Public Procurement and Rent-Senking: the Case of Paraguay

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Abstract

A model of entrepreneurial choices in an economy with a corrupt public procurement sector is built, providing predictions along two main dimensions. First, corruption is more frequent in sectors where public institutions are large buyers. Second, firms favoured with corrupt contracts enjoy extra returns, so that procurement related activities attract the best entrepreneurs. A large scale microeconomic database, including all public procurement operations over a 4 year period in Paraguay, amounting annually to approximately 6% of the country's GDP, is then used to corroborate these predictions

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JEL codes: H57, D73, D72, O5

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1 Introduction

Public procurement of goods and services is one of the main areas at risk of corruption in developing countries where regulations and legal enforcement are weak. On top of the static cost of corruption and fund embezzlement, systematic departures from competition in the attribution of public markets are likely to have a devastating impact on economic agents' incentives and as a result on these countries' productive structure. This paper presents the first large scale micro-level evidence on the channels of rent-seeking and its impact on economic development, using a unique database of nearly 50,000 public procurement operations in Paraguay, covering the period 2004 to 2007. In a nutshell, we show that in Paraguay corrupt behavior in the allocation of public contracts is a key channel for rent-seeking. This large-scale network of favoritism, sometimes coined "la patria contratista",[1] has deeply damaging economic consequences: public institutions buy goods and services at inflated prices, and the set of incentives facing potential entrepreneurs is biased towards unproductive activities.

To guide the analysis, we model the choice of potential entrepreneurs with idiosyncratic cost levels, between remaining in the informal sector or paying a fixed entry fee to become formal. Moreover, in the formal sector they face the additional alternative of joining a productive segment, where they serve private consumers competitively, or a rent-seeking one, where they sell to public institutions. In this rent sector, contracts are attributed by corrupt officials, who distort allocation rules in exchange for bribes. Firms willing to do business with the Government must therefore be profitable enough to cover their production costs as well as the formality fee and the bribes. We derive from the model two main sets of predictions that are sustained by the data, revealing the following story.

First, we establish that in Paraguay the main channel for corruption

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[1]The "contracting homeland", see for example Alfredo Boccia Paz, Diario Ultima Hora, Asuncion, March 4th, 2009.

in procurement is the systematic use of an "exceptional" purchase mechanism, which bypasses legally required minimum standards of transparency and competition. Exceptional purchases are made more frequently by institutions, which are big buyers of specific goods. Thus, when the public sector concentrates a large share of a domestic market, which happens mostly in import-oriented and service activities, corruption rises. Moreover, the data reveal that this effect is reinforced by repeated interactions of these institutions with favoured firms: exceptional purchase is used more often by institutions-firms pairs that trade in large volumes.

Second, this implies that firms making more business with the State, those in the so-called rent sectors, enjoy above normal rates of return and are the most efficient ones. We provide evidence of these two aspects, by showing that firms selling more to the public sector, as well as those selling more through the exception channel, have higher profit margins, despite the fact that they trade mostly in standard goods and should face competition for the market.

As a result, average relative profitability should be biased towards sectors with an important procurement component, distorting firms' incentives and inducing additional entry in these activities. To the extent that this self-selection process pushes some of the best potential entrepreneurs towards rent sectors, distracting them from innovative or export-oriented ventures, it generates a serious misallocation of talents issue across the economy. Indeed, we document this strong selection bias by exploiting an original econometric strategy using firms' names.

The rest of the paper is structured as follows. Section 2 reviews the main strands of related literature and spells out the contributions of the paper. Section 3 describes the Paraguayan institutional environment. Section 4 develops the model and derives empirical predictions. Section 5 presents the data. Sections 6 and 7 present the results related to the two main sets of theoretical predictions, and Section 8 concludes.

2 Literature Review

The idea that rent-seeking behavior has important social and economic costs is a relatively long-standing one in the economic and political science literature. Early contributions such as Tullock (1967; 1971), Buchanan (1980), Krueger (1974) and Baghwati (1982), were concerned, mostly in a theoretical framework, with the different types of costs associated with the transfer of rents and the waste generated by agents engaging time and resources in competing for rents, for example through political lobbying or corruption.

More recently, some papers have provided explanations for ways in which rent-seeking entails dynamic costs. Baumol (1990) and Murphy, Shleifer and Vishny (1991) focus for example on the resulting dysfunctional allocation of talents. In this approach, potential investments in physical or human capital are directed to rent-abundant sectors (such as those stemming from political favors, corruption or exploitation of natural resources), while investments in innovative activities, which have greater growth potential, become relatively less attractive and are discouraged. As supporting empirical evidence, Murphy et al. (1991) present cross-country growth regressions augmented with country level proportions of engineering and law students, where the former are said to correspond to investments in productive activities while the latter are considered rent-seekers. Baumol's evidence, on the other hand, is based on historical accounts from Rome, Ancient China and the Middle Ages.

To date, there is still very little micro-evidence on the actual channels and consequences of rent-seeking in developing economies. Some papers have stressed the difference in performance between "captor" and "non-captor" firms in transition countries (depending on their ability to influence regulations or attract specific concessions), using either subjective answers on influence in firm surveys (Hellman, Jones and Kaufmann, 2003; Fries, Lysenko, and Polanec, 2003), or regional measures of preferential treatment received by a sub-sample of large firms (Slinko, Yakovlev and Zhuravskaya, 2004). Other contributions have documented the importance of political con-

nections in securing access to key economic inputs. For example, Li, Meng, Wang and Zhou (2008) show that Chinese Communist Party members are more likely to obtain credit for their firms; Khwaja and Mian (2005) show how lending by public banks in Pakistan is systematically distorted towards firms with politicians on their boards; Hsieh, Miguel, Ortega and Rodriguez (2008) show that firms, whose directors have signed the recall petition against Chávez in Venezuela (the "Maisanta"), have experienced significantly lower performance thereafter, in particular because of a rising tax burden and more difficult access to foreign exchange; Agrawal and Knoeber (2001) study how directors' political connections help secure better regulatory conditions in the US; Fisman (2001) computes the stock market value of Indonesian firms derived from political connections to the Suharto network, using exogenous shocks to the dictator's health. At a more general level, the large literature on corruption that developed since the 1990s is also relevant here, and especially the strand of more recent papers using microeconomic evidence to directly measure corruption and its effects on outcomes.[2]

A few contributions have dealt specifically with public procurement. Hyytinen, Lundberg and Toinaven (2007), who study the effects of politics on municipal cleaning contracts in Sweden, show that the lowest bidder does not win 58% of the time and that the choice of the winner is subject to political considerations; Goldman, Rocholl and So (2009) show that US companies connected, through the composition of their boards, to the winning party in both legislative and presidential elections (in 1994 and 2000) are significantly more likely to have experienced an increase in procurement contracts. References dealing explicitly with corruption include Di Tella and Schargrodsky (2003), who document the impact of a crackdown on corruption in Argentinean hospitals, and Bandiera, Prat and Valletti (2009), who disentangle

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[2]Authoritative surveys on corruption include Bardhan (1997), Rose-Ackerman (1999), Svensson (2005) and Pande (2008) among others. Micro-econometric papers include Reinikka and Svensson (2004), Olken (2007), Bertrand, Djankov, Hanna and Mullainathan (2007) and Ferraz and Finan (2007) to mention only a few.

the effect of passive (inefficiency) versus active waste (corruption) in Italy, finding that the former accounts for about four times the effect of the latter.

With respect to this literature, our paper provides several original contributions. First, we have data not only on the expenses realized by public institutions, but also on the firms that are on the selling side. This enables us to capture the effect of large scale corrupt practices on the profitability of firms and hence on the industrial structure of the economy.[3] We provide evidence of the distortive effects of rent-seeking in terms of economic efficiency, by showing that it implies an inefficient specialization of the more able entrepreneurs in imports and procurement activities. Second, we document one of the most prevalent channels of corruption in procurement activity, namely the use of purchase mechanisms circumventing standard rules, and uncover the economic characteristics of the institutions and sectors more prone to it.

3   Country Overview: Rent-Seeking and Corruption in Procurement

Paraguay is a small landlocked country of 6.2 million inhabitants (2008) located in the heart of South America. With a per capita GDP of US$ 1,670 in 2008, it is a low-middle income country. Its main sources of growth are agrarian activities and local services.[4] The country also enjoys a unique source of rent in the form of revenues from big hydroelectric dams shared with its neighbors Argentina and Brazil. The biggest one is Itaipú, on the river Paraná between Paraguay and Brazil. Until the Chinese Three Gorges dam was built, Itaipú was the largest hydroelectric power plant in the world.

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[3]Related papers are Rama (1993), who tracks the number of foreign-trade rent-seeking regulations over the XXth century in Uruguay and relates these to political and economic variables, and Fisman and Sarria-Allende (2004), who present cross-country, industry level evidence of the effect of regulatory distortions on the industrial structure.

[4]Indeed, a few non-processed commodities constitute its very narrow export base: 50% of all exports are in 3 traditional products (soy, cotton and meat); adding other barely processed commodities makes up close to 90% of total exports.

It has 20 turbines, 1 of which provides 90% of all the energy used in Paraguay. The rest is channeled to Brazil.[5] In exchange, Paraguay receives every year an enormous amount of royalties, amounting to US$ 366 millions in 2005 (resp. US$ 553 millions in 2006), equivalent to 4.9% (resp. 5.8%) of GDP. This is approximately 50% of the total government tax collection (from VAT, custom duties, and rent, by order of magnitude).

Politically, after enduring the dictatorship of Alfredo Stroessner between 1954 and 1989, Paraguay returned to democracy through a military coup in 1989. Yet, the Asociación Nacional Republicana, traditionally known as *Colorado Party*, managed to retain power for 61 years, including the 19 years elapsed since the 1989 coup and covering the whole period of our study.[6] Given this political context, the dams' propitious source of income shaped the growth of the Paraguayan "rent-seeking economy". First, the dams' construction fostered a culture of intense rent-seeking and corruption and allowed a few entrepreneurs that were on good terms with the dictator to become immensely rich. Second, the free flow of resources to the government's budget meant that bureaucrats were in a position to favor friends through public expenses. During the whole period, the party effectively "privatized" public resources, using public employment and procurement to favor party members.[7] As a result, Paraguay is considered to be one of the most corrupt countries in the world.[8]

An important channel for corruption, which we focus on here, is the allo-

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[5]Additionally, there is another huge dam, the Yacyreta one, lower down on the same river, on the border between Paraguay and Argentina. It is about one fourth the size of Itaipú.

