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The Impact of Centralization on Pharmaceutical Procurement Prices:

The Role of Institutional Quality and Corruption

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Abstract

This paper deals with the open issue about the choice between a centralized versus a decentralized public procurement strategy. Using a unique dataset on tender prices of selected drugs for hospital usage awarded by a sample of 52 Italian local health service providers (ASLs) between 2009 and 2012, we test which procurement system (centralized, decentralized or hybrid) performs better. Controlling for several covariates, among which measures of institutional quality and corruption, we always find that centralized and hybrid procurers pay lower prices as compared to decentralized units. Moreover, our results show that in areas in which institutional quality is lower, or corruption is higher, the effect of centralization in negotiating lower prices is much stronger, with savings that can reach also 50 percent of the price paid by ASLs that procure on their own.

Keywords: public procurement, centralization, decentralization, pharmaceutical spending.

JEL codes: H57, H83, L33

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1. Introduction

Public procurement, i.e. the purchasing of goods, construction works and services by the public sector, represents a considerable share of the GDP of a country: 13% on average across OECD countries, ranging from 5.6% in Mexico to 22% in the Netherlands (OECD, 2013a). In the recent period of economic and financial crisis, the procurement activity has become a crucial policy issue. Indeed, in an attempt to reach important savings in the use of public funds, many governments set on their agenda the reform of the public procurement sector.

The pharmaceutical expenditure accounts for 1.5% of GDP and 17% of all health expenditure on average across OECD countries (OECD, 2013b). The yearly per-capita expenditure in Italy is 487 US dollars, roughly half (twice) the figure recorded in the United States (Denmark). Carone et al. (2012) evaluate EU pharmaceutical policies aimed at keeping pharmaceutical spending under control, and highlight the advantages of using public tendering for procuring pharmaceutical products for hospital care as well as for ambulatory care, and the benefits that can be reached by increasing the diffusion of generic drugs. Vellez (2011), using Italian data on the purchase of medical and treatment devices by healthcare facilities, does not find that auctions are leading to lower prices as compared to negotiations. However, as highlighted by AVCP (2011), competitive tendering procedures for the procurement of drugs in Italy suffer from many drawbacks, among which the low number of firms participating to the auctions, the uncertainty about the length of the supply contract (on average, two or three years, but with the possibility to renegotiate it with the winner up to six years), the uncertainty about the quantity which will be actually provided (since the quantity is often not precisely specified in the tenders), the inability to verify the congruity of the winning bid, the delay in the payment of the public administration, the difficulty for suppliers of generic drugs to participate to the procedures. As to this last issue, Arvate et al. (2013), using data on electronic auctions organized by Brazilian public hospitals and health centers to procure drugs, find that the entry of off-patent's suppliers is leading to considerable price rebates. In particular, the presence of generic drug bidders is reducing branded drug supplier's participation to the tender as well as inducing the remaining ones to behave more aggressively.

One way to increase the efficiency and the effectiveness of public procurement is the choice between a centralized system, where there is a central body who is in charge of handling the purchasing activity (select contractors, negotiate prices and conditions, make purchasing decision) for end-users (i.e. local units), who are just required to send their requests to it, and a decentralize system, where local units procure on their own.

Dimitri et al. (2006) claim that there is a clear trend towards centralization of public procurement in Europe, United States and Southern America, even if governments change frequently direction and the new reforms are conflicting with the preceding ones. A fully decentralized purchasing process, where procurement is managed at the local level, is usually criticized on the ground that it can be associated with fragmentation, inefficiency and poor transparency. However, a fully centralized system could suffer from a lack of flexibility, which is required when goods and services that must be procured are complex and involve, other than cost considerations, quality and value aspects, too (OECD, 2000).

The choice of centralizing procurement activities in order to reach cost savings can be associated to the broad issue of the impact of fiscal federalism on the provision of public goods such as infrastructure and education or, more generally, on long run economic growth, a strand of literature which has not yet reached conclusive results (OECD, 2013c): for example, Blochliger et al. (2013, p. 23) state that: *“The set of empirical studies that have established a link between intergovernmental fiscal frameworks and economic activity has generated every possible answer, from a clear positive to a clear negative relationship, with several studies concluding that there is no relationship at all. Averaging over all studies leads to the conclusion that decentralization and growth are unrelated”*. If, on the one hand, decentralization is expected to generate welfare gains in the allocation of resources, because local governments have better information about local residents’ preferences and services costs¹, with centralization, on the other hand, it is possible to exploit economies of scale, to hire well trained bureaucrats, and to be more sheltered from lobbies, corruption and crime infiltration. In a recent paper, Filippetti and Sacchi (2013) stress the role of the institutional setting on shaping the above relationship, and find for a sample of OECD countries that fiscal decentralization leads to higher rates of economic growth when institutional complementarities are at work (i.e. when it is coupled with administrative and political decentralization).² Guccio et al. (2014) test whether the reasons for decentralization stand as far as the execution of public works is concerned and find for a sample of 9622 infrastructure projects (such as construction of roads, highways and railways, house building, infrastructures for sport, show and tourism, school building, hospital building, etc.) awarded in the period 2000-2004 in Italy

¹ Moreover, decentralization enhances citizens’ participation (because local governments, being closer to citizens, are more likely to be accountable), induces competition among local jurisdictions, and favors the experimentation of innovative policies to improve efficiency at the local level.

² Administrative decentralization occurs when the regional government is highly independent from the central authority and when it is capable to influence and determine central decision making. Political decentralization occurs when the country is organized as a federation instead of a unitary state and when sub-national officials are directly elected by citizens.

that local governments are suffering from longer delays in infrastructure realization than the central government, and do not seem to be under sufficient and effective pressure to act efficiently.

