argentina during 1996-97. As in previous, informal accounts of corruption-crackdowns, there is a well defined, negative effect on the measures used to capture corruption. Prices paid by hospitals for basic inputs fall by 18% during the first six months of the crackdown. After this period prices rise, but they are still 10% lower than the pre-crackdown level. Input prices paid are uncorrelated with the wage premium received by the procurement officers of the hospitals when the audit intensity can be expected to be very low (prior to the crackdown) or very high (during the first months of the crackdown). After the initial six months, however, the effect of efficiency wages on prices is negative and well defined. The effects are economically significant: a 10% increase in the procurement officer's wage when the perceived probability of punishment is at the average of our sample is expected to bring about a 1.2% reduction in input prices. These results are consistent with the standard model of bribes of Becker and Stigler (1974). Using micro data helps avoid simultaneity problems.

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I. Introduction

There is a growing awareness that corruption has a negative impact on growth and development.[1] Accordingly, fighting corruption has now become an important priority for the international organizations. The International Monetary Fund, for example, has made financial support to member countries conditional on their efforts to reduce corruption and improve "governance".[2] These initiatives, often called "second generation reforms", include areas where progress is likely to take a long time. This is the case, for example, with programs aimed at giving more independence to members of the judiciary and improving the legal system in general. Those who desire more immediate results are left with very few options. One, popular with politicians and lawyers, is to audit all areas where there are suspicions of corruption. There are many examples of this approach, from the "mani-pulite" prosecutions in Italy in the early nineties to the recent prosecutions of federal judges by President Chavez of Venezuela.[3] One of the characteristics of these anti-corruption crackdowns is that their effects do not seem to last very long.[4] Another approach, emphasized in World Bank (1997), is to improve the salaries of public officials.[5] The hypothesis is that bureaucrats will not engage in risky activities, such as bribe taking, when there is a wage premium to working in the public sector.

Theoretically, the idea that above-market-clearing wages may be convenient in a corruption context goes back, at least, to the work of Becker and Stigler (1974) and is

[1] See Mauro (1995) for the first empirical estimate.

[2] A commitment to fight corruption is now routinely incorporated into the letters of intent that the IMF signs with debtor countries. At the time of writing the latest such letter is with Cambodia, and can be found at http://www.imf.org/external/np/loi/1999/093099.htm. The role of the World Bank in controlling corruption is also discussed in Rose-Ackerman (1997).

[3] Between August and November 1999, the crackdown included firing 195 allegedly corrupt judges in Venezuela. Early steps are described in "Caribbean Jacobinism", *The Economist*, August 14th, 1999.

[4] China is a classic example of a country where attempts to control widespread corruption include recurrent anti-corruption campaigns. These often include "exemplary" punishments (including death) applied to those found guilty of corruption. Lui (1986) provides a detailed account of the main three corruption crackdowns during the period 1949-83. Liu (1983) describes corruption-related news reports during the purges in the Chinese communist party.

standard in a principal agent framework (see Besley and McLaren (1993) for a general model, see also Rose-Ackerman (1978, 1986)). Empirically, however, there seems to be little evidence in favor of this hypothesis. To our knowledge only a few papers test the effect of public sector wages on corruption. All of them use highly aggregated data (e.g. at the country level). Such an approach has two problems. One is of interpretation: the data on wages may refer to a different group of individuals than the data on corruption. The second is that it is hard to isolate causal effects in these papers. Even if a strong negative correlation between wages and bribes would emerge, plausible arguments for reverse causality could be made. Corruption, for example, is a drain on public resources (lower tax collections and higher procurement expenses) so it constrains the ability of the bureaucracy to pay high wages. Some economists have taken the logical next step, which is to examine the impact of exogenous forces on the variables that capture the quality of government (of which *both* corruption and wages are indicators). This is the case of La Porta *et al* (1998) who study the impact of variables such as religion, ethnolinguistic heterogeneity and geography.[6] Furthermore, Besley and McLaren (1993) have shown that in a very dishonest environment it is in fact optimal to pay low wages (called the reservation and capitulation wage regimes).

The empirical work, however, does not provide strong evidence in favor of a negative relationship between corruption and wages. Goel and Rich (1989) find some evidence that corruption (measured as the proportion of all government employees who are convicted of bribery in the US in a given year) is negatively correlated with a variable designed to capture wage premiums in the public sector.[7] Three papers study the effect of bureaucratic wages on survey measures of corruption across countries. The first paper, Rauch and Evans (1997), uses wage data for 35 countries collected by the authors in a survey of country experts coming mainly from the academic community. It finds no evidence that wages deter corruption. Furthermore, wages sometimes enter with the

[5] For example, wage increases are a part of the current effort to reduce corruption and drug smuggling in the Mexican federal police. See "Reforming Mexico's police", *The Economist*, December 11th, 1999.

[6] Although the estimated effects are clearly exogenous, the policy implications are less direct.

[7] The wage premium is defined using the total payroll divided by the number of employees by level of government to capture public official wages and the average income of middle grade accountants to measure alternative wages in the private sector.

wrong sign and the coefficient is always very small when compared with other variables included to capture other aspects of bureaucratic efficiency, such as meritocratic recruitment or career stability. A paper by Treisman (1998) uses a new data set compiled by Schiavo-Campo *et al* (1997) where efficiency wages in the bureaucracy are proxied by the ratio of average central government wages to GDP per capita. Again, it reports an insignificant coefficient on wages in a corruption regression. The third paper, by Van Rijckeghem and Weder (1997), finds evidence consistent with the theory in a cross section of 28 developing countries.[8] The evidence is not favorable to the standard model once fixed effects are included.

Our paper presents a different approach that takes advantage of a crackdown on corruption that occurred in the city of Buenos Aires, Argentina, in 1996-7. Following allegations of widespread corruption under the previous administration, the newly elected city government collected and compared the prices paid by all public hospitals in the city for a number of very basic inputs, such as ethyl alcohol and hydrogen peroxide. These are homogeneous inputs, so differences in their prices could not be attributed to quality differences. We estimate a large and well-defined fall in prices (18%) following the introduction of the monitoring policy. As in previous, informal accounts of corruption-crackdowns, the estimated effects of the policy fall over time. After the initial six months, average prices paid by the procurement officers rise, but are still 10% lower than their pre-crackdown levels. Prices paid by hospitals for basic inputs prior to the start of the monitoring policy and during the initial period are uncorrelated with the wage premium received by the procurement officers. After the initial crackdown period, the effect of efficiency wages is negative and well-defined. The estimated effect is large. A 10% increase in the wage of a procurement officer who has the average perceived probability of punishment in the sample is expected to bring about a 1.2% reduction in input prices.

[8] They present three types of specifications: i) a univariate, ii) a regression that controls for the quality of the bureaucracy, an index of law and order and dummies for Nicaragua and Korea, and iii) a full specification, with a large set of controls and dummies for Singapore and Korea. The wage data is obtained by dividing the wage bill by employment in the public sector. The alternative wage is the manufacturing wage. The authors discuss the role of measurement error (given that there are some differences in the definition of the wage data across countries) and the possibility of simultaneity bias. The paper by Van Rijckeghem and Weder is interesting also for theoretical reasons. They present a model of "fair wages" that has similar implications to the efficiency wage hypothesis only for some ranges of wages.