[6]See Pérez-Liñán et al. (2006) for a description of the political environment of Paraguay. In April 2008, the Colorado party was finally defeated in the presidential election by an opposition coalition led by former Catholic bishop Fernando Lugo.

[7]See for example Nickson and Lambert (2002).

[8]It has lingered in the bottom 4% of surveyed countries included in Transparency International's Corruption Perception Index since its inclusion in 2002. It had for instance a score of 2.1 in 2005, placing it 144th out of 158, and the same score in 2009 (154th out of 180).

cation of public contracts to firms that in most cases are created with the sole purpose of supplying the state, often by selling a wide variety of imported goods. There is ample anecdotal evidence of corruption in public procurement. As a result, and under pressure from international organizations, a law regulating public procurement practices (law 2051/03) was enacted in 2003 by the government of the newly elected president Nicanor Duarte Frutos, with the announced intention of promoting transparency and efficiency in public purchases. The most significant of its provisions were the creation of a public procurement watchdog (the National Directorate of Public Procurement, or DNCP), the design of a menu of purchase mechanisms to regulate procurement procedures, and the compulsion to make all information (calls, providers, award etc.) public. This last proviso was accompanied by the creation of the DNCP web site where this information is available, but in practice access is often intermittent and the interface is impractical.

There are strong indications however that improvements in the regulatory framework did not translate quickly into cleaner procurement practices, partly because many officials did not comply with the new law and the wrongdoings continued.[9] As shown in Figure 1 below, in the period under study over 70% of all procurement contracts are awarded without competition. The main mechanism through which firms are favored is the use of the exceptional purchase mechanism, by which specific regulations, such as the obligation to organize public tenders above certain amounts, are disregarded (see details in Section 5 below).

In 2006, Transparencia Paraguay (TP), the local chapter of Transparency International, published an extensive report focusing on the excessive use

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[9]The World Bank's review of Paraguay's public expenditure in 2006 states that: "Operational efficiency is reduced by the existence of informal arrangements alongside formal rules. While spending control is highly centralized, with detailed rules concerning (...) procurement and other items of expenditure, these formal controls are often violated in practice [and] informal arrangements dictate how (...) procurement is contracted. When formal rules are unworkable and government operates through extralegal means, corruption rises although it often goes undetected or unreported."

of exceptional procedures, which was clearly identified as one of the main irregularities in the procurement process. Indeed, in 2004 and 2005 purchases made through the "exceptional" procedure amounted to nearly 23% of the total procurement spending. For example during that period public firms awarded close to 90% of their advertisement contracts through exceptions. As for specific institution, the Office of the First Lady spent respectively 40% and 93% of its budget in these two years using the exceptional mechanism.[10]

Because the report was given ample coverage in the local media and through public presentations, some of the officials in charge of procurement in public institutions may have become more cautious. Indeed, purchases made through the "exceptional" procedure decreased over the period that we study. Still, they did not disappear, representing 17.3% of the total procurement spending between 2004 and 2007.

In 2006 the Superior Tribunal of Electoral Justice channeled 23% of its total spending through exceptions, while for the public enterprise "Cañas Paraguayas"[11] the corresponding figure was 59%. In 2007, an electoral year, the Presidency spent 16% of its budget through exceptional contracts. In all these cases, it is difficult to argue that the use of the exception responded either to situations of emergency or to non-competitive markets. The Electricity State-owned enterprise ANDE has also been pointed out for buying large numbers of electric transformers in this way, despite the fact that these are routinely required by the firm for network repairs. Firm officials recognize that this practice usually generates excess pricing of between 17 and 27%.[12] During the yellow fever outbreak of 2008, a state of national emergency was declared and, as a result, the Health Ministry proceeded to buy

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[10]Some cases have made headlines, such as the use of this procedure to pay close to US$ 100,000 to a consulting firm formerly owned by the President, for the organization of the XIIIth conference gathering Americas' First Ladies in 2005 in Asunción (Diario Ultima Hora, Asunción, June 7th, 2007).

[11]The State-owned alcohol-producing firm.

[12]Diario ABC Color, Asunción, January 3rd, 2010. This figures are consistent with the estimation by Auriol (2006) and with the results in Section 7 below.

large quantity of fuel through exceptional purchases. The main provider, benefited with half of the total purchase, did not even have a distribution network in the interior of the country where the immunization campaign was taking place, and close to three quarters of this fuel was actually delivered after the emergency period.[13] In a recent scandal, the education ministry invoked exception grounds to spend US\$3 millions on a building in the center of Asunción, although such move had been planned for a about a year. Another year later, it was announced that the building was falling apart and that US\$700,000 would be needed to fix it.[14]

The next Section builds a model from which we derive testable predictions.

4   The Model

The model focuses on constant returns to scale industries (i.e., linear cost function).[15] Entrepreneurs have the choice between the informal and the formal sectors. In the informal sector, denoted by the superscript I, there is no entry fee or taxation. Traditional production techniques prevail so that the cost of production is $C^I(q) = \overline{c}q$, where $q \geq 0$ is the quantity produced by the firm. The sector being competitive, in equilibrium the price is $p^I = \overline{c} > 0$.

By contrast, in the formal sector, denoted by the superscript f, firms need to pay an entry fee $F \geq 0$.[16] The total cost function of a producer

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[13]Diario Ultima Hora, Asunción, July 25th, 2008.

[14]Diario ABC Color, Asunción, January 6th, 2010, and Diario Ultima Hora, Asunción, December 22nd, 2010.

[15]This assumption is consistent with existing evidence on manufacturing and service firms in developing countries, whether they belong to the formal or the informal sector (see Tybout, 2000). It is also consistent with the nature of activities included in our procurement database.

[16]In the model taxation goes entirely through the entry fees. Yet we could add a linear tax t on operational profit without changing the equilibrium (see Auriol and Warlters, 2005). In practice entry fees are higher, in percentage of per capita GDP, in poor countries than in rich ones (Djankov et al., 2002).

operating in the formal sector is $C^f(q) = F + c^f q$, where by assumption

A1 c^f is independently and uniformly distributed in $[0, \overline{c}]$.

Formality gives access to a large set of technologies and management techniques so that entrepreneurs "abilities" (i.e., education, physical capital, experience, attitude towards innovation, access to credit markets and so on) matter. Production costs are hence lower and have *a priori* a wider dispersion in the formal sector than in the informal one.

As a benchmark, we first briefly discuss the corruption-free equilibrium. In the absence of rent-seeking opportunities, entrepreneurs specialize in productive activities. They serve market demand competitively and make no rents in equilibrium. The demand is composed of the private demand $D(p) = A - p$, where $A > \overline{c}$ is a scale parameter that indicates the depth of the market,[17] and the public demand $D^{Pub}(p) = \frac{Q\overline{c}}{p}$, where $Q\overline{c} > 0$ is the fixed public budget allocated to procurement. For the private demand consumers purchase from the cheapest provider. Proposition 1 summarizes the industrial organization of this economy (see derivation in the Appendix).

Proposition 1 *In a corruption-free economy, formality prevails in a given industry if and only if*

$$A + Q \geq \overline{c} + \frac{F}{\overline{c}}. \tag{1}$$

Proposition 1 implies that if F is small the traditional technique of production disappears. On the other hand, in countries where barriers to entry are high there is a segmentation between formal and informal sectors based on types of business or industry. The sector is organized formally if demand is strong (i.e., A and Q large), and if the difference in productivity between traditional and modern methods of production, $c^I - c^{f*} = \overline{c}$, is large enough.[18]

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[17] Assumption $A > \overline{c}$ rules out corner solutions in the sequel of the paper. Note that results are robust to other demand specifications (e.g., Cobb-Douglas).

[18] We expect $c^I - c^{f*}$ to be small for services such as car washing or fruit selling. As a result, these activities are informal in developing countries. On the contrary, sophisticated

If (1) does not hold, public procurement cannot occur because by regulation public officials are required to purchase from the formal sector. To rule out this possibility in the sequel of the paper we make the following assumption:

A2 $$F < \overline{c}Q.$$

Since $A > \overline{c}$, under assumption A2 condition (1) always holds so that in the absence of corruption formality prevails. Any distortion away from this efficient equilibrium can then be related to corruption.

4.1 Rent-Seeking

We assume that individuals managing public institutions' purchases aim at maximizing the total amount of bribes they extract from their suppliers. While this assumption cannot be directly tested, because in practice corruption and bribes are not observed, the model based on this null hypothesis will generate a number of testable predictions discussed below.

The first prediction, which is from Auriol (2006), is that, independently of the type of commodity, a corrupt procurement official favors limited tendering procedures, thereby maximizing the price of the purchase and his bribe. We thus expect **corrupt Paraguayan public institutions to rely on the exceptional purchase mechanisms**. A firm, which is invited to serve the market in a monopoly position, asks for the highest possible price, $\overline{c}$. In the rent sector, denoted by the superscript r, a contract of size q hence costs $T^r(q) = \overline{c}q.$[19]

The decision parameter of government officials is $b \in [0, 1]$, the share of $T^r(q)$ they take in exchange for giving the market to a firm without competition. In doing so, government officials do not try to distinguish between different entrepreneurs: they simply split the total quantity in equal parts among them, asking for a fixed share of each of these contracts in bribes.

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commodities such as medicine or cars, which require a warranty or a certification, are characterized by larger values of $c^I - c^{f*}$, justifying that firms choose formality.

[19]For more details see Auriol (2006).