Our paper takes a similar approach, and analyses the impact of centralization of pharmaceutical procurement using data relative to tender prices of selected drugs for hospital usage awarded by a sample of 52 Italian public procurers between 2009 and 2012. Controlling for several covariates, we always find that centralized and hybrid systems (i.e. consortia of local health service providers) pay lower prices as compared to decentralized purchasing bodies. The average cost saving is greater than 20% for centralized agencies and around 8% for hybrid procurers. When we consider the role of the institutional setting in shaping the above relationship, we find price reductions that range from 5%, for procurers located in areas where the institutional quality is high, to 50%, for agencies located in regions where the institutional quality is very poor.

The remainder of the paper is organized as follows. In Section 2 we provide a critical overview of the literature dealing with the centralization/decentralization choice. Section 3 focuses on the Italian context, and describes the activities of the central agency, of the regional purchasing bodies, and the specific characteristics of public procurement in the Italian pharmaceutical sector. Section 4 describes our dataset on the procurement of drugs for hospital usage. Section 5 presents our empirical strategy and shows our main findings on the impact, in terms of purchasing prices, of the three different procurement systems which are used to buy pharmaceutical products. Section 6 concludes.

2. Centralization *versus* decentralization of procurement

While it was traditionally considered as an operational routine, nowadays the purchasing activity has become crucial for both the public and the private sector. Cousins and Spekman (2003) assess that the manufacturing sector spends more than 65% in purchasing goods and services, so it is not surprising that private managers, public managers and policy makers are putting more and more attention on this practice. During the 90's, many big companies went through important reorganizations of their activities, including purchasing, and adopted different combinations of centralized and decentralized procurement. Some of them, as Motorola, General Electric, United Technologies and Fiat, decentralized this function, while some others, such as Honda and General Motors, centralized it. Some scholars examine the purchasing cooperation between independent firms. For example, Tella and Virolainen (2005) use data on Finnish machine manufacturing

industry and find that the main motivations for the establishment of purchasing consortia are to save on costs and to collect information on supply markets. It is straightforward to notice that advantages deriving from belonging to a consortium could be very close to the advantages of using a centralized structure.

The studies focusing on the private sector provide useful frameworks and benchmarks to be applied to the public sector, too. However, it is necessary to take into account that the two systems differ at least in terms of performance measures and organization goals, and they differently react to the lack of resources (Reed et al., 2005). For example, the private sector reacts by increasing competition and shake-out, while the public sector reacts by raising inter-organizational cooperation through centralization in order to lower duplications or through purchasing by consortia (Johnson et al., 2003).

The main advantages of centralization are due to the exploitation of economies of scale (by bundling quantities, by minimizing duplications, by reducing the number of transactions) and to the better organizational structure of the central agency (which has higher bargaining power, can hire more experienced and skilled managers, can grant higher product and service quality, can reduce supply risks and legal costs for litigations, can have better access to resources and markets). On the contrary, the literature stresses several disadvantages of recurring to a central agency: higher coordination, set-up and maintenance costs, impossibility to satisfy unique requirements, loss of relationship with local suppliers, possible exclusion of small firms, potential lock-in phenomena (Thai, 2009; Tella and Virolainen, 2005; Albano and Sparro, 2010).

Economies of scale can be easily reached if products are highly standardized. Indeed, on the supply side, standardized products allow firms to lower unit costs and, on demand side, they permit to pool the requests, to raise the volumes, and to use such leverage to negotiate lower prices. Therefore, the success of the centralization strategy is inherently linked to the product characteristics: the more similar products are, the easier aggregation is. It is the case, for example, for IT equipment, paper, stationery, fuel, coupon for meals, credit cards, electric power. Conversely, when products are peculiar and/or single units have specific needs, it is difficult to use a centralized framework.

Estimates of savings due to centralization are not easy to find in the literature. Karjalainen (2011), focusing on Finnish government data, estimates the potential price savings by comparing the prices paid by the centralized agency to the market prices for two selected products. She finds savings of around 8% for toner cartridges and of around 37% for specific flights tickets (with very

flexible contracts and cancellation terms). In a recent paper, Kastanioti et al. (2013) find that the establishment in 2008 of the Health Procurement Committee in Greece had the effect of unifying tenders, and prices reduced overall by 10%. Moreover, framework agreement tenders for selected medical devices (prostheses, pacemakers, dialysis systems, lenses) and e-auctions for 32 active substances resulted in an abatement of purchasing prices of the order of 30-75% and 57%, respectively. Bandiera et al. (2009) provide an important comparison between centralized and decentralized procurement, and find that a central agency can produce considerable cost savings. Using Italian data on a set of 21 standardized items (such as paper, printers, gasoline, laptops, lunch vouchers), they estimate that public bodies that buy through CONSIP, the national procurement agency, save on average 28% of the purchase price. Moreover, the authors introduce a distinction between active and passive waste, where the former could be represented by corruption in procurement while the latter relates to inefficiency, i.e. to waste that does not procure a benefit for the buyer (for example the inability to lower costs because of low skilled employees).³ According to their estimates, the second type of waste counts much more (83% of total waste) than the waste due to corruptive practices.