Thus, and in contrast to previous research, we find evidence consistent with the basic model of bribes of Becker and Stigler (1974).

The distinctive feature of our approach is that it is based on micro data. Most of the empirical research on corruption relies on data aggregated at the country level. These papers use subjective measures of corruption recorded in surveys of businesspersons or polls of experts.[9] In this paper we study the relationship between the incentives faced by procurement officers and the prices they pay for homogeneous inputs. There are advantages and disadvantages to this approach. One problem, for example, is that only one of the reasons for high procurement prices can be traced back to dishonesty. Other potential reasons include lack of motivation for good performance or lack of information. We believe that these are relatively minor factors compared to corruption as causes of price differences in our sample. Anecdotal evidence is overwhelmingly suggestive that corruption in input procurement in the city of Buenos Aires is high.[10] A focused survey conducted amongst 360 doctors and nurses in Buenos Aires hospitals showed that corruption in input purchases in public hospitals was perceived to be moderate to high. Respondents also considered corruption in the health sector to be at the average level for the country.[11] More importantly, perhaps, the monitoring policy was officially designed to attack a problem of corruption. In several public speeches, the Secretary of Health of the City of Buenos Aires presented the policy of monitoring prices as an attempt to control corruption with no reference to informational asymmetries or under-provision of effort.[12]

Our approach, however, has some advantages over previous work. First, the fact that our study is at the micro level implies that the identification strategy used is

[9] Recent empirical papers on corruption using subjective measures of corruption include Mauro (1995, 1998), Hines (1995), Ades and Di Tella (1999), Wei (1997), Tanzi and Davoodi (1997), Treisman (1998), Svensson (1999), La Porta *et al* (1998), Kaufmann and Wei (1999), Alesina and Weder (1999), Gatti (1999), Fisman and Gatti (1999), *inter alia*.

[10] The former head of the PAMI, the publicly provided health insurance for pensioners, was accused of buying services and inputs at inflated prices (see, for example, *Clarin*, March 15, 1999). The present head is under investigation for similar crimes at the time of writing (see, for example, *Clarin*, November 9, 1999). For allegations of overpricing in procurement of medicines, diapers, liquid oxygen and audiphones see *La Nacion*, December 23, 1999.

[11] Survey data suggests that corruption in Argentina is very high by international standards. See, for example, Gallup (1998).

[12] See, for example, page 23 of *Salud Para Todos*, January 1999.

relatively clean. Inputs and wages are paid out from two different budgets, so it cannot be argued that hospitals that pay high prices and spend a lot of money on input purchases have little money left to pay the procurement officer's wage. This helps avoid simultaneity problems. Second, the incidence of omitted variables can be expected to be low. All the hospitals are in the city of Buenos Aires and operate under a similar managerial and organizational environment. This also implies that all bribers and corrupt agents have a similar cultural background, something that seems desirable given the concern in the previous literature over the influence of cultural factors in corruption studies (e.g. Huntington (1968)). The hospitals are in a small geographical area so transportation costs are unlikely to unevenly affect delivery prices and all hospitals face the same group of potential suppliers. Importantly, procurement officers that are caught taking bribes face identical punishment, which basically amounts to dismissal from the job. Although wages follow a government scale, different personal characteristics of procurement officers introduce an important amount of heterogeneity to identify the effect of efficiency wages on procurement efficiency. Third, the interpretation of the results is not obscured by aggregation. Our wage data corresponds to the person who is actually making the purchases. Fourth, we study the effect of wage premiums at different levels of auditing, as suggested in the theoretical literature.

A related empirical literature has advanced significantly our understanding of the ways in which procurement processes can be manipulated and how the public sector can end up paying above-market clearing prices (on bid rigging in highway construction contracts and the supply of milk for public schools, see Porter and Zona (1993, 1997); on fraud in the defense procurement industry, see Karpoff, Lee and Vendrzyk (1999)).[13] The focus in this literature is the behavior of firms who act as suppliers. As a consequence, the motivation of procurement officers is kept in the background in the institutional settings studied. In general the results are equally consistent with "innocent" procurement officers or with officers that take active part in the bid rigging process. Our paper can be thought of as complementary to this literature. We focus on the behavior of the procurement officer and provide little information about the actions of supplier firms. In

other words, our results are equally consistent with firms that coordinate rent extraction for the hospitals with the officers or with firms that acquiesce to bribe demands in order to stay in business.

Section II describes our data and the sequence of events during the period under study. Section III presents our model and empirical strategy. The results are presented in section IV, while section V briefly discusses policy implications and concludes.

II. A Unique Event of Corruption Control

In August 1996, and after a campaign focused on the issue of corruption by the salient administration, a new government was formed in the city of Buenos Aires, Argentina. One of the first initiatives of the new authorities in the Health Secretary was aimed at controlling corruption in input procurement in public hospitals. The focus of this initiative was all public hospitals dependent on the Government of the City of Buenos Aires (GCBA).[14]

Public hospitals depending on the GCBA acquire their inputs in a decentralized way. Each hospital acquires its own inputs. Input purchases are financed by an annual budget assigned to each hospital by the GCBA's Health Secretary. Each hospital has an employee in charge of a small procurement office. This office must acquire all the supplies required for the normal operation of the hospital. Procurement officers have no monetary incentives to obtain savings in input procurement. The only incentive for an officer to save money on these purchases is to make these funds available to the hospital to buy other inputs. The funds cannot be used for purposes other than input procurement, even within the same hospital. To acquire a given input, procurement officers have to

[13] Within the health literature, our paper is related to work studying cost functions for hospitals and other institutions in the health sector (see Carey (1997), Gertler and Waldman (1992), *inter alia*).

[14] The GCBA is the largest single supplier of health services in the city. It receives more than eight million annual visits. GCBA hospitals account for over 36% of the hospital beds available in the city. The city supply of beds is completed by the private sector (45%), the trade unions (7%), the armed forces (5%), university institutions (4%) and federal hospitals (3%). While access to medical attention in this second group of hospitals is restricted by affiliation and/or by ability to pay, access to public hospitals is open and free. In general, GCBA hospitals serve low and middle-income population.

follow one of six alternative procedures, depending on the amounts of money involved and the urgency with which the inputs are needed. Ordered according to the tightness of their transparency requirements, the six procedures used are public bidding, private bidding, *Decreto 69*, direct purchase, special account, and emergency purchase. Requirements are tighter in terms of the number of suppliers that have to be invited to bid; the length, number and type of publications that have to be made announcing the bid and the results; and the number and rank of public officers that monitor the transactions (procurement officer, hospital director, etc.).