Let $c^r(b) \in [0, \bar{c}]$ denotes the firm that is just indifferent between the rent and the productive sector. We show in the appendix that

$$c^r(b) = \bar{c}\ (1-b)\frac{\bar{c}Q}{\bar{c}Q + F}. \tag{2}$$

We deduce that $\Pi^r(c) = Q\bar{c}\left[\frac{c^r(b)-c}{c^r(b)}\right] > 0$ if and only if $c < c^r(b) < \bar{c}$. **Entrepreneurs who choose to do business with the government are the most efficient ones and they make rents**. By contrast entrepreneurs with costs higher than $c^r(b)$ would make a loss, and so prefer not to enter the procurement sector. It is intuitive that the share of firms in the rent sector, $\frac{c^r(b)}{\bar{c}} = (1-b)\frac{\bar{c}Q}{\bar{c}Q+F} < 1$, decreases with b and F and increases with $\bar{c}Q$. The more greedy government representatives are, the more profitable firms need to be to do business with them: they need to be able to cover the fixed cost of entry plus the bribes and still make non-negative profit.

To compute the optimal bribe rate, public officials internalize the risk of corruption being detected and punished.[20] Consistently with empirical evidences in Paraguay for the time of our study, we focus on weak punishment: in case of detection the bribe is simply lost to the officials. We assume that the probability of detection for any procurement contract is $G(\frac{\bar{c}-c^r(b)}{\bar{c}})$ where $\frac{\bar{c}-c^r(b)}{\bar{c}}$ is the fraction of firms excluded from the rent sector and $G(x)$ is a strictly increasing and convex function varying between 0 and 1 for $x \in [0, 1]$. The expected bribe value writes $B = b\bar{c}Q\left(1 - G(\frac{\bar{c}-c^r(b)}{\bar{c}})\right)$. We deduce the next result.

Proposition 2 *Let $\phi = \frac{F}{Q\bar{c}} \in [0, 1)$ by assumption A2. Let $H_G(x) = \frac{g(x)}{1-G(x)}$ be the hazard rate function associated to $G(x)$. The optimal bribe rate, b^r, is solution to:*

$$H_G\left(\frac{b+\phi}{1+\phi}\right) = \frac{1+\phi}{b} \tag{3}$$

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[20] This is a common assumption in the corruption literature, going back to the Becker and Stigler (1974) crime-deterrence model. See for example Besley and MacLaren (1993) and Mookherjee and Png (1995). Di Tella and Schardgrosky (2004) is an empirical application.

Under a technical assumption, one can check that $\frac{db^r(\phi)}{d\phi} < 0$ for all $\phi \in [0, 1]$ (see proof in the Appendix). Proposition 2 hence implies that the optimal bribe rate decreases with F. This is because corruption competes with taxation: firms that have to pay bribes are less able to pay taxes. More importantly for the empirical analysis, the optimal bribe rate also increases with the amount spent in public procurement $Q\overline{c}$. Institutions with large budgets are able to distribute larger lots to more firms, hence they can ask for a larger share of contracts in bribes without increasing the risk of detection. We hence expect, **at the purchasing institution level, a positive correlation between the volume of procurement activity and the use of exceptional purchase**.

In practice corruption detection varies from one institution to another. These differ in their level of exposure to public scrutiny, depending for example on how many people are harmed by corruption or on how politically sensitive their activities are. They also differ in their capacity to realize and hide corrupt acts. In the context of the model, this simply translates into hazard rate dominance, which implies stochastic dominance.[21] The next result is derived in the Appendix.

Proposition 3 *Let $G(.)$ and $K(.)$ be two distributions of corruption detection.*

$$\frac{g(x)}{1-G(x)} \leq \frac{k(x)}{1-K(x)}, \ \forall x \in [0,1] \quad \Rightarrow \quad b^r_G \geq b^r_K. \tag{4}$$

Everything else equal, institutions characterized by a lower probability of detection (i.e., lower hazard rate) will have a higher bribe rate and, by virtue of equation (2), smaller number of firms, and thus larger lots size. We deduce that, everything else equal, **institutions characterized by a lower probability of detection will rely more heavily on exceptional purchase and will have larger lots size attributed to their providers**. We are now ready to derive the global market equilibrium.

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[21]Let $K(.)$ and $G(.)$ be two probability functions so that $\frac{g(x)}{1-G(x)} \leq \frac{k(x)}{1-K(x)} \ \forall x \in [0,1]$, then it implies that $G(x) \leq K(x) \ \forall x \in [0,1]$ (e.g., see Nanda and Shaked, 2001).

Proposition 4 *Let $b^r(\phi)$ be defined by equation (3) and $c^r(\phi) = \frac{1-b^r(\phi)}{1+\phi}\bar{c}$.*
Entrepreneurs choose the rent sector if and only if

$$c \leq c^r\left(\tfrac{F}{Q\bar{c}}\right). \tag{5}$$

In the productive sector, formality prevails if and only if

$$A \geq \bar{c} + \frac{F}{\bar{c} - c^r\left(\frac{F}{Q\bar{c}}\right)}. \tag{6}$$

Proposition 4 (see derivation in Appendix) indicates that the most productive entrepreneurs (i.e., those with $c \leq c^r(\frac{F}{Q\bar{c}})$) choose the rent sector where there is no competition and commodities are overpriced, while the less productive firms are left to serve private demand. Compared to a corruption-free economy, prices are higher both in the public and private segments of the economy so that the quantities consumed and produced in equilibrium are everywhere smaller, leading to lower aggregate production. Comparing condition (6) with condition (1), it is straightforward to check that the formal productive sector shrinks. This effect is stronger in sectors where public purchases are large. Indeed, since $\frac{db^r(\phi)}{d\phi} < 0$, proposition 4 implies that $\frac{dc^r(\phi)}{d\phi} < 0$ for all $\phi \in [0,1]$ so that $\frac{dc^r(\frac{F}{\bar{c}Q})}{d\bar{c}Q} > 0$. Moreover we can show that $\frac{dq^r}{dQ} > 0$ (see Appendix). **Everything else being equal, the percentage of entrepreneurs who enter the rent sector and the size of their lots both increase with $\bar{c}Q$.**

4.2   Implications of the Model

The model generates 2 main sets of testable predictions.

1. *Corruption and the structure of purchases.* In practice procurement activities are decentralized at the institution level (ministries, state enterprises, etc.), so the predictions of the model apply at the purchase center-level. The theory predicts that corrupt institutions rely on the exceptional mechanism

to circumvent competition and maximize bribes. We do not observe bribes, but we do observe purchase mechanisms. Therefore, we use the occurrence of exceptional purchases as dependent variable, to proxy for the fact that a given contract involves corruption.

First, proposition 2 shows that corrupt demands increase in markets where institutions are big buyers of the good. Therefore, controlling for all other standard determinants of exceptions, the likelihood that an individual contract is made by exceptional purchase should be higher when an institution's budget, as a percentage of the total sector's production, increases.

Second, controlling for institutions' budget size (which will be taken care of by institutions-year fixed effects), we can exploit the heterogeneity in the probability of corruption detection at the institution level stressed in proposition 3. For institutions that are more efficient at hiding corruption, we expect a stronger correlation between the frequency of exceptional purchases and the market shares attributed to providers.

2. *Profitability of firms.* Entrepreneurs in the rent sector make profits that exceed the levels observed in normal competitive sectors. These rents are derived from sales at inflated prices, because competition for the market is suppressed by corruption. However, only entrepreneurs that are efficient enough can afford to cover the cost of the related bribes. A corollary is therefore that these entrepreneurs are also the most able ones, those with the highest intrinsic or acquired abilities (see (5) in proposition 4).

Finally, the model has noteworthy industrial organization implications. Although we do not intend to test these directly in this paper, we briefly address them in the conclusion. In sectors producing goods procured intensively, the formal productive sector shrinks (see (6) in proposition 4). In addition, sectors in which a large fraction of output is sold to the government are characterized by less competition. Where there is corruption, prices are bid up in all sectors and quantities are depressed, leading to lower aggregate production.

5 The Data

Procurement data

The main data set tracks all the procurement transactions made over the period 2004 to 2007 between 73 public entities (representing over 90% of total Paraguayan public spending and employment) and 5,517 different private suppliers.[22] These 47,615 public purchases include all types of goods and services, from stationary to machinery, oil purchases, food, services, etc. There are good reasons to believe that no public procurement operations escape registration as, under the new system, contracts need to be registered and executed before the corresponding funds are released. Total public spending amounts to Gs. 12,400 bn. (approx. US$ 2,235m), which represents 5.5% of Paraguay's GDP in 2004, 5.6% in 2005, 6.3% in 2006 and 6.9% in 2007.

Each observation in the procurement data set contains the name and type of the public entity, the name and legal registration number (RUC) of the supplying firm and its owner, and information on the purchase including the nature of the good or service categorized in 16 different groups, the total cost in local currency, and the purchase mechanism used.

Purchase mechanisms are a key provision of the 2003 public procurement law, regulating the procedures to be followed in allocating contracts depending on their total value expressed in multiples of the current legal minimum daily wage (mdw).[23] There are five legal purchase mechanisms with gradually increasing constraints on the minimum number of offers, the mode and length of publication of the call for offers, and the attribution procedure. Below a value of 2,000 mdw, a direct purchase is allowed, with public institutions legally compelled to have offers from at least three different firms. Between 2,000 mdw and 10,000 mdw, a so-called competitive bidding process

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[22]The data we use was initially painstakingly compiled by Transparencia Paraguay (TP), the national chapter of the international NGO Transparency International, using the information published on the DNCP web site.