3. The Italian context

3.1 The national purchasing body: CONSIP

Italy has its central agency, named CONSIP, which is a private company completely held by the Ministry of Economy and Finance. CONSIP was founded in 1997, initially to manage the information technology change in the former Ministry of Treasury. Subsequently, two years later, CONSIP was designed as the structure designed to buy goods and services for the Public Administration in order to rationalize the public expenditure through standardized purchase orders. In 2001 and 2002⁴ the role of CONSIP was reinforced, as it became mandatory for all central administrations to use the framework contracts subscribed by CONSIP, while it remained as an option for other public administrations. Nevertheless, since 2002, if a local administration decides to follow its own procedure for purchasing a specific good, even in the case of the existence of a framework for that good already signed by CONSIP, it is compulsory to use the prices negotiated by CONSIP as a starting point for its procurements. In 2003, laws⁵ weakened CONSIP's role by

³ However, as argued by Piga (2011), inefficiency, incompetence and corruption feed on each other and sometimes the distinction between these concepts is artificial.

⁴ Laws n. 388, December 23rd, 2000, and n. 448, December 28th, 2001.

⁵ Decree n. 143, June 24th, 2003, Law n. 326, November 24th, 2003, and Law n. 350, December 24th, 2003.

limiting its purchasing area and the compulsory requirement for the central administration. However, just one year later, its functions were again extended. In fact, starting from 2003, new rules⁶ modified the compulsory requirements for public administrations as well as the range of CONSIP's functions: essentially, CONSIP's agreements are mandatory for State administrations, while all the other public entities are required to use CONSIP prices and quality requirements as a benchmark for their own tenders.

At the time we are writing, the last main government intervention on centralized procurement is the "spending review" decree (D.L. 95/2012, then turned into law n. 135 of August 7th, 2012), an urgent measure which intended to rationalize public expenditure. To achieve this goal, the Italian Government places its trust in centralized procurement and in information and communication technologies (ICTs) as peculiar tools to diminish the costs for the procurement process. In fact, CONSIP's own research evaluates that, by aggregating demand from different public administrations, it is possible to save 15-20% of purchasing costs without reducing quality standards. The decree implements the use of internet platforms and forces central administrations and municipalities to use them for purchases valued less than the European threshold. It enlarges the number of entities that are obliged to use CONSIP contract frameworks and imposes their use for products such as fuel, electricity, telecommunication services. Moreover, the spending review decree introduces strong penalties for public administrators who sign public contracts in violation of the obligation of recurring to the centralized procurer. This violation implies a disciplinary offence and an administrative responsibility for the signer, and entails the nullity for that contract.

3.2 The Regional Purchasing Bodies

Italian Regions have the possibility to set up their own centralized purchasing bodies, which act on behalf of regional or local authorities. In 2001, the Ministry of Economy was given the task of improving the aggregation of local purchasing bodies as Provinces, Municipalities, *ASLs* (i.e. *Aziende Sanitarie Locali*, that is local health authorities), and Universities, and different laws were introduced or modified to implement the use of regional purchasing bodies.⁷ In particular, Law 266/2005 introduced the possibility for local units such as municipalities, provinces, consortia and "*comunità montane*", to group together and act as central purchasing bodies that sign framework

⁶ Law July 30th, 2004, Law n. 266, December 23rd, 2005, Law n. 244, December 24th, 2007, Decree n. 112, June 25th, 2008, Law n. 191, December 23rd, 2009.

⁷ In Italy, a province is an administrative division of intermediate level between a municipality and a region, similar to a county. A province is composed of many municipalities, and usually several provinces form a region.

agreements for their group members. Law 296/2006 introduced the so called “*sistema a rete*”, a network which can be used by regional central bodies and CONSIP in order to capitalize the different experiences, harmonize functions and tools, give evidence on best practices and incentivize a national e-procurement system. This ambitious project encountered some problems in its implementation, as observed by AVCP’s Census. The Authority monitored the activity of the Central Purchasing Bodies (*CPBs*) for the period 2007-2008, finding that in 2008 they were handling procedures for 9.7 billion euro (87% of which were in the health sector and concentrated in Northern Italy). In any case, the Census noticed many differences among the central bodies regarding the coverage in terms of users, the economic values and the functions involved. While reinforcing the role of CONSIP, the spending review decree has also redefined the role of the regional purchasing units. In fact, *CPBs* have to consider CONSIP’s frameworks for price and quality benchmarks but they are free to contract without being subject to the limitation imposed by the decree to all the other administrations. Furthermore, the limitations do not cover all the contracts signed by a single administration if the contract belongs to a regional framework. Finally, to facilitate demand aggregation, municipalities with less than 5000 inhabitants can opt between the introduction of a central purchasing unit and the use of the e-platform available from CONSIP or from their regional purchasing unit.

As will be explained in the next section, our dataset refers to pharmaceutical items which are purchased directly by the local health authority, by a consortium of *ASLs*, or by the regional purchasing body. Therefore, our maximum level of centralization is not the national agency, CONSIP, which is instead the object of analysis of the study by Bandiera et al. (2009).

3.3. The Italian public procurement of pharmaceuticals

The health sector represents a consistent part of GDP: the OECD average is 9.3%, ranging from 5.9% in Estonia to 17.7% in the United States, and the public source is higher than the private one almost everywhere. As pointed out in the introduction, from a public expenditure perspective, the health sector, as well as its pharmaceutical component, are a challenge, given the current economic crisis and the consequent pressure on national public debts.

The public procurement for the health sector varies across countries and has been largely studied in the academic literature. For example, Sorenson and Kanavos (2011) discuss the procurement of selected medical devices in England, France, Germany, Spain and Italy, highlighting that there has been a movement towards more centralized procurement with the

introduction of purchasing groups or consortiums. In a similar vein, Nollet and Beaulieu (2003) analyze the benefits of establishing purchasing groups by interviewing 73 individuals working in the health sector (as purchasers, suppliers, hospital CEOs, etc.) and coming from different countries (United States, Canada, France and Belgium).