Motivated by a number of informal accounts of corrupt practices in the health sector, the newly appointed Health Secretary implemented a monitoring initiative on hospital procurement on September 9, 1996. This consisted of a request to the 33 GCBA public hospitals to report information on price, quantity, brand, supplier, procedure, and month of each purchase for a limited group of inputs. The information was to be collected directly from the invoices of each purchase. The inputs were selected to make price comparisons as powerful as possible. The first group of products included were very homogeneous, with product differentiation small or non-existent. Thus, the criterion used by the government was to select products where price differences could not be explained in terms of quality. For the first product -normal saline- the Health authorities collected information going back to June 1996. For the next products -ethyl alcohol, iodine povidone, and hydrogen peroxide- the information collected went back only to August 1996. Other products were gradually incorporated into the price lists, but are not considered here because there is no price data prior to the implementation of the monitoring policy and their product definitions are less homogeneous. Thus, the four products included in our study are normal saline (500 ml.), ethyl alcohol (96°), 5% iodine povidone, and hydrogen peroxide (100 vol.).

The information was compiled by the Health Secretary and periodically resent back to the hospitals, starting October 7, 1996. This was done by circulating a list showing the price paid for the inputs by each hospital. The list highlighted the hospitals that paid the lowest and the highest price for each product. No prizes or punishments were announced at the time (nor were they applied on the basis of this information throughout the period). The information was compiled until December 1997. No price

information was collected after this date. Not all the institutions acquired the four sample inputs during the period considered. Out of the 33 city hospitals, one hospital did not acquire any of these four inputs during the period of analysis.[15]

The wage information was obtained through personalized interviews where procurement officers in each hospital were asked their nominal wage and their personal characteristics. These included their gender, age, tenure on the job, marital status, head of household status, and education. The interviews were conducted in 1998 and required a special permission from the Health Secretary. The support of the Health Secretary was helpful in having all officers answer the survey and obtaining good quality data on sensitive issues such as earnings.

The monitoring initiative was uniform across hospitals. Yet, procurement officers may have different perceptions of the level of enforcement of laws designed to punish corrupt practices in the public sector. To capture this heterogeneity, we also ask them: *"On a scale from 0 to 100, what is the probability that somebody who commits an act of corruption in a public hospital ends up being fired?"*[16] The responses to this question were varied. Some officers provided further details. In one hospital the procurement officer added: *"Never in 30 years."* In another hospital the response was: *"I do not know of a single case in the city government in 20 years."* There is, however, a group of hospitals where the perception of control is very high. In one hospital, the procurement officer added, *"The office here is very small. If there were somebody committing acts of corruption it would be known immediately. I never heard of such a case."* In another hospital the answer was more specific: *"In our hospital, there was the case of two employees who came here from another hospital under accusations of corruption. There was a judiciary process. When there was a verdict, they where both fired."* The survey also requested data on other features of the office in charge of procurement in each hospital. The procurement officer provided the number of employees that worked in the office and the number of computers that they had available.

[15] This is a psychiatric hospital that belongs to the GCBA.
[16] Gaynor and Gertler (1995) use survey data on individual attitudes towards risk, in their study of moral hazard in medical partnerships.

In four cases, we found that the person in charge of the office at the time of the survey had been appointed after our period of analysis.[17] The original officer had retired, moved out to another job or had been promoted. In none of these cases was the replacement of the purchase officer related to the results of the monitoring policy. Unfortunately, for these four hospitals we cannot relate the input prices to the procurement officer's efficiency wage, as we were unable to collect the information on the wage and personal characteristics of the person who was in charge at the time of the purchases. This reduces our sample to 28 hospitals.

For these four products, 548 transactions were registered. However, two observations were excluded because the quantity acquired was not provided, and two observations were interpreted as misreport and eliminated because the reported prices were in excess of 3.5 times the average weighted product price.[18] Thus, our final sample contains 544 observations and 28 hospitals. In three hospitals, the procurement officers did not provide an answer to the question on the perceived probability of punishment. We first concentrate on the 499 transactions for the 25 hospitals for which we have complete answers, and then include these three hospitals. The data is summarized in Appendix 1.

III. Model and Empirical Strategy

III. a. A Simple Model

Our empirical strategy is based on the following model. Procurement officers earn a wage *w*, and buy a medical input for the hospital. The going price *p* is random and observable only to the agent, with $p \sim N(P, s)$. Procurement officers have two options. [19] If they are honest and do not take bribes, their utility is given by their wage: $u^h = w$. Alternatively,

[17] In no case did the procurement officer change during the period of analysis (June 1996 through December 1997).

[18] We took this number from Borenstein and Rose (1994).

[19] We focus on the agent's incentives for taking bribes. Related models where the principal's behavior is analyzed include Besley and McLaren (1993), Reinganum and Wilde (1985), Mookherjee and Png (1992) and Ades and Di Tella (1999). Theoretical work in the area also includes Becker and Stigler (1974), Rose-Ackerman (1975, 1978) and Shleifer and Vishny (1993). We do not study the behavior of suppliers. It is simple to use the mechanism described in Cadot (1987) to incorporate the decisions of firms to denounce officers who demand bribe

they can over-invoice the hospital for the input in the amount *b*. In other words, publicly observed prices are the sum of going prices and bribes taken, *PRICE* = *p* + *b*. If caught taking bribes, the officers are expelled from their jobs and earn their opportunity wage. The latter depends on their personal characteristics, and is given by w^0. The probability of being audited is denoted $q(a,b)$, where a is the intensity of auditing. We assume procurement officers differ in *w*, w^0, and *r*, a parameter that captures their belief (or fear) that they will be punished if they take bribes and are audited.[20] Adopting the convention that *b* is kept by fired officials, the utility level for dishonest officers is given by

$$u^d(b,a,r,w,w^0) = \big(1-q(a,b)\big)(w+b) + q(a,b)[r(w^0+b)+(1-r)(w+b)].$$

Simplifying yields $u^d(b,a,x) = w+b-q(a,b)x$, where $x = r(w-w^0)$ is called the efficiency wage (as explained in the empirical strategy, section III.b. below) and distributes in $[\underline{x},\bar{x}]$. Given our assumption that bribes are kept by fired officials, we also assume that there is a technological upper limit to taking bribes, $\bar{b}$, with $\bar{b} < \underline{x}$.[21]

Defining $b^*(a,x)$ as the optimal bribe level, Appendix 2 shows that, under plausible assumptions for $q(a,b)$, the following three corruption regimes exist:

Regime 1: No Corruption during Crackdown

If the level of audit is high enough, everybody is honest, average prices are low and wages do not affect prices: $b^*(a,x) = 0$, *PRICE* = *p* and $\frac{\partial b^*(a,x)}{\partial x} = 0$, $\forall x$.

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payments. None of the main results change. Papers studying the industry equilibrium under extortionary bribe demands include Bliss and Di Tella (1997) and Pil Choi and Thum (1999).

[20] This captures the possibility that the audit team finds no evidence of wrongdoing, that the proper administrative authority decides not to take action, and the probability that the evidence does not meet the quality standards required in a court of law. See Andreoni (1991) for a model with such a break-up in the probability of punishment.

[21] If bribes are kept and there is no upper limit to bribes, efficiency wages can never deter corruption. A situation where potential bribes exceed honest lifetime income by such large margins are perhaps more descriptive of other institutional settings (e.g. we do not expect a policy of high wages of border police to be successful against corruption by drug smugglers). Alternatively, we could have assumed that fired officials do not keep bribes and bribe income can exceed lifetime wages. Similar comparative static results obtain in this case.