[23]See the Appendix for more details.

is required, the call for offers must be published in advance and the minimum number of suitable offers is five. Finally, for contracts of a value above 10,000 mdw, a national or an international public tender must be organized, with still more stringent rules.
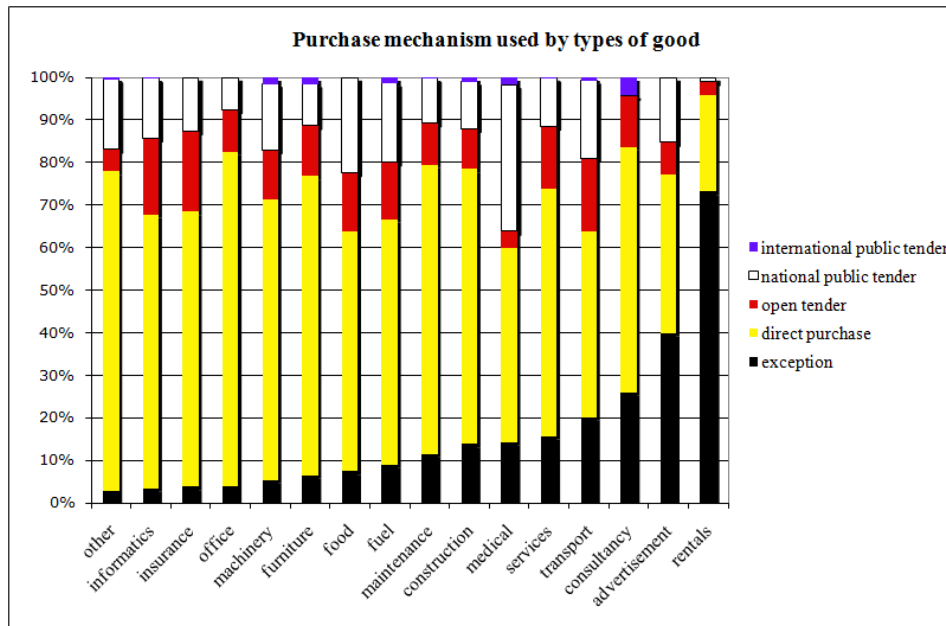
Figure 1

Finally, these guidelines can be disregarded in cases of emergency, such as natural disasters or health epidemics (for example the dengue fever outbreak of 2007), for the purchase of patented and copyrighted goods, or for purchases requiring defense secrecy. In those extraordinary circumstances, public officials can skip all formal purchase requirements through the so-called exceptional purchase mechanism. Figure 1 shows that exceptional purchases are quite common for certain categories of goods or services, such as rentals, advertisement, consultancy and transport.

The distribution of contract values has a fat left-hand tail (84% of purchases cost less than 2000 mdw.), while 5.5% of contracts costing over 10,000 mdw make up 86% of the total spending. The sample mean is approximately

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US$ 47,000, equivalent to 36 times the national per capita GDP at the time.[24]

Firms' profits

We use annual rankings of top taxpayers published on the Ministry of Finance's web site. Firms' ranks are determined by their total payments on all taxes.[25] Once public firms are excluded, we have information for 748 firms in 2004, 459 firms in 2005, 482 firms in 2006, and 478 firms in 2007.

We use the information on total tax disbursements to approximate firms' profits, exploiting the fact that the income gains tax had a flat rate of 30% in 2004, 20% in 2005 and 10% thereafter. Issues related to the inclusion of other taxes and to evasion are discussed in the empirical section below.

Import-export data

We also include annual rankings from the Customs' *SOFIA* official data base. These include the full universe of importers from 2004 to 2007, including the total free on board (FOB) value imported, and of exporters for the same period, including the cost, insurance, freight (CIF) value exported.

Production data

We are able to match the good categories from our procurement database with National Account data for 6 categories of goods (food, rentals, fuel products, construction, machinery and transport). This is sectoral gross GDP data at the 2-digit ISIC level, as published by the Paraguayan Central Bank's Office of Economic Studies. Fuel is an outlier, as large amounts are bought from foreign companies (total procurement represents up to 15 times national production in some years). Once it is excluded, we match 17,438 observations, equivalent to 36.6% of the initial sample. We use this data to create a variable measuring total national production of the respective sectors year by year.

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[24]There are a bit more than 200 contracts with a value superior to US$ 1 million and the largest contract is worth US$ 184 million. The 10 largest procurement contracts are oil purchase by the state monopoly Petropar.

[25]Systematic data on total sales, profits, etc., for the whole universe of firms could not be accessed due to confidentiality restrictions.

Institution-level corruption indices

We introduce institution-level corruption indices for a subset of 13 institutions in our sample.[26] In total, this covers 15,640 of our initial observations, equivalent to 32.8% of the total. These indices were developed by the NGO Transparencia Paraguay between 2004 and 2008 (see Appendix for details).

6   Corruption and the Structure of Purchases

6.1   Methodology

First, we want to test one of the model's main predictions, namely the fact that the use of exceptional purchases *increases* in the share of institutions' purchases in national sectoral production.

Our unit of observation is the individual purchase. Each of the 47,615 purchases available corresponds to a pair composed of a firm i and an institution j. The data set includes 73 institutions and 5517 firms, and in total there are 13,693 different "active" pairs, with an average number of contracts equal to 3.5 (std. dev. 10.5), a minimum of 1 (for 7,215 pairs) and a maximum of 460.

We estimate the following model:

$$exc_{ijkt} = 1[exc^* = \theta_i + \theta_j + \theta_k + \theta_t + \theta_{jt} + \beta_1 Q_{jkt} + X_{ijkt}\beta_2 + \varepsilon_{ijkt} > 0], \quad (7)$$

where $1[.]$ is an indicator function equal to 1 if the statement in brackets is true, exc is a binary variable equal to 1 if the contract is made through the exception, $\theta's$ are firm (i), institution (j), good (k), year (t), and institution-year (jt) fixed effects, X_{ijkt} is a vector of controls, and Q_{jkt} is the share of

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[26]The institutions are Customs, the Senate, the Ministry of Education, the Supreme Court, the Social Prevision Institute, the Ministry of Agriculture, the National Housing Council, the Ministry of Justice, the Ministry of Health, the Superior Tribunal for Electoral Justice, the National Institute for Rural Land Development, the Public Ministry (Public Prosecutors' Office), and the Police (which belongs to the Ministry of Interior).

the total national production of good k procured by institution j in year t. We expect β_1 to be positive.

The vector of controls includes firm-institution level variables: the total value of each pair's transactions, and the proportion of an institution's transactions done with each particular provider. These variables are meant to control for additional political or personal connections, and other effects such as reputation, which may influence contract allocation. We report these results, as they turn out to be relevant when we later introduce institution-level corruption. Other controls include the size of contracts, as we expect larger contracts that carry the obligation of an open bidding procedure to induce a different behavior, and the yearly level of production of the sector, to ensure that our results are not polluted by sector size effects, for example if smaller sectors are more dependent on public procurement and therefore more subject to abuses. These results are omitted to save space.

The inclusion of fixed effects allows us to capture any systematic determinants of exceptional purchase that would correspond to characteristics of the firms (competitive advantage, exclusive dealing on a specific good), the goods (patented or monopolistic goods) and the institutions (specifically dedicated to attend emergencies, involved in defense deals, etc., possibly with changes over time), as well as specific time fluctuations or trend in the use of exceptions. Once these fixed effects are introduced, we expect no additional features to be significant if procurement rules are applied correctly.

We use a linear probability model to estimate the model above. The inclusion of fixed effects prevents us from using a probit estimation, while a conditional logit would imply eliminating any pair for which there is no within variation, therefore reducing the final sample by approximately half.

6.2 Results

Table 1 contains the first set of results. It shows that more corruption (exceptional purchase) occurs when a public institution is a big buyer on the

market, in the sense of purchasing a large share of a sector's production. In columns 1 to 4, the variable Q_{jkt} (Procurement/Nat.Prod$_{jkt}$) is systematically positive and significant. One additional percentage point in the share of the sector's production implies a 0.2 to 0.3% increase in the probability of using the exception. It is hard to think of an explanation other than corruption to explain the positive sign of the variable Q_{jkt}.

This result is key to understanding the distortions induced by corrupt procurement. Indeed, it tells us that in each sector the prevalence of wrondoings is positively related to the weight of the public sector as a client. The economic effect is far from trivial. Domestic producers in sectors in which public purchases represent around 25% of total sales, such as drugs or machinery, face a 5 to 8% additional probability of being favoured with exceptional purchases compared with other sectors where public intervention is marginal (around 1% for transport or food for example). Given the extra-profitability that we uncover in the next section, this clearly increases the attractivity of these activities.

Moreover, this is reinforced by the nature of specific institution-firm interactions. In columns 2 to 4, we also show that firm-institution pairs that do more business together use the exceptional purchase mechanism more often. The coefficient for the total value of a pair's transactions ($firm\_instit\_val$) in column 2 implies that an additional US\$ 200,000 translate in an increase of 0.4% in the probability to use the exception. The coefficient for the share of institutions' transactions done with each particular provider ($instit\_firm\_val\_share$) in column 3 implies that an institution that increases the share of its total procurement volume allocated to a particular firm by one standard deviation above the sample mean (that is 3.8% of its portfolio rather than 0.9%), would increase the share of its contracts with that particular firm made through the exception by more than 13%. A pair with a volume of contracts two standard deviations above the sample mean (that is 6.7% of the institution's portfolio rather than 0.9%), would use the

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exception for 22% of its contracts.

[insert Table 1 here]

In columns 5 and 6, we run some robustness checks on the pair variables, using alternative samples.[27] First, we use the whole sample, and then restrict ourselves to the period 2004-2005, in which the prevalence of exceptional purchases was higher. In both cases, the signs are as expected and the $instit\_firm\_val\_share$ variable is nearly significant at the 10% level, while $firm\_instit\_val$ is strongly significant in the 2004-2005 sample.

Alternative interpretations are possible for the results that frequent pair interactions lead to more contracts through the exception. For example, one could argue that a "reputation" effect is at play. In circumstances where public institutions need to use exceptional mechanisms, for example because of some social emergency, they naturally turn to firms they have had frequent interactions with, because they know these are more reliable. Yet another explanation would involve simple inefficiency or passive waste, as Bandiera et al. (2009) document in the case of public procurement in Italy. Here, the argument would be that procurement officials simply award contracts to firms they already know, because they do not internalize the new rules (they may be badly informed about the regulations and fail to respect deadlines or to advertise the calls for applications) or because they are lazy and it is the solution that requires less effort.

To evaluate both the "reputation" and the "efficiency" arguments and compare them to the "corruption" story, we can use the result of proposition 4. It suggests that institutions more exposed to public scrutiny use less exceptional purchase. We use the institution-level corruption indices described in the data section to proxy for this exposure. We measure corruption with a synthetic index equal to the arithmetic mean of the three original indices,

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[27]As we include all good categories, this forces us to exclude the production share variable.

namely the evaluations based on the Comptroller General's report and on the number of administrative indictments in any given institution, and the number of newspaper articles mentioning corruption in the institution.[28]

We introduce the following specification:

$$exc_{ijkt} = 1[exc^* = \theta_i + \theta_j + \theta_k + \theta_t + \beta_1 Q_{jkt} + \beta_2 Inst\,Corr_{jt}$$
$$+ X_{ij}\beta_3 + (X_{ij} * Inst\,Corr_{jt})\,\beta_4 + X_{ijkt}\beta_5 + \varepsilon_{ijk} \quad > \quad 0]. \quad (8)$$

If the corruption story is relevant, we expect β_2, and especially β_4 to be positive.