Some data for the Italian context are provided by Calabrese et al. (2010), Vellez (2011), and by France et al. (2005). As highlighted by Calabrese et al. (2010, p. 3), the Italian public health sector is an interesting case, because both centralized and decentralized systems coexist: “*Italy – as many others European countries – has been experimenting with a new idea of public purchasing that allows public administration to purchase goods using alternative methods and practices in every stage of the purchasing process such as on-line purchasing, purchasing group, purchasing consortia and centralized purchase systems*”.

Briefly, the National Health System (NHS) is managed by both central and regional governments. While the central government is responsible for the general organization of the NHS and for the essential levels of care to be granted to all citizens, the Italian regions have the exclusive responsibility for the organization and administration of regional budget allocation and control. At the lowest level, the *ASLs* are in charge of coordinating and providing primary medical services (primary care, ambulatory specialist medicine, residential care) and secondary care (for acute and rehabilitation patients) for each regional area, through a network of hospitals and health care centers. While some single *ASLs* carry out public procurement on their own (i.e. following a decentralized system), some regions have introduced a centralized system, where procurement has been delegated to a central body (*Centrale di Acquisto Regionale* or *Centrale di Committenza Regionale*). In general, if a central unit is constituted, the *ASLs* located in the regional area have to procure through it.⁸ Finally, *ASLs* could also group together and designate one who is in charge of buying for the whole group. The latter procurement strategy could be considered as a hybrid model. In principle, hybrid systems could match the advantages of the other two systems: by exploiting the benefits of demand aggregation, *ASLs* that group purchases can bring cost savings (as in a centralized system), while at the same time they can have a better knowledge of the needs of procurers and of the reference market (as in a decentralized system). In fact, in our sample, a hybrid model is just a “larger” *ASL*, endowed with all specific expertise of employees in the health structure. Moreover, while a centralized system implies extra management costs (for example, the

⁸ *ASLs* can procure otherwise (on their own or grouping with other *ASLs*) if the good they need is not in the list of the goods acquired by the regional agency.

structural costs of the new body appointed to pull the decentralized needs), the hybrid system requires only networking costs. On the other hand, in areas plagued by corruption or endowed with low levels of institutional quality, a centralized system may be better equipped to pursue efficiency goals, since a central structure can be more sheltered from the conditions of operating in a weak institutional environment.

4. The dataset

As detailed above, the Italian health procurement system presents three types of procurement organizations: a centralized system (*Centrali di Committenza Regionale*), a decentralized model (single *ASL*), and a hybrid (group of *ASLs*) system. We investigate which type of procurement organization performs better using a unique dataset on drugs for hospital usage purchased by single *ASLs*, groups of *ASLs* and central (i.e. regional) units between 2009 and 2012. These data were collected from AVCP in April 2012 in order to compute the “reference prices”⁹ for goods acquired by public health purchasers. This special commitment was assigned to AVCP by the “spending review” Decree. The object of this decree, that has partially reformed the health sector procurement, was to rationalize the public health expenditure through the introduction of benchmark prices. Namely, if the price paid by a public health contractor for item A exceeds 120% of the reference price computed by AVCP, then the public procurer has to renegotiate with A’s seller that price in order to bring it back to the required threshold (i.e., reference price for item A plus 20%) or, even better, below it.

AVCP, in collaboration with *AGENAS*¹⁰, has firstly collected data on prices paid by public administrations for five health products which have been selected for their impact on the national health expenditure: drugs for hospital usage, medical devices, food service, cleaning service and laundry service. Regardless of the motivation behind the introduction of the reference prices and their effective application¹¹, this data collection represents an opportunity to study how prices vary across the different regions of the country. Most importantly, for the topic of this paper, it is a unique occasion to investigate if and how prices differ among the three procurement organizational structures of interest.

⁹ For more details on the reference prices see AVCP’s “Annual Relation 2012” at: http://www.avcp.it/portal/rest/jcr/repository/collaboration/Digital%20Assets/pdf/Relazione_2012.pdf (AVCP, 2013).

¹⁰ *AGENAS* is the National Agency for Regional Health Services, and provides technical and operational support for government health policies shared between the central government and the regions.

¹¹ AVCP faced the resistance of some pharmaceutical companies who have undertaken legal actions in order to block the publication of these prices.

Thanks to AVCP, we have been given the possibility to analyze drugs' prices. The data appear to be particularly interesting for at least three reasons. First, drugs' expenditure is a considerable part of the entire health spending. In particular, in 2010, the Italian pharmaceutical expenditure counted for the 1.24% of GDP, and the public sector financed about 75% of the total drugs' purchase. Second, AVCP data are relative to a short period of time (2009-2012); this is an important aspect, since prices could strongly vary across time, especially for drugs which are covered by patents¹². Third, AVCP gathered data regarding the procurement of the active principles in pharmaceutical products, rather than the final specific drug; this allows to compare highly standardized items. This means that we can observe and examine procurers' performance relating to almost identical items. We believe that these last two points constitute the major strengths of our analysis.