Regime 2: Rampant Corruption

If the level of audit is low enough, everybody over-invoices the maximum feasible bribe, average prices are high and wages do not affect prices: $b^*(a,x) = \bar{b}$, *PRICE* = $p + \bar{b}$, and $\frac{\partial b^*(a,x)}{\partial x} = 0$, $\forall x$.

Regime 3: Corruption as a Function of Efficiency Wages

If the level of audit is intermediate, officers with low efficiency wages are dishonest, officers with high efficiency wages are honest, average prices are intermediate and prices are (weakly) decreasing in wages: $0 < b^*(a,x) \leq \bar{b}$, and PRICE = p + $b^*(a,x)$, for officers with low *x;* and $b^*(a,x) = 0$, and *PRICE = p,* for officers with high *x.*

III. b. Empirical Strategy

Using the assumption that over invoicing is determined by the three-regime process described above, we estimate an equation of the following form:

$$PRICE_{ih} = l\ W_{ih} + b\ S_h + d\ r_h\ (w_h - w^0_h) + p_{ih}\ ,$$

where the true price p_{ih} acts as our error term assumed to be i.i.d., and $PRICE_{ih}$ is the price of the input bought in purchase *i* by hospital *h*. Prices are normalized to run a joint regression for the four products. Where possible, we consider packages of identical size in order to minimize problems of comparability. Thus, for example, all the purchases of normal saline included in our sample are of bottles of 500ml. W_{ih} is a vector of characteristics of each purchase that may be correlated with price. All regressions include the size of each purchase (to control for quantity discounts) and six procedure dummies (to control for the method of purchase). The term S_h captures hospital characteristics that are expected to affect price. These are proxies for the size of the hospital that may give the hospital bargaining power when negotiating prices in addition of quantity discounts, and the level of technology of the procurement office, which may proxy for efficiency differences.

In a model where agents are identical, the efficiency wage is usually defined as the nominal wage for which agents prefer honesty, $u^h \geq u^d$. In our empirical set-up, nominal wages are exogenous (set by the government scale). Our identification strategy exploits the heterogeneity introduced by the officers' personal characteristics. For the procurement officer of hospital *h,* we define the wage premium as $(w_h - w_h^0)$, and the efficiency wage as $r_h(w_h - w_h^0)$. The wage premium is the difference between the officer's nominal wage, w_h, and the opportunity wage, w_h^0, predicted for an individual with his or her observed characteristics (gender, education, experience, seniority, marital status and head of household status) from an earnings equation for inhabitants of the city of Buenos Aires. The details of the estimation of the wage premiums are presented in Appendix 3. The efficiency wage is the product of the wage premium times the perceived probability of punishment.

III. c. Simultaneity

As we mentioned briefly in the introduction, the institutional features of public hospitals in the city of Buenos Aires imply that the identification strategy used is relatively clean. The resources received by the hospitals from the government of the city to pay wages and inputs are earmarked separately for each particular use. Funds received to pay wages cannot be used to pay inputs or vice versa. Thus, it cannot be argued that hospitals that pay very high prices for their inputs are then left with less money to pay the wage of the procurement officer because the latter comes from the central government's wage bill of public employees and cannot be utilized to acquire inputs. It can be argued, of course, that when corruption in procurement is high resources to pay out wages are low for *all* the hospitals. But the link going from purchase prices to procurement officer's wage at the individual hospital level is broken.

The institutional arrangement is useful in disposing of another argument that could be made: that good hospitals buy well and, at the same time, are better at detecting and recruiting the more able procurement officers. Wages follow a public sector scale that does not vary across hospitals. Since, given tenure, all the variation comes from the individual's personal characteristics, efficiency wages can be reasonably presumed to be

exogenous. If good hospitals hire the better people, in the sense that they have more qualifications for example, then the market "value" of these officers would be high. This means that, constrained to pay the same wages, the better hospitals would be paying *lower* efficiency wages. This would induce a positive relationship between prices and wages.

Lastly, it has been argued that when corruption is rampant the principal may be better off paying very low wages (the "capitulation" and "reservation" wage regimes of Besley and McLaren (1993)). First, wages for procurement officers in public sector hospitals are higher than what a simple earnings equation would predict for individuals with their characteristics. Second, wages follow the same scale across all hospitals so this feature would explain low wages in the sector, not variations across individual hospitals.

IV. Empirical Results

We start by analyzing the effect of the anti-corruption policy on prices. Column A in Table 1 includes a dummy for the period when the monitoring policy was active (*Policy*) and a basic set of controls. These include a proxy for the size of the hospitals (*Beds*), the size of each purchase (*Quantity*) and six procedure dummies for the way the inputs were bought. *Beds* is included to control for bargaining power of the hospitals, *Quantity* to control for quantity discounts while the procedure dummies allow for different circumstances under which the purchases are made.[22] There is weak evidence of quantity discounts. The monitoring policy had an economically and statistically significant effect on prices. Normalized prices dropped 14% after the policy was implemented.[23]

We can study the temporal pattern of prices by looking at the evolution of monthly average prices over time. The drop in prices is greater at the beginning of the crackdown. March 1997 marks the first time that we cannot reject that prices are similar to their pre-September level. This provides a natural division of our sample period.

[22] The sample is restricted to 499 purchases so as to allow comparisons with regressions E onwards. The results do not change if we consider the maximum sample feasible for this particular specification (544). All results discussed but not reported are available upon request.

[23] During all the period of analysis (June 1996 through December 1997), the pharmaceutical wholesale price index for Argentina dropped half a percent. The series shows no seasonality and very low variability.

Accordingly, we define three period dummies: *Period 1* (June 1996-August 1996), before the policy was implemented; *Period 2* (September 1996-February 1997), from the month the monitoring policy was implemented to the first month we cannot reject prices are similar to the pre-September levels; and *Period 3* (March 1997-December 1997), from the price rebound to the end of the period of analysis.[24]

Column B in Table 1 studies the effect of the monitoring policy partitioning the period of analysis in this way. Prices dropped by 18% in *Period 2*, relative to their original levels, but recovered by eight percentage points in *Period 3*. Taken as a whole, prices during *Period 3* were still 10% lower than in the pre-crackdown period. The magnitude of the estimated effects is not out of line with anecdotal evidence on the size of bribes in Argentina.[25] We reject the equality of the *Period 2* and *Period 3* coefficients at significance levels below 5%.[26] This suggests that the immediate effect of the crackdown was stronger than its longer-term effect (*Period 3*). This is consistent with what is found in informal descriptions of anti-corruption crackdowns (e.g. Lui (1986)).

We now explore the role of wages. In column C of Table 1, we include the wage premium, the difference between the nominal wages received by purchase officers and their estimated market wage. The effect of the procurement officer's wage premium on the prices they pay is statistically insignificant.

The previous literature using aggregate data found weak or no effects of bureaucratic wages on corruption. One potential explanation is that these studies include a number of observations drawn from environments where there is no active audit and the probability of being punished for corrupt acts is near zero. Since theory predicts that wages should have no effect on corruption in such circumstances, regressions that do not

[24] The results are robust to defining the start of *Period 2* as October 1996. This may be desirable given that the monitoring policy was implemented on September 9, and we only have data on month of purchase (not date). Our results are also robust to using February or April of 1997 to define the end of *Period 2*.