The results in Table 2 support the corruption hypothesis. In columns 1 to 3, we restrict our sample to the observations matched to the National Accounts. Note that the variable measuring the share of procurement demand in national production is again positive and strongly significant.

In column (1), corruption introduced alone is positive (more corruption corresponds to a higher value of the index) and nearly significant.[29] In column 2, pairs' contract value becomes negative, while its interaction with corruption is positive and significant. This confirms that the link between frequent interactions and exceptional purchases is mediated by corruption. Compared with Table 2, the effect is 4 times larger for an institution that is at the top of the corrupt scale (an additional US$ 200,000 translate in an increase of 1.6% in the probability of using the exception, i.e., such an institution would use it for 20% of its contracts). In column 3, the share of an institution's transactions done with a particular provider is now negative,

[28]The news index might be subject to caution, as press coverage of specific institutions, based for example on journalists inquiries or on denunciations, is likely to be influenced by the nature of the institutions and their past behavior in procurement or other activities. Using only the mean of the evaluations based on the Comptroller General's report and on the number of administrative indictments in any given institution yields similar results.

[29]Note that when corruption is introduced alone, it rules out the use of institution-year fixed effects. When introducing interactions, we prefer to control for these fixed effects rather than just for corruption, as they capture the whole set of institution-year unobserved effects.

while its interaction with corruption is positive and nearly significant at the 10% level. Again comparing with Table 2, the effect is 9 times larger for an institution at the top of the corrupt scale: for one additional standard deviation above the sample mean, this institution now has 120% more contracts by exception than the sample mean, i.e., it would use it for 38% of its total purchases with that firm.

[insert Table 2 here]

In columns 4 to 6, we perform robustness checks on the whole sample, and in columns 7 to 9 we use the 2004-2005 subsample. Corruption alone is now strongly significant. In the 2004-2005 subsample, a 1 point increase in the 10 points scale implies a 23% increase in the probability that the exception is used. The interaction terms are again as expected. In column 6, the $instit\_firm\_val\_share_{ijkt}$ variable is negative, while its interaction with corruption is positive and significant at the 10% level, and it is also nearly so in column 9. In column 8, the $firm\_instit\_val_{ijkt}$ variable is negative, while its interaction with corruption is positive and significant at the 1% level. The marginal effects are comparable to those described above.

In the next Section, we show how this higher prevalence of corruption in sectors where public institutions are big clients, and with specific frequent sellers, distorts the profitability of firms.

7   The Profitability of Firms

The model second prediction is that, as a result of the corrupt practices unveiled above, entrepreneurs doing business with public institutions are more profitable than their counterparts serving private consumers. As a result, we expect the most able entrepreneurs to self-select into the more profitable procurement activities, as only they are efficient enough to afford both the entry cost to formality and the bribes to public officials.

7.1 Methodology

To test these effects, we first perform a reduced form analysis of the effect on firms' profits of a number of variables, derived from the results in the previous section. As a proxy for the share of "favoured" contracts in the firm's portfolio, we use the share of a firm's contracts made through the exception, and the weighted average level of corruption of the institutions it deals with (where the weights are the share of the sales to these institutions in the firm's total sales). In addition, we also use firms' amount and number of contracts.

The amount of taxes paid provides a reasonable approximation for profits because the tax rate on gains is flat and uniform in each period (30% in 2004, 20% in 2005, 10% in 2006 and 2007). While the inclusion of other taxes (among which custom duties are by far the largest component) introduces some noise in the mapping between profits and taxes paid, we control for total imports in all estimations to minimize this issue. The model we want to estimate is:

$$G_{it} = \alpha + \beta_1 Z_{it} + \beta_2 M_{it} + X_{it}\beta_3 + \theta_t + \varepsilon_{it}, \tag{9}$$

where G_{it} denotes the net gains of firm i in year t, Z_{it} is the variable of interest (alternatively, the share of sales through the exception, average corruption of buyers, total sales to the state, number of contracts), M_{it} is the total amount imported, X_{it} is a vector of control variables, and θ_t are time fixed effects.

However, the income tax and other taxes are amalgamated in the tax data, so we only observe:

$$T_{it} = x_t G_{it} + \delta_i M_{it} + \nu_{it}, \tag{10}$$

where $x_t = 0.3$ for 2004, $x_t = 0.2$ for 2005, and $x_t = 0.1$ for 2006 and 2007. In order to obtain the firms' net gains we therefore divide the total amount paid in taxes by the corresponding tax rates.

The distribution of profits resulting from the available data is truncated at a strictly positive point. Moreover, the set of firms for which we have non-zero tax data is not constant over time. This forces us to restrict the panel to the subset of strictly positive tax observations.[30] As a result, we obtain an unbalanced panel of 2167 observations across 4 years for 1017 private firms.

Using this sample, we test the following specification:

$$T_{it}/x_t = \alpha + \beta_1 Z_{it} + (\beta_2 + \delta_i/x_t)M_{it} + X_{it}\beta_3 + \theta_t + \varepsilon_{it} + \frac{\nu_{it}}{x_t}, \qquad (11)$$

under the assumption that Z_{it} is uncorrelated with ν_{it}.

One worry is that unobserved firm characteristics might be correlated both with the amount of taxes paid and with some of the Z_{it} variables on the right hand side.[31] For example, more efficient entrepreneurs might be more successful in general, hence pay more taxes, and also win more procurement contracts or be more frequently favoured through exception because of their good reputation. Another concern is related to firm size. Indeed, bigger firms may have larger overall profits and also be in a better position to win procurement contracts or to respond to emergency calls from public institutions. To address such issues, we add firm level fixed effects θ_i to (11), exploiting the panel dimension of the data to wash out any time invariant firm-level unobserved characteristics.[32]

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[30] Using all the observations to measure the variations in net gains, we would have some positive measurement errors (when a firm's tax observation is out of the sample and therefore set at zero for one year and is positive the following one), some negative ones (in the reverse case), and more generally errors going either way for firms that do not make it to the ranking of top taxpayers.

[31] Note however that such endogeneity concerns are much less obvious for variables such as the average level of corruption.

[32] We do not have additional firm-level data to control for such general characteristics. Fixed effects will take care of the size issue as long as it is reasonably constant over the period of study.

7.2   Results

The results in Table 3 support our hypotheses. Column 1 shows that firm's profits are significantly increasing in the share of its contracts made by exceptional purchase. The average marginal effect implies that a 1 percent increase in the share of contracts made by exception corresponds to Gs. 28 millions (US\$ 5,600) additional profits.

In column 2, the correlation between the average level of corruption of public buyers and firms' profitability is positive but only nearly significant at conventional levels, which is not surprising given that the sample size is reduced to 261 since corruption indices are not available for all institutions.

[insert Table 3 here]

Finally, in columns 3 and 4, we look directly at the correlation between firms' profits and their procurement activity. The coefficients of both the amounts sold and the number of contracts are positive and significant. In terms of marginal effects, every additional Gs. sold to the state translates into a Gs. 0.29 increase in profits, i.e., a rate of return on procurement operations of nearly 29%, while a firm obtaining an additional contract increases its profits by Gs. 154 millions (approx. US\$ 30,800).[33]

A technical concern has to do with tax evasion. Indeed, it is likely that Paraguayan firms do not report all of their sales for tax purpose, possibly biasing our estimations. One could think that sales to the State, because they are publicly registered, imply lower rates of evasion than other sales, in which case we may be facing an upward bias in our estimations. However, strong anecdotal evidence does suggest that well-connected firms use their influence to evade a bigger share of their tax obligations. Large state providers exploit loopholes in the tax system, in particular the fact that in Paraguay there is not tax on personal gains, to transfer firms' benefits to non-taxable kind of

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[33]Results not shown here to save space indicate that the results in columns 1 and 2 are robust to systematically controlling for the amounts of firms' sales to the State.

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revenues. This leads us to think that our estimates should be considered as a lower bound on the true returns of these firms.

These results, together with those of the previous Section showing that corruption looms larger in sector with important public purchases, imply that average profitability should be higher in sectors with an important procurement component. In turn, this is likely to distort firms' incentives and induce additional entry of potential entrepreneurs into these sectors. Next, we provide evidence of this self-selection process.

7.3 Misallocation of Talents

An important point of the model is that firms' unobserved attributes (entrepreneurial or networking skills, efficiency, etc.) should explain part of their increased profitability due to a self-selection process. Some of the best entrepreneurs are attracted to sectors where they can benefit from the corrupt allocation of procurement contracts, resulting in a misallocation of talents in the economy.

The following test explicitly addresses the process of self-selection into the procurement sector, using a procedure proposed by Wooldridge (2002, p 631) to correct for the failure of the ignorability-of-treatment assumption.[34] This entails estimating first a probit model to explain the fact that firms intervene in the procurement sector or not:

$$Y_i = 1\left[Y_i^* = \theta_0 + X_i\theta_1 + S_i\theta_2 + e_i > 0\right], \tag{12}$$

where Y_i is a dummy variable equal to 1 if the firm sells to public institutions at any point during the sample period, X_i is a vector of firm-level observables, and S_i is a set of instruments. From (12), we derive $\widehat{\phi}$, the predicted density and $\widehat{\Phi}$, the corresponding predicted cumulative density. We then estimate,

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[34]Fafchamps and La Ferrara (2009) apply this technique to control for individuals' self-selection into self-help groups based on unobservable characteristics.

for each year, the following tobit model:

$$G_{it} = \max\left[0, \alpha + \beta_1 Z_{it} + X_{it}\beta_2 + \beta_3 Y_i \frac{\widehat{\phi}}{\widehat{\Phi}} + \beta_4\left(1 - Y_i\right)\frac{\widehat{\phi}}{1 - \widehat{\Phi}} + \varepsilon_{it}\right]. \quad (13)$$

Remember that G_{it} denotes the net gains of firm i in year t, Z_{it} is either total firm's sales to the state or its total number of contracts, and X_{it} is a vector of control variables. We are interested in the statistical significance of the two last regressors, as an indication of self-selection, as well as in how their inclusion will affect the coefficient β_1.