In 2012, AVCP interviewed 52 procurement agencies. The latter have been selected mainly taking into consideration the coverage index (i.e. the ratio between the number of drugs advertised in tenders by a specific agency and the total amount of drugs tendered in the region in which it is located). Data on drugs refer to 43 selected active principles (classified according to the Anatomical Therapeutic Chemical or ATC system). They are characterized by a specific dosage and a specific shape. This implies that for each ATC principle there could be several items (i.e. ATC x DOSAGE x SHAPE). In our data, 43 ATCs turn into 141 items. In the interviews, the 52 agencies have been asked to report the last paid price and purchased quantity of these 141 items. We restrict the dataset by dropping items with less than 10 observations and, keeping in mind the aim of our analysis, by dropping items that are bought using a procurement model which cannot be classified in one of our three categories (i.e., centralized, decentralized, or hybrid). Our final dataset contains 52 procurers, 41 ATCs, 116 items and 2343 observations.

Table 1 shows that the decentralized system has been preferred by 34 procurers (who bought on aggregate 933 items), while the other *ASLs* have chosen to aggregate purchases so as to form 10 regional bodies (who bought 666 items) and 8 hybrid units (who bought 744 items). Table 2 shows that there is a huge price variation (from 0.03 € to 1534 €) and that, on average, the price paid by centralized agencies (121 €) is lower than the price paid by hybrid (131 €) and decentralized

¹² We have controlled our data for this issue. For all items, there is no significant correlation between price and time.

procurers (150 €). The above characteristics are repeatedly met when we classify drugs according to different price ranges.¹³

5. Empirical strategy and results

In order to understand if there is any significant difference in paid prices among the three structures we estimate the following econometric models, which include also drugs, procurers, years as well as geographical areas dummies¹⁴:

$$\ln \text{PRICE}_{ijrt} = \alpha + \beta_1 \text{CENTR}_{ijt} + \beta_2 \text{HYBRID}_{ijt} \quad (1)$$

$$\begin{aligned} \ln \text{PRICE}_{ijrt} = \alpha + \beta_1 \text{CENTR}_{ijt} + \beta_2 \text{HYBRID}_{ijt} + \beta_5 \ln \text{POP}_{rt} + \beta_6 \ln \text{DSO}_{it} + \beta_7 \text{POLIT}_{rt} \\ + \beta_8 \ln \text{GDP}_{rt} + \beta_9 \text{RP}_{rt} \end{aligned} \quad (2)$$

where the index i indicates the procurer, j the item procured, r the area (province or region), and t the year.¹⁵ *CENTR* is a dummy that identifies centralized procurers, *HYBRID* is a dummy for hybrid procurer, while the omitted dummy is the decentralized agency.

While paid price could obviously be correlated with quantity, in the AVCP survey, unfortunately, only few procurers have reported quantity data. Some respondents refer that they have faced some difficulties in reporting this information because sometimes they did not know it or because they just knew the required quantity reported on the tender documents, which often did not match with the quantity actually purchased. Moreover, most of them asserted that they could not observe any relationship between quantity and prices. Some of them suggested that prices could be more correlated with the time of payment rather than with quantity. For instance, if the procurer usually pays in due time, then the seller is more prone to offer a lower price. For these reasons, instead of reported quantity, we use the number of residents of reference area as a proxy of potential users of the hospital services (*POP*). Since it is hard to disentangle the potential users of single health structures, we use population in the province in the case of single *ASL*s¹⁶ and regional

¹³ Unfortunately, for privacy reasons, we are forced to use ATC codes and we cannot disclose the different active principles used in the analysis.

¹⁴ Fixed effects could account for the presence of generic substitutes in procurement auctions, or for the effect of reference prices as well as of other factors affecting drug suppliers' bidding behavior.

¹⁵ Price and right-hand side non dichotomous variables have been log-transformed in order to mitigate data skewness and because coefficients can be easily interpreted as elasticities. However, we performed also regressions exhibiting linear and semi-log relationships, obtaining very similar results.

¹⁶ This could be a good proxy considering that AVCP has selected the most important procurers for each region in terms of coverage index. This implies that the single *ASL* considered should be the most important at least at province level.

population in case of both group of *ASLs*¹⁷ and centralized structures. Following what respondents have noticed, we control for payment delays. For drug payment delay we refer to *DSO* index (days sales outstanding) computed by Assofarmaco – Confindustria. Then, we use *DSO_{drug}* that is the number of delay days (yearly average) for drugs payments. Considering that the price offered by drugs sellers in auction in t could be more correlated with payment delay in time $t-1$ rather than in t , we compute a second variable, that is *DSO_{drugL1}*, i.e. the lagged *DSO_{drug}*. Unfortunately, Assofarmaco computes only payment delays at the regional level. Since Dirindin et al. (2012) find significant interregional differences in terms of payment delay, we use also a *DSO* measure for medical devices that is computed at single procurer unit level (*DSO_{med}*). Unfortunately, we have *DSO* for medical devices only for 2013.

RP is a dummy for a region where a repayment plan applies. A repayment plan is a special program for regions which exhibit a large deficit for health expenditure.¹⁸ Since the health budget is mainly managed at regional level, we check if different government coalitions have different attitude toward health expenditure. In particular, we include the following political regional variables: POLIT, which is equal to 1 if there is a right-wing government coalition, and Δ POLIT, which is a dummy equal to 1 if a majority change (from right to left or *vice-versa*) took place in the previous twelve months. Finally, GDP, the per capita value added of the reference area, takes into account the differences in income among Italian provinces. Indeed, richer areas may have more financial resources available and higher level of expertise, which could turn into better procurement activity and more convenient purchasing prices. Table 3 presents the descriptive statistics of the variables included in the analysis.

Table 4 presents the results of the estimates of models [1] and [2]. The coefficients indicate that centralized and hybrid systems perform better (in terms of awarded prices) compared to decentralized system. On average, the centralized (hybrid) procurer pays about 20%-23% (7%-9%) less than the decentralized agency. Such figures seem quite reasonable, with price reductions similar to the ones found by Bandiera et al. (2009) and by Kastanioti et al. (2013), for goods and services procured through the Italian and the Greek central agency, respectively.