[25] Recent investigations revealed that the price paid by the pensioners' social security agency for funeral services was inflated by 20%, while the price for dental services was inflated by 27% (see *Clarin*, May 28, 1998), and that for psychiatric services was 25% (see *Clarin*, March 15, 1999). A survey of German exporters carried out in 1994 indicated that German businessmen paid between 10% and 15% of the price of the exported goods in bribes in order to place exports in state owned Argentine companies (Neumann (1994)).

control for audit intensity will tend to find insignificant effects of wages. Agents evaluate not only the wage premium they lose if they are caught in an act of corruption, but they also take into account the probability of suffering this punishment. We first exploit variations over time in the intensity of audit. Given that the auditing conditions faced by these officers seem to have changed during the period of analysis, we treat the wage premium as a step function in column D. The coefficient on the wage premium is not significant for any of the three sub-periods.

There are substantial differences in the way procurement officers perceive the monitoring initiative and its consequences. A number of officers declare to think that punishment (separation from the job) follows with certainty after committing an act of corruption. Another group of officers declare that this is never the case. In column E we exploit this heterogeneity across officers by including the wage premium multiplied by the perceived probability of punishment if caught in an act of corruption (*Efficiency Wage*). The estimated effect is negative, though it is only significant at the 19% level. The effects of the *Period 2* and *Period 3* dummies are negative and significant at the 1% level.

Column F in Table 1 exploits variations over time and across agents in the perceived intensity of the monitoring policy. Prior to the start of the monitoring policy (during *Period 1*), efficiency wages show no effect on prices. The same is true during the first six months of the crackdown. In *Period 3*, however, efficiency wages have a negative and significant effect on procurement prices. Interestingly, the *Period 2* dummy remains negative and significant, but the significance of the *Period 3* dummy falls below standard levels.

One interpretation of these results was given in our model. With no monitoring in place in *Period 1*, prices are high and not sensitive to efficiency wages. In *Period 2*, the implementation of the monitoring policy induces a general increase in detection probabilities. The effect of the policy is to reduce purchase prices for all the hospitals, regardless of the wage paid out to the procurement officer. This explains why *Period 2* is significant and its effect is not dependent on the officer's efficiency wage. Finally, after

[26] The *Period 3* dummy is significant at conventional levels, even though we cannot reject equality of average prices between the pre-crackdown period and some individual months (the

the first few months of being implemented, the effects of the monitoring policy on prices are much weaker. In fact, in this regression we can no longer reject that the *Period 3* dummy is equal to zero at standard significance levels. This does not mean, however, that there is a general increase in prices. Prices increase the most in hospitals where the procurement officers receive low efficiency wages, because they either receive a low wage premium or because they believe that there is a low probability of punishment.

Our results identify the three periods suggested by our model. In *Period 1,* when audit was low or non-existent, prices are high and efficiency wages by themselves are not enough to deter corruption (we called this *Rampant Corruption* regime). When the monitoring policy is implemented in *Period 2,* the immediate effect is to lower all prices paid for hospital inputs, regardless of purchase officers' efficiency wages (a regime we called *No Corruption during Crackdown*). When the monitoring policy is perceived to be weaker in *Period 3,* its general effect vanishes and the interaction of the wage premium and punishment fear is necessary to reduce procurement prices (called *Corruption as a Function of Efficiency Wages* in our model).

Table 2 presents a number of checks on our results. In Column A we show that there is some evidence that the effect of our size controls is non-linear. The result that higher efficiency wages induce lower procurement prices is significant at the 5.5% level once the controls for size squared are included.[27]

The Secretary of Health's interpretation that the high prices were correlated with corrupt practices could be contested by the procurement officers. It could be argued that high prices were driven by other inefficiencies in the procurement process, unrelated to dishonesty. There is little evidence that this is true. Column B shows that the main results are unaltered if we control for the number of employees and the number of computers in the procurement office. The availability of computers has a weak, negative effect on prices suggesting that officers that have more resources buy at lower prices (only significant at the 8% level). The estimated effect of efficiency wages is still negative, significant and 28% larger than the one obtained for regression F in Table 1.

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first of these months is March 1997).

[27] Results are also robust when annual outpatient visits or number of discharges are used as measures of size, and to using the total quantity of each input acquired by each hospital during the whole period as control.

It could also be argued that the procurement officers manipulate the choice of procedure used to purchase inputs in their favor. For example, they could try to use emergency purchases more often with the hope that there would be lower requests for transparency. In this case the procedure selection would be endogenous. Our information suggests that the scope of such actions is limited.[28] In Column C, however, we run our basic regression excluding the procedure dummies. The results are robust to this specification. In Column D, we include monthly dummies instead of the *Period 2* and *Period 3* dummies to control for seasonal factors. In Column E we include product dummies to control for potential differences across products. The main results are also robust to these two specifications.

In three hospitals, the procurement officers declined to answer the punishment probability question during our survey. It could be argued that the non-response of these hospitals might generate a selection bias. For example, if the procurement officers of these hospitals take bribes that inflate the medical input prices and have high efficiency wages, the negative effect of wages on prices that we found could not be robust to the inclusion of these hospitals. However, the missing hospitals seem to pay low prices relative to other hospitals in our sample.[29] To look further into this issue, however, we use an instrumental variable procedure. First, we run the perceived punishment probability on personal characteristics of the purchase officer (gender, seniority, education, and nominal wage) and hospital characteristics (beds, computers, and employees) for the respondent procurement officers. We then utilize the estimated coefficients from this regression and the non-respondent officers' personal and hospital characteristics to extrapolate their responses. Column F in Table 2 shows that the results are robust to the inclusion of the non-respondent officers with this procedure.[30]

[28] For example, emergency purchases occur in response to urgent medical requests.

[29] According to their average input purchase price, these three hospitals rank 8th, 20th, and 22nd among our 27 hospitals. According to their wage premiums, the procurement officers of these three hospitals rank 8th, 17th, and 6th, respectively. They also represent a relatively low fraction of the sample (10.7% of the hospitals and 8.3% of the observations).

[30] See Heckman (1979). The results are robust to considering only the officer's personal characteristics as instruments, or to instrumenting with the officer's response to other related questions in the survey.

V. Policy Implications and Conclusions

One of the most influential policy proposals in the anti-corruption debate today is that of increasing the salaries of public officials. Theoretically, higher-than-market-clearing wages deter corruption in the existence of positive levels of auditing (Becker and Stigler (1974)). The previous empirical literature finds very weak or no effects of wages in aggregate (country-level) corruption regressions. One difficulty with previous work, however, is that it is very hard to control for audit intensity at the country level with the data available. A possible explanation for the weak results obtained is that previous work includes observations where audit intensity and monitoring of the bureaucracy is close to non-existent. For such cases, the theory predicts no correlation between wages and indices of bureaucratic performance, such as corruption. Including such observations in these studies will bias the results towards finding no significant effects of wages on corruption. Simultaneity of corruption and wages is also a potential source of concern in previous work.