The crucial point is the availability of suitable instruments, that would predict access to the procurement sector, while being excludable from the second stage. To generate instruments, we exploit the fact that apart from raising the cost of procurement and changing the identity of sellers, corruption also distorts the sectorial abundance of firms. We capture this bias by exploiting firms' names, which are specific to the procurement categories where a large number of firms are active (see ranking in Figure A.1). First, there is a large number of contracts in office and machinery categories sold by commercial intermediaries; locally, these are often nicknamed "suitcase firms", because they specialize in importing and selling any item upon request.[35] Next, many contracts are in the construction and maintenance categories. Finally, we also focus on services, which are generally provided by consulting firms.

For each of these three groups, we define sets of related words and create three dummy variables, equal to one if at least one of the specific words appears in the firms' official denomination.[36] The first stage shows that our

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[35]For example, one of the firm in our sample, run by a member of close circuit of the former president (also member of the Masonic loge and honorary consul of an Eastern European country), won 301 contracts between 2004 and 2007, for close to \$1.45m worth of office supplies, electric material, cooking utensils, textile, chemical products, cleaning products, computing equipment, Paraguayan flags, etc.

[36]See the Appendix for the specific list of words used and descriptive statistics on these

instruments are very strong predictors of firms being active in procurement (see Appendix). Note that there is no reason to think that names influence firms' profitability directly, supporting the excludability requirements.

Table 4 shows the results from estimating (13) on a sample of 12,759 firms. For each year, we first display the results from a standard tobit estimation and then provide the results including self-selection correction terms, with bootstrapped standard errors. Panel 1 uses the total volume of procurement contracts as our variable of interest Z_{it}, while panel 2 uses the total number of contracts.

[insert Table 4 here]

The correction terms are strongly significant (at the 1% level) in all estimations. Moreover, their inclusion systematically induces a reduction in the estimated coefficients of the variables of interest. The marginal effect of firms' contract volume on their profitability is reduced by between 9 and 19% (except in 2005, when it remains constant), and loses significance in the last three years. Similarly, the marginal effect of the number of contracts is reduced by between 19 and 42%, and becomes insignificant in the 2005 sample.

We conclude that part of the link between procurement and firms' profitability relates to unobserved self-selection of entrepreneurs into activities that offer privileged access to the procurement sector. This provides the final element of our story, in which would-be entrepreneurs are likely to be disproportionately attracted to sectors in which strong demand from corrupt public buyers generate opportunities for rent-seeking.

dummy variables.

8 Conclusion

We have illustrated the fact that rent-seeking is costly to development, by showing how entrepreneurs' economic incentives are distorted toward unproductive activities as the result of favoritism in the allocation of public contracts in Paraguay. After building an industrial organization model, we have used a large scale microeconomic database including all public procurement operations over a 4 year period to test the predictions of the model. In Paraguay, institutions with an important procurement activity are more likely to engage in corrupt dealings. As for firms, they have a greater probability of obtaining a contract directly through an exceptional procedure from an institution with which they have a strong contractual relation, both in terms of the total value and frequency of transactions, particularly when dealing with more corrupt State entities.

We have also shown that firms trading more with the public sector are more profitable, even when controlling for their unobserved characteristics. This overall picture embodies the consequences of a systematic misallocation of talents à la Murphy et al. (1991). In that sense, rent-seeking is particularly costly because it destroys the development potential of the best entrepreneurs.

Indeed, the Paraguayan entrepreneurial class is in its overwhelming majority imports-oriented, with over 90% of the top 500 taxpayers being importers. Over the decade 1996-2005, the commercial balance displayed an average deficit of 8.5% of GDP. Large rents linked to the resale of imported goods to the State and the historical absence of an import-substitution strategy have contributed to make Paraguay one of the least industrialized economy in South America as, apart from the soybean and meat sectors, its entrepreneurs have systematically specialized in commercial intermediation, often with the public sector as sole client, rather than in production.[37]

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[37] This has also fueled a flourishing and illegal reexportation business to the neighbors Brazil and Argentina. See Masi (2007) and Straub (1998) for more details on this.

The costs of this productive atrophy and biased specialization are reflected in the poor record of economic growth. After a period of significant growth in the 1970s and early 1980s, linked in particular to the massive construction projects including the hydroelectric dams, the rate of growth of per capita income was only 0.8% in the 1980s and strictly negative after that (-0.1% and -0.6% in the 1990s and 2000s). Over the last two decades, the Paraguayan Central Bank indicates that 92% of growth fluctuations were due directly to fluctuation in agricultural production and exports. As a result, per capita income was lower in real terms in 2005 than it was at the beginning of the 1980s.

Appendix 1: The Model

Proof of proposition 1

The traditional method of production is less efficient than the modern method, so in the absence of an entry fee the informal sector disappears. Indeed, when $F = 0$, the best technology prevails so that in equilibrium $p^* = \underline{c} = 0$. However this outcome is upset when $F > 0$, as firms need a mark-up to cover F. More generally let $c \in [\underline{c}, \overline{c}]$. Under competitive pressure the smallest possible price compatible with a firm breaking even is so that $(p - \underline{c})(D(p) + \frac{Q\overline{c}}{p}) = F$. Setting $\underline{c} = 0$ and $D(p) = A - p$ yield $p(A - p) + Q\overline{c} = F$. Solving this second order equation in p we obtain $p^{f*} = A/2 - \sqrt{A^2/4 + Q\overline{c} - F}$. In equilibrium formality prevails if $p^{f*} \leq p^I = \overline{c}$. Proposition **1** follows. QED

Proof of proposition 2 and of $\frac{db_G^r(\phi)}{d\phi} \leq 0$

Substituting $c^r(b)$ from (2), we get $B = b\overline{c}Q \left(1 - G(\frac{b\overline{c}Q+F}{\overline{c}Q+F}) \right)$. Under the assumption that $G(.)$ is convex, one can easily check that $EB(b)$ is concave in $b \in [0, 1]$. The first order condition is sufficient, so that the optimal bribe rate, denoted b^r, solves $\frac{dEB(b)}{db} = 0$. Proposition **2** follows. QED

Let $\phi = \frac{F}{Q\overline{c}}$ and let $V(\phi, b) = \frac{1}{1+\phi} H_G \left(\frac{b+\phi}{1+\phi} \right)$. It is straightforward to check that under the assumption that $G(x)$ is increasing and convex, $\frac{\partial V(\phi,b)}{\partial b} > 0$. By virtue of Proposition 2, $b_G^r(\phi)$ is such that: $V(\phi, b) = \frac{1}{b}$. Since V increases with b while $\frac{1}{b}$ decreases with b these functions cross only once. A sufficient condition for $\frac{db_G^r(\phi)}{d\phi} \leq 0$ is that $\frac{\partial V(\phi,b)}{\partial \phi} > 0 \ \forall b \in [0, 1]$, which is equivalent to $-H_G \left(\frac{b+\phi}{1+\phi} \right) + \frac{1-b}{1+\phi} H_G' \left(\frac{b+\phi}{1+\phi} \right) \geq 0 \ \forall b \in [0, 1]$. A sufficient condition for the result to hold is thus $\frac{\partial log \left(H_G(\frac{b+\phi}{1+\phi}) \right)}{\partial \phi} \geq \frac{1}{1+\phi} \ \forall b \in [0, 1]$. This technical condition depends on the distribution function $G(x)$. An example of function that meets the paper conditions is $G(x) = x^2 \ \forall x \in [0, 1]$. One can check that $\frac{\partial V(\phi,b)}{\partial \phi} \geq 0$ is then equivalent to $\frac{1-b}{b+\phi} + 2\frac{b+\phi}{1+2\phi+b} \geq 1 \ \forall b \in [0, 1]$. Differentiating the left hand side of the inequality with respect to b it is straightforward to check that it is decreasing with b. We deduce that

$\frac{1-b}{b+\phi} + 2\frac{b+\phi}{1+2\phi+b} \geq \frac{1-1}{1+\phi} + 2\frac{1+\phi}{1+2\phi+1} = 1$. Computing the optimal bribe rate we get: $b^r = \frac{\phi}{3}\left(\sqrt{3(\frac{1}{\phi}+1)^2+1} - 2\right)$. QED

Proof of proposition 3

Let $\kappa = \frac{F}{\bar{c}Q+F} \in [0,1)$. Let $\beta(b) = \frac{b\bar{c}Q+F}{\bar{c}Q+F} \in [\kappa, 1]$. Let $H_G(x) = \frac{g(x)}{1-G(x)}$ (respectively $H_F(x) = \frac{f(x)}{1-F(x)}$) be the hazard rate function associated to the distribution function $G(x)$ (respectively $F(x)$) $\forall x \in [0,1]$. Then, by virtue of equation (3), $\beta_G^r = \beta(b_G^r)$ is such that $\frac{1}{H_G(\beta_G^r)} = \beta_G^r - \kappa$, while β_F^r is such that $\frac{1}{H_F(\beta_F^r)} = \beta_F^r - \kappa$. Under the assumption that the distribution functions are convex the inverse of the hazard rate function, $\frac{1}{H_F(x)}$ and $\frac{1}{H_G(x)}$, are decreasing in x. Moreover $H_G(\beta) \leq H_F(\beta)$ implies $\frac{1}{H_F(\beta)} \leq \frac{1}{H_G(\beta)}$ $\forall \beta \in [\kappa, 1]$. We deduce that $\beta_G^r \geq \beta_F^r$ which implies $b_G^r \geq b_F^r$. QED