Regional dummies show that procurers set in the central and southern parts of Italy perform worse than procurers operating in the north-west, and year dummies indicate a declining trend in

¹⁷ In the case of a group of *ASLs*, we are probably overestimating the potential users (since they are more than the number of residents in the province where that procurer unit is located, but lower than the residents in the region), but unfortunately we have no information on the number of *ASLs* which form each group.

¹⁸ The Italian regions most involved in the program are: Lazio, Abruzzo, Campania, Molise, Calabria.

paid prices across time. Ln GDP is negative and significant suggesting that procurers set in richer provinces perform better than the others. The dummy for repayment plans is negative and significant, as expected. Conversely, the coefficient relative to our proxy for quantity (i.e. residents in the area of interest for the procurer) is not significantly different from zero. Even if it could seem a puzzling result, it is in line with the observations reported by some workers we interviewed.¹⁹ Contrary to the results of Vellez (2011), who found that payment delay was directly discouraging participation and indirectly increasing prices, and to what some respondents were expecting, the signs of the coefficient of days of outstanding payments index is negative (the longer is the delay, the lower is the paid price).²⁰ Finally, ΔPOLIT exhibits a positive and significant coefficient, suggesting that procurers settled in areas in which there has been a majority change in the previous year are paying drugs at higher prices.²¹

5.1. The Role of Institutional Quality and Corruption

As highlighted in the introduction, the literature on fiscal federalism stressed the importance of institutions in shaping the relationship between decentralization and growth. Indeed, there is a growing literature on the link between the quality of government institutions and economic performance. For example, Di Liberto and Sideri (2015) find that the value added of Italian provinces in 2001 is significantly related to a composite measure of institutional quality.²² In order to test if the results reported in table 4, showing an average impact of centralization on pharmaceutical prices, are affected also by the quality of institutions prevailing in Italian provinces, we enrich model [2] by adding among the regressors the Governance indicator introduced by Kaufmann et al. (2010) and used, among others, by Nifo and Vecchione (2014).

$$\begin{aligned} \ln \text{PRICE}_{ijt} = & \alpha + \beta_1 \text{CENTR}_{ijt} + \beta_2 \text{HYBRID}_{ijt} + \beta_5 \ln \text{POP}_{rt} + \beta_6 \ln \text{DSO}_{it} + \beta_7 \text{POLIT}_{rt} + \beta_8 \ln \text{GDP}_{rt} \\ & + \beta_9 \text{RP}_{rt} + \beta_{10} \text{GOVERN}_r + \beta_{11} \text{GOVERN}_x \text{CENTR} + \beta_{12} \text{GOVERN}_x \text{HYBRID} \end{aligned} \quad (3)$$

¹⁹ In a similar vein, Vellez (2011) found for her sample of medical technologies that size was not associated to lower purchasing prices.

²⁰ Results of regressions in which DSO_{drugL1} or DSO_{drug} are alternatively tested are similar and available from authors upon request.

²¹ However, Table 3 highlights that a majority change occurred only for 4% of observations, so we cannot put too much emphasis to this somewhat puzzling result. POLIT does not seem to have a discernible impact in all specifications. Results are available upon request.

²² In particular, the measure is based on 14 different output indicators relating to five areas of public service provision (environmental protection, energy, health, education, judicial efficiency).

Following Nifo and Vecchione (2014), GOVERN is an index which summarizes the institutional quality in the province (or in the region, in the case of centralization) in which the procurer is located. This index includes five different dimensions of quality such as: voice and accountability (citizens' participation to public elections, number of associations and social cooperatives), government effectiveness (endowment of social and economic structures and quality of public polices in areas such as health, waste management, environment protection), regulatory quality (the ability of local administrators to promote and protect business activity), rule of law (crime levels, shadow economy, magistrate productivity, trial times), corruption (crimes against the public administration).²³

However, Breen and Gillanders (2012) argue that, while institutions are “the rules of the game in a society”, corruption requires a criminal intent to subvert such rules, and as such it must be treated as a distinct issue. For such a reason, we run also model [4], where INSTQUAL includes only four dimensions of institutional quality (voice and accountability, government effectiveness, regulatory quality, rule of law), as well as model [5], where the role of corruption is analyzed separately.

$$\begin{aligned} \ln PRICE_{ijrt} = & \alpha + \beta_1 CENTR_{ijt} + \beta_2 HYBRID_{ijt} + \beta_5 \ln POP_{rt} + \beta_6 \ln DSO_{it} + \beta_7 POLIT_{rt} + \beta_8 \ln GDP_{rt} \\ & + \beta_9 RP_{rt} + \beta_{10} INSTQUAL_r + \beta_{11} INSTQUAL \times CENTR + \beta_{12} INSTQUAL \times HYBRID \end{aligned} \quad (4)$$

$$\begin{aligned} \ln PRICE_{ijrt} = & \alpha + \beta_1 CENTR_{ijt} + \beta_2 HYBRID_{ijt} + \beta_5 \ln POP_{rt} + \beta_6 \ln DSO_{it} + \beta_7 POLIT_{rt} + \beta_8 \ln GDP_{rt} \\ & + \beta_9 RP_{rt} + \beta_{10} CORRUPT_r + \beta_{11} CORRUPT \times CENTR + \beta_{12} CORRUPT \times HYBRID \end{aligned} \quad (5)$$

Table 5 reports our main results. All specifications contain drugs, procurers, years as well as geographical areas dummies. The estimates show that the previous results, as far as the impact of POP, DSO, ΔPOLIT, GDP, RP, geographical and year dummies are concerned, are robust to the

²³ See Nifo and Vecchione (2013) for a detailed description of the elementary indexes use to build up the *GOVERN* variable, which ranges between zero and one.

inclusion of new controls. Moreover, GOVERN, INSTQUAL and CORRUPT²⁴ are negatively correlated to pharmaceutical prices.