In this paper we study the effect of bureaucratic wages on corruption and procurement efficiency. The distinctive feature of our approach is that it is based on micro data. We exploit a unique event of corruption control in the public hospitals of the city of Buenos Aires. After a change of government, the new authorities implemented a policy of monitoring input prices. We analyze the effect of the procurement officers' wages on the prices paid by the hospitals for a basic set of products at different levels of audit. One advantage of this data source is that the wage data corresponds to the person who is actually in charge of making the purchases. In other words, our data is not aggregated, which helps the interpretation of the results. Another important advantage is that the funds available to pay the wages of the procurement officer are not affected by the amount of money spent in input procurement. They come from two different budgets. This reduces the possibility that our measures of bureaucratic wages and corruption are simultaneously determined.

As in previous, informal accounts of corruption-crackdowns there is a well-defined, negative effect of the monitoring policy on the measures used to capture corruption. During the first six months after the crackdown, prices paid by hospitals for a

homogeneous group of inputs fall by almost 18%. This is similar to the estimates corresponding to Argentina based on surveys of businesspersons (see Neumann (1994)). After the initial crackdown period, purchase prices rise but are still 10% lower than their pre-crackdown levels. The hypothesis of zero correlation between efficiency wages and prices prior to the start of the monitoring policy and during the initial period cannot be rejected. However, after the initial six months that follow the crackdown, there is a negative and well-defined effect of wages for the hospitals where there is a positive perceived probability of punishment. The effects are economically significant: a 10% increase in the procurement officer's wage when the probability of audit is at the average of our sample is expected to bring about a 1.2% reduction in input prices. Given the volume of purchases in the GCBA hospitals, our estimates suggest that anti-corruption wage policies would be cost effective even for implausibly large costs of implementing audits of the procurement officers. Thus, and in contrast to previous research, we find evidence consistent with the basic model of bribes of Becker and Stigler (1974).

Our findings suggest that the degree of audit intensity is crucial for the effectiveness of anti-corruption wage policies. Exclusive emphasis on wage raises may be misplaced, as such policies would only work if there were audit policies in place. In other words, we provide empirical evidence that carrots and sticks should be viewed as complementary tools in fighting corruption. Historian Thomas Macaulay provides an example in his account of Lord Clive's experience in 1765 India:

> *"But Clive was too wise a man not to see that the recent abuses were partly ascribed to a cause which could not fail to produce similar abuses as soon as the pressure of his strong hand was withdrawn. The Company had followed a mistaken policy with respect to the remuneration of its servants. The salaries were too low to afford even those indulgences which are necessary to the health and comfort of Europeans in a tropical climate..."*(Macaulay, "Lord Clive", cited in Klitgaard (1988), pp. 80-81).

Table 1: Dependent Variable: price (normalized)

Variables	A	B	C	D	E	F
Quantity	-0.01159	-0.01305*	-0.01307*	-0.01275*	-0.01304*	-0.01205
	(-1.591)	(-1.806)	(-1.812)	(-1.794)	(-1.737)	(-1.599)
Beds	0.00006	0.00005	0.00005	0.00005	0.00006	0.00006
	(0.914)	(0.783)	(0.733)	(0.743)	(0.956)	(1.007)
Policy	-0.13930***					
	(-4.872)					
Period 2		-0.18252***	-0.18260***	-0.17581***	-0.18358***	-0.16766***
		(-6.023)	(-6.029)	(-4.414)	(-5.808)	(-4.367)
Period 3		-0.10334***	-0.10352***	-0.04507	-0.10483***	-0.05678
		(-3.027)	(-3.042)	(-0.847)	(-3.074)	(-1.675)
Wage Premium (WP)			4.82E-06			
			(0.107)			
WP * Period 1				0.00012		
				(1.166)		
WP * Period 2				0.00009		
				(0.961)		
WP * Period 3				-0.00005		
				(-0.839)		
Efficiency Wage (EW)					-0.00010	
					(-1.340)	
EW * Period 1						0.00008
						(0.698)
EW * Period 2						-4.86E-06
						(-0.051)
EW * Period 3						-0.00021**
						(-2.104)
Procedure dummies	YES	YES	YES	YES	YES	YES
Observations	499	499	499	499	499	499
R^2	0.0665	0.0798	0.0798	0.0869	0.0866	0.0954

Notes: Clustered t-statistics are in parentheses. Procedure dummies are not presented. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2: Dependent Variable: price (normalized)

Variables	Squared Size Controls (A)	Purchase Office Resources (B)	Without Procedure Controls (C)	With Monthly Dummies (D)	With Product Dummies (E)	Instrumenting for Non-Respondent Officers (F)
Quantity	-0.03510**	-0.01152	-0.01802**	-0.01182	-0.01416*	-0.01384*
	(-2.657)	(-1.706)	(-2.302)	(-1.531)	(-1.904)	(-1.852)
Beds	0.00040**	0.00002	0.00004	0.00009	0.00005	2.37E-06
	(2.083)	(0.319)	(0.633)	(1.352)	(0.803)	(0.068)
$(Quantity)^2$	0.00118**					
	(2.241)					
$(Beds)^2$	-2.81E-07*					
	(-2.029)					
Computers		-0.03248*				
		(-1.807)				
Employees		0.02176				
		(1.678)				
Period 2	-0.18038***	-0.17224***	-0.15867***		-0.14972***	-0.16260***
	(-3.865)	(-3.940)	(-3.904)		(-4.172)	(-4.331)
Period 3	-0.06509*	-0.05365	-0.02880		-0.06454*	-0.05061
	(-1.843)	(-1.647)	(-0.654)		(-2.013)	(-1.460)
EW * Period 1	0.00008	0.00001	0.00009	0.00007	0.00006	0.00009
	(0.753)	(0.083)	(0.743)	(0.708)	(0.556)	(0.738)
EW * Period 2	0.00001	-0.00007	-0.00005	-0.00008	-0.00006	0.00001
	(0.113)	(-0.778)	(-0.521)	(-0.867)	(-0.731)	(0.141)
EW * Period 3	-0.00020*	-0.00028**	-0.00022**	-0.00023**	-0.00021*	-0.00022**
	(-2.016)	(-2.686)	(-2.268)	(-2.217)	(-2.046)	(-2.129)
Monthly dummies	NO	NO	NO	YES	NO	NO
Procedure dummies	YES	YES	NO	YES	YES	YES
Product dummies	NO	NO	NO	NO	YES	NO
Observations	499	499	499	499	499	544
R^2	0.1107	0.1056	0.0802	0.1525	0.1319	0.0933

Notes: Clustered t-statistics are in parentheses. Constant, and monthly, procedure and product dummies are not presented. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Appendix 1: Data Definitions, Sources and Summary Statistics