Proof of proposition 4

Let $\phi = \frac{F}{Q\bar{c}}$. Substituting $b_G^r(\phi)$, implicitely defined by equation (3), in equation (2) yields $c^r(\phi)$ as defined in proposition 3. In the formal productive sector, under the pressure of competition the best available technology prevails. The price in the formal economy is such that $(p - c^r(\phi))D(p) = F$ which is equivalent to $(p - c^r(\phi))(A - p) = F$. Substituting $c^r(\phi)$ in this equation yields: $-p^2 + [A + c^r(\phi)]p - [F + Ac^r(\phi)] = 0$. Solving this second degree equation in p yields the value of the price in the formal sector (i.e., the lowest root): $p^f = \frac{1}{2}\left[A + c^r(\phi) - \sqrt{[A - c^r(\phi)]^2 - 4F}\right]$. Finally the formal productive sector prevails in equilibrium if and only if $p^f \leq p^I = \bar{c}$. One can check after some computations that this is equivalent to equation (6). QED

Finally we check that $\frac{dq^r}{dQ} > 0$. Let $q^r = \frac{\bar{c}Q}{c^r(\phi)}$. We deduce that: $\frac{dq^r}{dQ} = \frac{\bar{c}}{c^r(\phi)} - \frac{d\phi}{dQ}\frac{dc^r(\phi)}{d\phi}\frac{\bar{c}Q}{c^r(\phi)^2}$. Substituting the derivative of $\phi = \frac{F}{Q\bar{c}}$ by its value $\frac{d\phi}{dQ} = \frac{-\phi}{Q}$, this is equivalent to : $\frac{dq^r}{dQ} = \frac{\bar{c}}{c^r(\phi)^2}\left(c^r(\phi) + \phi\frac{dc^r(\phi)}{d\phi}\right)$. We deduce that $\frac{dq^r}{dQ} > 0$ if $\frac{dc^r(\phi)}{d\phi} > -\frac{c^r(\phi)}{\phi}$. By virtue of equation (2) we have $\frac{dc^r(\phi)}{d\phi} = \frac{\bar{c}}{(1+\phi)^2}\left(-\frac{db_G^r(\phi)}{d\phi}(1+\phi) - (1 - b_G^r(\phi))\right)$. We deduce that $\frac{dq^r}{dQ} > 0$ if $\frac{\bar{c}}{(1+\phi)^2}\left(-\frac{db_G^r(\phi)}{d\phi}(1+\phi) - (1 - b_G^r(\phi))\right) > -\frac{\bar{c}}{\phi}\frac{1-b_G^r(\phi)}{1+\phi}$, which is equivalent to $-\frac{db_G^r(\phi)}{d\phi}(1+\phi)\phi > -(1 - b_G^r(\phi))$. A sufficient condition is that $\frac{db_G^r(\phi)}{d\phi} \leq 0$.

Appendix 2: Procurement Data

Figure A1 shows the distribution of total volume and total number of contracts, as well as total number of firms active by categories of goods and services.
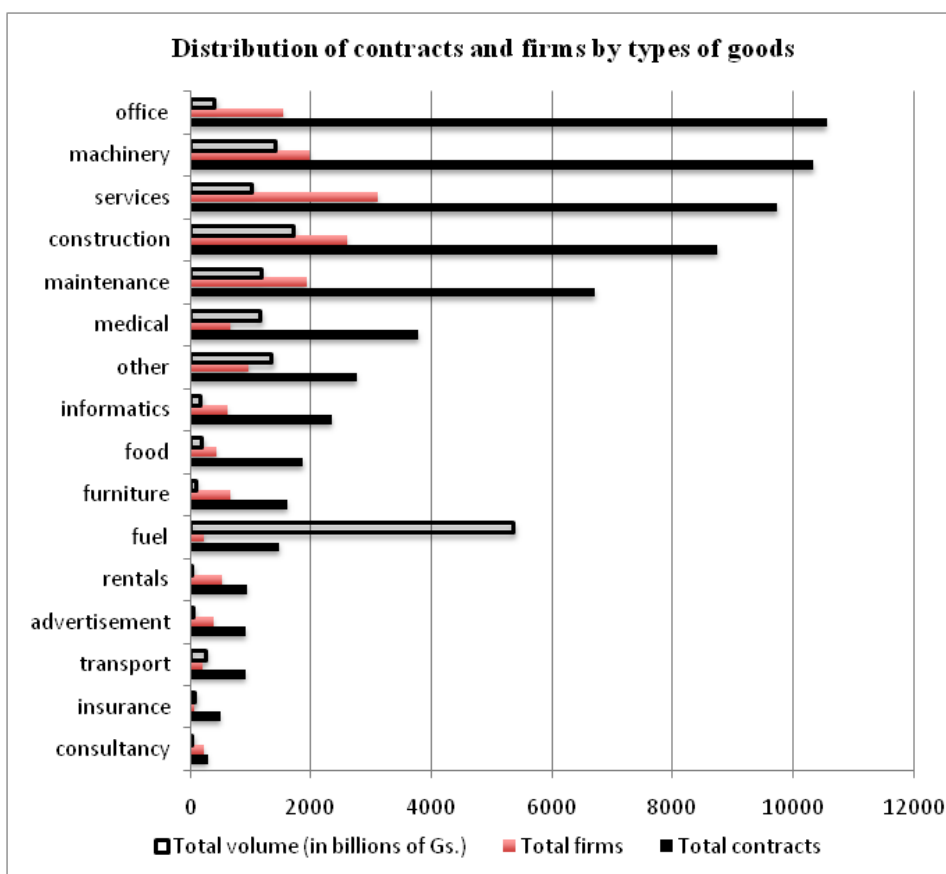

Figure A1

Legal requirements for public procurement purchases

The 2.051/03 law of Public Procurement aims to promote competition among state providers and transparency in the procurement process. To this end, it regulates purchases differently according to their value.

The largest contracts (above 10,000 mdw; see Table A1 below) are made through a Public Tendering. Calls for offers on such contracts must be published in the national press for a minimum of three days on top of the usual publication in the official newsletter and web site. The requirements and criteria for evaluation must be restricted to technically indispensable requisites. Grounds for disqualification must concern the failure to comply with substantial requisites, such as threatening the legality or solvency of the proposal. In this way calculus mistakes or mistakes in the layout of the offer, which were often used to justify dismissal of an offer are no longer considered valid grounds. If two or more offers comply with the technical requirements, the offer with the lowest price wins. Bids and the winning offer are published on the web site.

The competitive bidding process (between 2,000 and 10,000 mdw) does not require a call for offers in the national press. However five different firms have to make offers and the call must be published on the web for any firm who might qualify to participate in the bidding.

When the value of the contract does not reach 2,000 mdw, the contracting institution can allocate the contract directly to a firm without organizing an auction. It must however have published the call on the official web site and have received at least three official offers from different firms. contracts worth less than 20 mdw a 'fixed funds' mechanism was created to allow institutions to purchase directly from a single supplier without justification. This mechanism has no specific requirement on the number of offers or publication of the call for offers. We include it as a direct purchase.

Finally, in order to bypass costly administrative procedures in cases of "force majeure", the exceptional purchase mechanism described in the text was created. Under this regime, institutions can purchase as much as they want from a firm of their choice. The law stipulates that a report explaining the reasons of the purchase and justifying the choice of provider should be supplied to the national watchdog within a month after the date of purchase.

In practice, this is rarely done.

Table A1 summarizes the evolution of the Paraguayan minimum daily wage, the Guarani/US$ exchange rate, and the value of the thresholds defined above in US$.

Table A1: Minimum daily wage, exchange rate and procurement thresholds

	Until April 2004	April 2004 to March 2006	March 2006 to September 2007	Since September 2007
Mdw in Gs.	Gs. 37,401	Gs. 41,889	Gs. 46,915	Gs. 51,607
Mdw in US$	6.28	6.78 - 7.47	8.37 - 9.34	10.28
Exchange rate bounds	1$ = Gs. 5,955	Gs. 5,608 < 1$ < Gs. 6,178	Gs. 5,021 < 1$ < Gs. 5,608	1$ = Gs. 5,021
Procurement thresholds (US$)				
20 mdw	125.6	135.6 – 149.4	167.4 – 186.8	205.6
2,000 mdw	12,560	13,560 – 14,940	16,740 – 18,680	20,560
10,000 mdw	62,800	67,800 – 74,700	83,700 – 93,400	100,280

Note: Average exchange rate provided by BCP (Paraguay Central Bank), 1 US$ = Gs. 5955 in 2004, 1 US$ = Gs.6178 in 2005, 1US$ = Gs. 5608 in 2006, 1 US$ = Gs.5021 in 2007.

Institution corruption data

There are three tentative measures of corruption: the news index, which counts the number of newspaper articles referring to corruption cases involving each specific institution, published in the 3 main national newspapers each year; the control index, based on the Comptroller General's (the "contraloria") evaluation of each institution; and the trial index, summarizing the number of outstanding administrative corruption cases in any given administration. We rescale all indices on a 0-10 scale, with 10 representing more corruption. The appeal of these indices, contrary to those based on perceptions of corruption, is the objectivity of the criteria used to construct them. More importantly, our theory calls for a measure of the probability of detection at the institution level, which is well captured by these indices as they are widely advertised.

Appendix 3: Empirical Evidence. Complements

Descriptive statistics on the relationship between institution budget size, corruption and contracts size.

The model predicts that public institutions with larger procurement budgets contract with more firms ($\frac{dc(b^r)}{dQ} > 0$) and that their providers get larger contracts ($\frac{dq^r}{dQ} \geq 0$).

For the 230 institution-year data points available, Table A2 displays the empirical correlations between institutions total budget and average contract size, total number of contracts and of providers, as well as the level of corruption for the subset of 37 institution-year pairs available. The correlations between total budget and the first three variables are all positive and strongly significant, indicating that institutions with bigger procurement budgets do indeed offer more and larger lots to a larger pool of providers. Moreover, the average index of corruption (computed as the arithmetic mean of the indices defined above) displays the expected positive correlation, supporting the idea that large buyers are more corrupt (although the correlation is not significant due to the reduced sample size).

Table A2: Institution-level correlations

	Average contract size	Number of contracts	Number of providers	Corruption measures
Institution total budget	0.95[a]	0.18[a]	0.27[a]	0.19
N	230	230	230	37

[a] Significant at the 1% level.