The positive and significant coefficients on the interacted variables clearly indicate that the benefits of both *CENTR* and *HYBRID* are reduced in correspondence of high governance/institutional quality levels²⁵ (low corruption levels). To elaborate more on this, we report the impact using a centralized or a hybrid system for different levels of governance, institutional quality and corruption in Figures 1, 2 and 3.

To be more specific, Figure 1 reports on the vertical axis the following coefficients (and the same applies for Figures 2 and 3, where GOVERN is substituted by INSTQUAL and CORRUPT, respectively):

$$d(\text{Ln PRICE}) / d(\text{CENTR}) = \beta_1 + \beta_{11} * \text{GOVERN}$$

$$d(\text{Ln PRICE}) / d(\text{HYBRID}) = \beta_2 + \beta_{12} * \text{GOVERN}$$

Figure 1 shows that, at very low levels of governance, centralized and hybrid systems have a similar impact, since they both imply savings of around 45% with respect to a decentralized system. As far as the quality of governance increases, the savings reduce, at a faster rate for a hybrid system. For a local health unit located in a province endowed with very high governance quality, the benefits of regional centralization are about 4%, while recurring to a hybrid system would imply an increase in drugs' purchasing price of about 20%. In a similar vein, Figures 2 and 3 show that for very high corruption levels (very low institutional quality levels), the two systems have a similar positive impact, with a price rebate of 60% (40%), while for very low corruption levels, only centralization is effective in reducing purchasing prices.²⁶

²⁴ In order to be comparable to the other measures of institutional quality, the corruption index is constructed in such a way that a value of zero corresponds to maximum corruption, while one identifies minimum corruption.

²⁵ We have performed also regressions in which, instead of the composite index *INSTQUAL*, separate measures for voice and accountability, regulatory quality, rule of law and government effectiveness are introduced. Results confirm that each component of institutional quality has the effect of reducing pharmaceutical prices. Moreover, the interacted terms with the two centralization dummies confirm that both strategies are less effective in correspondence of high levels of institutional quality

²⁶ The corruption measure computed by Nifo and Vecchione (2013) is a weighted average of three indices: the number of crimes committed against the public administration, the number of city councils dismissed over "mafia infiltration", and the Golden and Picci (2004) index, which compares the value of public infrastructure with the costs borne by the government to build it. By running regressions in which we included only the Golden-Picci index or the index based on the number of crimes, as alternative measures of corruption (see Abrate et al. 2014, for more details), we obtained very similar results.

Our results contribute to the literature dealing with favoritism and corruption in public procurement (Burguet and Che, 2004; Lengwiler and Wolfstetter, 2006). For example, Lengwiler and Wolfstetter, (2006) review different kinds of corruption that have been observed in procurement auctions and discuss some tools which could be useful to fight corruption (i.e., the choice of the auction format, or the use of secure electronic bidding systems). The centralization/decentralization choice clearly affects the extent to which corruption and favoritism are plaguing the procurement process. One could argue that local administrators are more sensitive to pressures from local firms to obtain rents. Centralization involves a larger size of the tender, and leaves less opportunity for bribes and corruption. As to favoritism, if on the one hand local units have more information about local suppliers, which can be seen as a positive factor, on the other hand such a proximity could favor the chances for local bidding activity. To that respect, Vagstad (2000) shows how a decentralized organization could be better considering quality because of the importance of local information. However, she also points out that a local unit may favor local firms over foreign ones, which could cause inefficiencies.

6. Conclusion

Choosing between a centralized and a decentralized procurement policy is not an easy task. Many factors have to be taken into account, and it is difficult to ascertain *a priori* which is the best procurement system. This paper contributes to the literature by using as performance indicator the prices of selected drugs for hospital usage awarded by a sample of 52 Italian public procurers (ASLs) between 2009 and 2012. We group the ASLs into three categories: decentralized, centralized and hybrid procurers. This latter category refers to a model where some decentralized units group together and designate one ASL who procures for the whole group.

Our regressions show that, controlling for several covariates, centralized and hybrid systems perform better with respect to decentralized systems. In particular, in our favorite specification, the hybrid agency pays about 8% less and the centralized agency pays about 20% less than decentralized procurer. The average cost savings inflate up to 40%-60% for areas which are highly plagued by corruption or, more generally, which are characterized by low levels of institutional quality.

Overall, our results show that regional centralization and, to a lesser extent, the establishment of purchasing consortia among ASLs, could be effective ways to reduce the prices at which pharmaceutical products, which are rather standardized items, are bought. This is particularly true

for regions in which there are high corruption levels (low levels of institutional quality). On the contrary, according to our estimates, if corruption is very low (institutional quality is very high), the benefits from recurring to a centralized system reduce from 40% (60%) to 5%, while the advantages of using a hybrid system disappear. From a policy standpoint, therefore, our findings are supportive of the view that centralization, other than allowing the exploitation of scale economies, could be also a good strategy to shelter *ASLs* from corruption practices.