Data Definitions and Sources

Variable	Definition	Source
$Price_{ih}$	Unit price of the input bought in purchase *i* by hospital *h* normalized by the weighted (by quantity) average price for that product.	Health Secretary, GCBA
$Quantity_{ih}$	Quantity of input bought in purchase *i* by hospital *h* normalized by the average purchase quantity for that product.	Health Secretary, GCBA
$Beds_h$	Annual average daily availability of beds in hospital *h* for 1997.	*Sintesis Estadistica*, Health Secretary, GCBA (1997)
$Policy_{ih}$	Dummy variable which equals 1 if purchase *i* by hospital *h* was performed after the monitoring policy was launched (September 1996 through December 1997), and equals 0 otherwise.	Health Secretary, GCBA
$Period\ 1_{ih}$	Dummy variable which equals 1 if purchase *i* by hospital *h* was performed from June 1996 through August 1996, and equals 0 otherwise.	Health Secretary, GCBA
$Period\ 2_{ih}$	Dummy variable which equals 1 if purchase *i* by hospital *h* was performed from September 1996 through February 1997, and equals 0 otherwise.	Health Secretary, GCBA
$Period\ 3_{ih}$	Dummy variable which equals 1 if purchase *i* by hospital *h* was performed from March 1997 through December 1997, and equals 0 otherwise.	Health Secretary, GCBA
Wage Premium$_h$	The difference between the actual monthly wage received by the procurement officer of hospital *h* and the monthly wage predicted by an earnings equation estimated on permanent household survey data for a person with the procurement officer's personal characteristics.	Calculated from Survey and Argentine Permanent Household Survey (see Appendix 2)
Perceived Punishment Probability$_h$	The answer given by the procurement officer of hospital *h* to the question *"On a scale from 0 to 100, what is the probability that somebody who commits an act of corruption in a public hospital ends up being fired?"*	Survey
Efficiency Wage$_h$	*Perceived Punishment Probability*$_h$ * *Wage Premium*$_h$.	See *Perceived Punishment Probability* and *Wage Premium.*
$Employees_h$	Number of employees in the procurement office in hospital *h*.	Survey
$Computers_h$	Number of computers available in the procurement office in hospital *h.*	Survey
Procedure Dummies$_{ih}$	Set of dummy variables for purchase procedure (public bidding, private bidding, direct purchase, *Decreto 69*, special account, and emergency purchase) utilized in purchase *i* by hospital *h*.	Health Secretary, GCBA
Monthly Dummies$_{ih}$	Set of monthly dummy variables (June 1996 through December 1997) for purchase *i* by hospital *h.*	Health Secretary, GCBA
Product Dummies$_{ih}$	Set of dummy variables for product (normal saline, ethyl alcohol, iodine povidone, and hydrogen peroxide) acquired in purchase *i* by hospital *h*.	Health Secretary, GCBA

Summary Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Price	544	1.045283	.2695	.394505	4.172777
Quantity	544	1.108088	1.695926	.0085469	25.69593
Beds	28	285.8929	365.2481	0	1598
Policy	544	.8713235	.3351497	0	1
Period 1	544	.1286765	.3351497	0	1
Period 2	544	.2996324	.4585186	0	1
Period 3	544	.5716912	.4952891	0	1
Wage Premium	28	352.9481	319.2265	-214.4923	1105.761
Perc. Punishment Prob.	25	.4448	.4329754	0	1
Efficiency Wage	25	168.5016	239.7574	-214.4923	879.7065
Employees	28	4.821429	2.05577	2	9
Computers	28	2.678571	1.492042	1	6

Appendix 2: Proof of Proposition

We assume that the probability of being audited is denoted $q(a,b) = \min\{1, g(a,b)\}$, with *g(a,b)* continuously differentiable in $[0,1]\times[0,\bar{b}]$ with $\partial g(a,b)/\partial b > 0$, $\partial g(a,b)/\partial a > 0$, $\partial^2 g(a,b)/\partial b^2 > 0$, $\partial^2 g(a,b)/\partial a \partial b > 0$, $g(0,b) = 0$, and $g(1,b) \geq 1$.

In order to prove our proposition, we first show how the optimal level of bribes chosen depends on the auditing level α for any given efficiency wage *x*. Let's fix *x* in $[\underline{x}, \bar{x}]$.

i) We define $\hat{b}(a,x)$ as satisfying the FOC: $1 = g_b(a, \hat{b}(a,x))x$. It is immediate that $\frac{d\hat{b}(a,x)}{da} < 0$. We also define $\tilde{b}(a,x) = \min\{\bar{b}, \hat{b}(a,x)\}$. Thus, $u^d(\tilde{b}(a,x), a, x)$ represents the optimized utility level for a dishonest officer.

ii) Given that $\lim_{a\to 0} q(a,b) = 0$, then $\lim_{a\to 0} \hat{b}(a,x) = \infty > \bar{b}$ and $\lim_{a\to 0} \tilde{b}(a,x) = \bar{b}$. Therefore, $\lim_{a\to 0} u^d(\tilde{b}(a,x), a, x) = w + \bar{b} > u^h$.

iii) Given that $\lim_{a\to 1} q(a,b) = 1$, $\lim_{a\to 1} u^d(\tilde{b}(a,x), a, x) = w + \tilde{b}(a,x) - x < u^h$ because $\bar{b} < \underline{x}$.

iv) When $\tilde{b}(a,x) < \hat{b}(a,x)$, $\frac{du^d(\tilde{b}(a,x), a, x)}{da} = -g_a x < 0$. When $\tilde{b}(a,x) < \bar{b}$, $\frac{du^d(\tilde{b}(a,x), a, x)}{da} = \frac{d\hat{b}(a,x)}{da}[1 - g_b x] - g_a x = -g_a x < 0$ (from FOC). Thus, $u^d(\tilde{b}(a,x), a, x)$ is strictly decreasing in a.

v) From (ii), $u^d(\tilde{b}(a,x), a, x) > u^h$ for $a \to 0$. From (iii), $u^d(\tilde{b}(a,x), a, x) < u^h$ for $a \to 1$. From (iv), $u^d(\tilde{b}(a,x), a, x)$ is strictly decreasing in a, then, by continuity of $u^d(\tilde{b}(a,x), a, x)$ with respect to a, for any *x* there exists a unique $a_1(x)$ such that $u^d(\tilde{b}(a_1(x), x), a_1(x), x) = w$. This identifies the critical auditing level for which the agent is indifferent between stealing and not stealing.

vi) When $\tilde{b}(a,x) < \hat{b}(a,x)$, $\frac{du^d(\tilde{b}(a,x), a, x)}{dx} = -q(a, \tilde{b}(a,x)) < 0$. When $\tilde{b}(a,x) < \bar{b}$, $\frac{du^d(\tilde{b}(a,x), a, x)}{dx} = \frac{d\hat{b}(a,x)}{dx}[1 - g_b x] - q(a, \tilde{b}(a,x)) = -q(a, \tilde{b}(a,x)) < 0$ (from FOC).

Thus, $u^d(\tilde{b}(a,x),a,x)$ is strictly decreasing in x and, therefore, $a_1(x)$ is strictly decreasing in x.

vii) For any given x, there may exist $a_2(x)$ such that $\bar{b} = \hat{b}(a_2(x),x)$. If it exists, $a_2(x)$ is decreasing in x because it is immediate that $\frac{d\hat{b}(a,x)}{dx} < 0$.

viii) Let's define $a_0(x)$ such that $a_0(x) = a_1(x)$ if $\pm a_2(x)$ or if $a_1(x) \le a_2(x)$, and $a_0(x) = a_2(x)$ otherwise. By construction, $a_0(x) \le a_1(x)$. As $a_1(x)$ and $a_2(x)$ are strictly decreasing in x, $a_0(x)$ is strictly decreasing in x.

ix) Procurement officers are dishonest if $u^d(\tilde{b}(a,x),a,x) > u^h$. Thus, for every x, $b^*(a,x) = 0$ for $a \ge a_1(x)$, and $b^*(a,x) > 0$ for $a < a_1(x)$. Moreover, if $a_0(x) < a_1(x)$, $b^*(a,x) = \bar{b}$ for $a < a_0(x)$, and $b^*(a,x) = \hat{b}(a,x)$ for $a_0(x) \le a < a_1(x)$. If $a_0(x) = a_1(x)$, $b^*(a,x) = \bar{b}$ for $a < a_0(x)$.