Self-selection dummies (Section 7.3)

We construct three dummy variables, equal to one if at least one of the specific keywords appears in the firms' official denomination and zero otherwise. The keywords are chosen so as to match standard names used by firms in the relevant sectors of activities (allowing for variations such as abbreviations):

- "Import-export" dummy: ferretería, comercial, distribuidora, casa, representación, servicio, supply, venta, supermercado, material, pieza, trade, import, export.

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- "Construction and maintenance" dummy: ingeniero, arquitecto, mecanico, taller, repuesto.

- "Consulting" dummy: abogado, auditor, consultor, associados, asesor, communicación.

Table A3 shows how these categories of firms are represented among state providers and non state providers respectively. Concerning excludability, as stated in the text, there is no reason why firms names would influence their profitability directly, other than through the nature of their branch of activity (the "construction" and "consultancy" dummies are actually negatively correlated with firm-level gains). The "import-export" dummy can be discussed on the ground that it may affect profitability through a distinct channel, namely the fact that firms in these activities could also be benefiting from the widespread smuggling rents available in the Paraguayan economy. To address this concern, we rerun the estimations excluding this variable from the set of instruments. Results, not shown here to save space, are identical to those in Table 6. Table A4 presents the first stage estimations, including respectively the three instruments or only the last two.

Table A3: Distribution of self-selection dummies

State providers		0	1	Total
Impexp				
	0	7,035 (97.1%)	4,170 (75.7%)	11,745
	1	213 (2.9%)	801 (24.3%)	1,014
Construct				
	0	7,224 (99.7%)	4,983 (90.4%)	12,207
	1	24 (0.3%)	528 (9.6%)	552
Consult				
	0	7,246 (99.97%)	5,277 (95.8%)	12,523
	1	2 (0.03%)	234 (4.2%)	236
Total		7,248	5,511	12,759

Note: In each cell, the number in parenthesis indicates the share of firms with or without the name attribute, as a percentage of the total of firms in the category (state provider or not). For example, firms in the "impexp" category represent 2.9% (213/7248) of non state providers, and 24.3% (801/5511) of state providers.

Table A4 : First stage estimations

	(1) State provider dummy	(2) State provider dummy
impexp	1.051	
	(0.080)***	
construct	1.540	1.781
	(0.164)***	(0.163)***
consult	2.244	2.170
	(0.547)***	(0.542)***
Importer	-2.414	-2.415
	(0.036)***	(0.034)***
Exporter	-1.235	-1.241
	(0.074)***	(0.076)***
Constant	1.303	1.379
	(0.026)***	(0.025)***
Pseudo R2	0.53	0.51
Observations	12759	12759

Robust standard errors in parentheses. *** significant at 1%.

Table 1: Exceptional purchase determinants

	(1)	(2)	(3)	(4)	(5)	(6)
	Matched sample goods only				Full sample	2004-2005 only
	Exc. purchase	Exc. purchase	Exc. purchase	Exc. purchase	Exc. purchase	Exc. purchase
Procurement/Nat.Prod$_{ikt}$	0.178**	0.167**	0.175**	0.0313***		
	(0.0834)	(0.0817)	(0.0819)	(0.0108)		
Firm_instit_val		0.0430***		0.0324**	0.000499	0.0296***
		(0.0139)		(0.0126)	(0.00160)	(0.00719)
Instit_firm_val_share			0.135***	0.101**	0.0211	0.0112
			(0.0508)	(0.0450)	(0.0136)	(0.00817)
Firms F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Instit. F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Goods F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Years F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Instit*years F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17438	17438	17438	17438	47615	22180
R-squared	0.597	0.597	0.597	0.598	0.532	0.524

Note: *Procurement/Nat.Prod$_{ikt}$* = institution j's purchase of good k as a fraction of sector k's production;
firm_instit_val = total value of pair ij contracts; *firm_instit_num* = total number of pair ij contracts;
instit_firm_val_share = value of institution j contracts with firm i as a share of total value of institution j contracts.
Robust standard errors in parentheses, clustered at the institution level. * significant at 10%;
** significant at 5%; *** significant at 1%.

Table 2: Exceptional purchase determinants and institution-level corruption

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Matched goods sample only			Full sample			2004-2005 only		
	Exc. Purch.	Exc. Purch.	Exc. Purch.	Exc. Purch.	Exc. Purch.	Exc. Purch.	Exc. Purch.	Exc. Purch.	Exc. Purch.
Procurement/Nat.Prod$_{ikt}$	1.026*	0.838*	0.813*						
	(0.472)	(0.398)	(0.405)						
Corruption	0.0212			0.0119*			0.234***		
	(0.0170)			(0.00617)			(0.0412)		
Firm_instit_val		-0.0381			0.0245			-0.0960	
		(0.0681)			(0.0209)			(0.0555)	
Valij_corrupt		0.0198**			0.00354			0.0270***	
		(0.00866)			(0.00429)			(0.00838)	
Instit_firm_val_share			-0.0385			-0.148			-0.151
			(0.284)			(0.103)			(0.148)
Sharej_valij_corrupt			0.124			0.0746*			0.0605
			(0.0808)			(0.0411)			(0.0443)
Firms F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instit. F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Goods F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Years F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instit*years F.E.		Yes	Yes		Yes	Yes		Yes	Yes
Observations	5435	5435	5435	15640	15640	15640	3474	3474	3474
R-squared	0.692	0.712	0.712	0.582	0.602	0.602	0.605	0.609	0.608

Note: *valij_corrupt* = interaction (firm_instit_val*institution corruption index); *sharej_numij_corrupt* = interaction (instit_firm_num_share* institution corruption index); See Table 2 notes for other definitions. Robust standard errors in parentheses, clustered at the institution level.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3: Procurement and profitability of firms

	(1)	(2)	(3)	(4)
	Gain	**Gain**	**Gain**	**Gain**
	Random effects	Fixed effects	Fixed effects	Fixed effects
Imports	0.001	0.003	0.000	0.000
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Exports	-0.000	-0.024	0.001	0.001
	(0.000)**	(0.021)	(0.000)**	(0.000)**
Exceptional purchase	2.834			
	(1.412)**			
Corruption index		1.205		
		(0.814)		
Amount sold			0.293	
			(0.108)***	
Number of contracts				0.154
				(0.062)**
Time F.E.	Yes	Yes	Yes	Yes
Firms F.E.	No	Yes	Yes	Yes
Observations	476	261	2167	2167
R-squared	0.46	0.66	0.25	0.25
Hausman chi2	0.40	0.00	0.00	0.00

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.
Note: All data adjusted for yearly price variations. In each case, we test the appropriateness of the random versus the fixed effect model, using the standard Hausman test. We report only the specification supported by the test.

Table 4: Self-selection into procurement and firms' profitability

Panel 1	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Tobit	**Tobit**	**Tobit**	**Tobit**	**Tobit**	**Tobit**	**Tobit**	**Tobit**
	Gains 2004	**Gains 2004**	**Gains 2005**	**Gains 2005**	**Gains 2006**	**Gains 2006**	**Gains 2007**	**Gains 2007**
Volume of contracts	0.009	0.008	0.041	0.041	0.129	0.105	0.075	0.068
	(0.006)	(0.019)	(0.016)**	(0.034)	(0.035)***	(0.141)	(0.026)***	(0.159)
Import dummy	3.701	4.101	10.653	11.527	27.689	29.632	30.800	33.454
	(1.130)***	(1.315)***	(3.172)***	(3.855)***	(7.237)***	(8.087)***	(8.443)***	(9.323)***
Import volume	0.000	0.000	0.002	0.001	0.001	0.001	0.001	0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)**	(0.000)***	(0.000)***
Export dummy	1.387	1.440	4.173	4.658	25.662	29.741	17.759	17.168
	(0.512)***	(0.553)***	(1.402)***	(1.690)***	(7.185)***	(8.254)***	(5.610)***	(5.732)***
Export volume	0.000	0.000	-0.001	-0.000	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)*	(0.000)	(0.001)	(0.001)	(0.000)***	(0.001)
mills1		1.035		1.552		10.834		10.103
		(0.283)***		(0.470)***		(2.583)***		(2.465)***
mills2		3.816		6.741		24.041		25.150
		(1.172)***		(2.201)***		(6.138)***		(6.823)***
Pseudo R2	0.185	0.232	0.275	0.289	0.133	0.162	0.156	0.178
Observations	12759	12759	12759	12759	12759	12759	12759	12759

Panel 2	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Tobit	**Tobit**	**Tobit**	**Tobit**	**Tobit**	**Tobit**	**Tobit**	**Tobit**
	Gains 2004	**Gains 2004**	**Gains 2005**	**Gains 2005**	**Gains 2006**	**Gains 2006**	**Gains 2007**	**Gains 2007**
Number of contracts	0.010	0.007	0.032	0.026	0.270	0.187	0.256	0.150
	(0.008)	(0.009)	(0.016)**	(0.024)	(0.069)***	(0.061)***	(0.083)***	(0.072)**
Import dummy	3.696	4.101	10.625	11.511	27.721	29.748	30.746	33.512
	(1.133)***	(1.386)***	(3.179)***	(3.634)***	(7.255)***	(7.935)***	(8.429)***	(9.360)***
Import volume	0.000	0.000	0.002	0.001	0.001	0.001	0.001	0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Export dummy	1.381	1.440	4.148	4.653	25.895	29.942	17.438	17.196
	(0.514)***	(0.566)**	(1.412)***	(1.606)***	(7.235)***	(8.331)***	(5.541)***	(5.616)***
Export volume	0.000	0.000	-0.001	-0.000	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)*	(0.000)	(0.001)	(0.001)	(0.000)***	(0.001)
mills1		1.020		1.501		10.328		9.694
		(0.289)***		(0.486)***		(2.446)***		(2.312)***
mills2		3.817		6.741		24.171		25.232
		(1.229)***		(2.063)***		(6.130)***		(6.751)***
Pseudo R2	0.186	0.232	0.275	0.289	0.135	0.162	0.157	0.178
Observations	12759	12759	12759	12759	12759	12759	12759	12759

Note: Tobit specifications with left truncation at the lowest observed profit level in each year. For each specification, explanatory variables correspond to the relevant year. Robust standard errors in parentheses (bootstrapped with 500 replications when mills ratios are included). * significant at 10%; ** significant at 5%; *** significant at 1%.

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