We can now show our proposition:

<u>Regime 1</u>

Defining $\bar{a} = a_1(\underline{x})$, $\bar{a} \ge a_1(x), \forall x$. Thus, for $a \ge \bar{a}$, nobody steals and $b^*(a,x) = 0, \forall x$.

<u>Regime 2</u>

Defining $\underline{a} = a_0(\bar{x})$, $\underline{a} \le a_0(x), \forall x$. Thus, for $a \le \underline{a}$, everybody steals and $b^*(a,x) = \bar{b}, \forall x$.

<u>Regime 3</u>

Let's define the inverse functions $x_0(a)$ such that $a_0(x_0(a)) = a$, and $x_1(a)$ such that $a_1(x_1(a)) = a$. Given that $a_0(x) \le a_1(x)$, $\forall x$, and $a_0(x)$ and $a_1(x)$ are decreasing in x, then $x_0(a) \le x_1(a)$, $\forall a$. If the level of audit a is such that $\underline{a} < a < \bar{a}$, then $\bar{x} > x_1(a) \ge x_0(a) > \underline{x}$. For this intermediate audit level, $b^*(a,x) = 0$ for $x \ge x_1(a)$; $b^*(a,x) = \bar{b}$ for $x < x_0(a)$; and, if $x_1(a) > x_0(a)$, $b^*(a,x) = \hat{b}(a,x)$ with $\frac{db^*(a,x)}{dx} < 0$ for $x_1(a) > x \ge x_0(a)$. Thus, agents with high x are honest and agents with low x are

dishonest. For intermediate audit levels, $b^*(a, x)$ decreases (weakly) monotonously in x from $b^*(a, x) = \overline{b}$ at $x = \underline{x}$ to $b^*(a, x) = 0$ at $\overline{x} = x$.

Appendix 3: Wage Premium

The wage premium for each procurement officer is constructed in three steps. We first run standard earnings equations for 1,838 employed men and 1,163 employed women (excluding self-employed) with only one job in Buenos Aires metropolitan area using data from the October 1998 wave of the Argentine Permanent Household Survey (Encuesta Permanente de Hogares, EPH). We then use the coefficients from these equations to predict the wage officers can expect to earn in the city's labor market, given their personal characteristics. We then subtract the predicted wage from their actual wage. On wage determination in Buenos Aires see Galiani (1999).

Step 1: Earnings Equations, City of Buenos Aires, 1998.

Variables	Men	Women
Primary School –Complete	118.6196**	37.989*
	(0.030)	(0.554)
High School – Incomplete	224.6391***	116.8461
	(30937)	(1.619)
High School – Complete	395.2444***	281.5437***
	(6.650)	(3.956)
Vocational School – Incomplete	571.0349***	232.1867**
	(3.673)	(2.160)
Vocational School – Complete	804.9289***	280.6352***
	(6.956)	(3.251)
University – Incomplete	641.8641***	449.3563***
	(9.807)	(5.712)
University – Complete	1498.703***	965.6974***
	(19.764)	(11.697)
Experience	22.15307***	15.9973***
	(5.161)	(3.742)
$(\text{Experience})^2$	-0.40201***	-0.3439***
	(-5.250)	(-4.128)
Seniority	9.23965***	14.51699***
	(4.941)	(6.358)
Live with Partner	-0.98655	50.26572
	(-0.019)	(0.930)
Married	30.35593	52.86548
	(0.607)	(1.243)
Divorced	-59.05412	-1.974706
	(-0.771)	(-0.034)
Widowed	289.5324**	-51.59204
	(2.118)	(-0.643)
Head of Household	149.7212***	131.6668***
	(3.382)	(2.806)
Constant	-5.889968	16.01924
	(-0.094)	(0.213)
Observations	1,838	1,163
R^2	0.3284	0.2842

Notes: Dependent variable: monthly income. Robust t-statistics are in parentheses. * Significant at the 10% level ** Significant at the 5% level *** Significant at the 1% level

where:

Primary School - Complete, High School - Incomplete, High School - Complete, Vocational School - Incomplete, Vocational School - Complete, University - Incomplete, University - Complete = dummy variables which equal 1 when this is the maximum educational level attained by the respondent, and equal 0 otherwise. The base category is Primary School - Incomplete.

Head of Household = dummy variable which equals 1 when the respondent is the household head, and equals 0 otherwise.

Experience = age minus 16 if the maximum attained educational level *is Primary School - Incomplete, Primary School - Complete* or *High School - Incomplete*; = age minus 18 if the maximum attained educational level is *High School - Complete*; = age minus 20 if the maximum attained educational level is *Vocational School – Incomplete* or *University - Incomplete*; = age minus 22 if the maximum attained educational level is *Vocational School- Complete*; age minus 23 if the maximum attained educational level is *University - Complete*.

Seniority = years of employment with the current employer.

Live with Partner, Married, Divorced, Widowed = dummy variables which equal 1 when this is the marital status of the respondent, and equal 0 otherwise. The base category is Single.

Step 2: In order to obtain data on the procurement officers, we obtained permission from the Health Secretary to run a focused survey on procurement officers. This was preceded by a letter from the Health Secretary requesting officers to participate in the survey. In the interviews, we asked the procurement officer's age, gender, education level, seniority, head of household status and marital status. With this information we calculated the wage that they would earn given their personal characteristics, C_h (experience, seniority, education, head of household status and marital status), and the estimated coefficients from the earnings equation presented above, which we denote $\hat{\beta}$. The opportunity wage these agents could earn working elsewhere in the city of Buenos Aires had they lost their appointments in the public hospitals is

$$w_h^0 = \hat{\beta} C_h,$$

where: w_h^0 = estimated purchase officer *h*'s market wage.

Step 3: The survey also asked the procurement officers' nominal wage. The wage premium was then obtained as the difference between the nominal wage and the outside opportunity wage:

$$wp_h = w_h - w_h^0,$$

where: wp_h = procurement officer *h*'s wage premium,

w_h = procurement officer *h*'s nominal wage.

For the 28 hospitals under consideration, the procurement officers' receive, on average, a monthly nominal wage of $1,285. Our estimates show that the average wage premium is $353 (approximately 27% of the actual wage).[31] The standard deviation of the wage premium is $319.

[31] This procedure implicitly assumes that the purchase officers would find immediately a new job if they are fired from their jobs. Given the high unemployment rate in Buenos Aires during this period, these agents would probably spend some time in the unemployment pool before getting a new job. Thus, our procedure overestimates the market wages.

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