References

Abrate G., Erbetta F., Fraquelli G., Vannoni D. (2014), The Costs of Corruption in the Italian Solid Waste Industry, *Industrial and Corporate Change*, DOI: doi:10.1093/icc/dtu014

Albano G.L., Sparro M. (2010), Flexible Strategies for Centralized Public Procurement, *Review of Economics and Institutions*, 1 (2), Article 4, 1-32.

Arvate P., Barbosa K., Gambardella D. (2013), Generic-branded Drug Competition and the Price of Pharmaceuticals in Procurement Auctions', *CMICRO Working Paper Series*, 333, Sao Paulo School of Economics.

AVCP - Italian Authority for the Supervision of Public Contracts (2011), *Indagine Conoscitiva sulle Gare per la Fornitura di Farmaci*, Rome, available at: <http://www.anticorruzione.it/portal/public/classic/AttivitaAutorita/Pubblicazioni/RapportiStudi/RelazioneFarmaci/>.

AVCP - Italian Authority for the Supervision of Public Contracts (2013), *Annual Report for 2012*.

Bandiera O., Prat A., Valletti T. (2009), Active and Passive Waste in Government Spending: Evidence from a Policy Experiment, *The American Economic Review*, 99(4), 1278-1308.

Blochliker H., Egert B., Fredriksen K. (2013), Fiscal Federalism and its Impact on Economic Activity, Public Investment and the Performance of the Educational Systems, *Economics Department Working Papers*, 1051, OECD, Paris.

Breen M., Gillanders R. (2012), Corruption, Institutions and Regulation, *Economics of Governance*, 13:263-285.

Burguet R., Che Y-K (2004), Competitive Procurement with Corruption, *Rand Journal of Economics*, 35, 1, 50-68.

Calabrese C., Delbufalo E., Fiorani G., Frey M., Meneguzzo M. (2010), *Centralization and Networking in Italian NHS*, European Benchmarking and Performance Evaluation.

Carone G., Schwierz C., Xavier A. (2012), Cost-Containment Policies in Public Pharmaceutical Spending in the EU, *European Economy*, Economic Papers, 461.

Cousins P., Spekman R. (2003), Strategic Supply and the Management of Inter and Intra Organizational Relationships, *Journal of Purchasing & Supply Management*, 9, 19–29.

Di Liberto A., Sideri M. (2015), Past Dominations, Current Institutions and the Italian Regional Economic Performance, *European Journal of Political Economy*, 38: 12-41.

Dimitri N., Dini F., Piga G. (2006), When Procurement Should be Centralized?, in Dimitri N., Piga G., Spagnolo G. (eds.), *Handbook of Procurement*, Cambridge University Press, Cambridge, N.Y..

Dirindin N., Piacenza M., Sorrenti G., Turati G. (2014), I Tempi di Pagamento della Pubblica Amministrazione. Il Caso della Sanità, *Politiche Sanitarie*, 15, 3, 115-132.

Filippetti A., Sacchi A. (2013), Fiscal Decentralization and Economic Growth Reconsidered: The Role of Institutional Setting, *Working Paper SSRN*, December 30th, available at: <http://dx.doi.org/10.2139/ssrn.2373164>.

France G., Taroni F., Donatini A. (2005), The Italian Health-Care System, *Health Economics*, 14: S187-S202.

Golden M.A., Picci L., (2005), Proposal for a New Measure of Corruption, Illustrated with Italian Data, *Economics and Politics* 17 (1): 37-75.

Guccio C., Pignataro G., Rizzo I. (2014), Do Local Governments Do it Better? Analysis of Time Performance in the Execution of Public Works, *European Journal of Political Economy*, 34, 237-252.

Johnson P., Leenders M., McCue C. (2003), A Comparison of Purchasing's Organizational Roles and Responsibilities in the Public and Private Sector, *Journal of Public Procurement*, 3 (1), 57-74.

Karjalainen K. (2011), Estimating the Cost Effects of Purchasing Centralization—Empirical Evidence from Framework Agreements in the Public Sector, *Journal of Purchasing and Supply Management*, 17, 2, 87-97.

Kastanioti C., Kontodimopoulos N., Stasinopoulos D., Kapetaneas N., Polyzos N. (2013), Public Procurement of Health Technologies in Greece in an Era of Economic Crisis, *Health Policy*, 109, 7-13.

Kaufmann D., Kraay A., Mastruzzi M. (2010), The Worldwide Governance Indicators. Methodology and Analytical Issues, *Policy Research Working Paper*, 5430, The World Bank, Washington DC.

Lengwiler Y., Wolfstetter E. G. (2006), Corruption in Procurement Auctions, *Discussion Paper SFB/TR 15*, Humboldt University.

Nifo A., Vecchione G. (2014), Do Institutions Play a Role in Skilled Migration?, *Regional Studies*, 48:10, 1628-1649.

Nollet J., Beaulieu M. (2003), The Development of Group Purchasing: An Empirical Study in the Health Care Sector, *Journal of Purchasing and Supply Management*, 9 (1), 3-10.

OECD (2000), Centralized and Decentralized Public Procurement, *Sigma Papers*, No. 29, OECD Publishing.

OECD (2013a), *Government at a Glance 2013: Procurement Data*, OECD Publishing, Paris, DOI:[10.1787/gov_glance-2013-en](https://doi.org/10.1787/gov_glance-2013-en).

OECD (2013b), Pharmaceutical Expenditure, in *Health at a Glance 2013: OECD Indicators*, OECD Publishing, Paris, DOI:[10.1787/health_glance-2013-67-en](https://doi.org/10.1787/health_glance-2013-67-en).

OECD (2013c), *Fiscal Federalism 2014: Making Decentralisation Work*, OECD Publishing, Paris, DOI:[10.1787/9789264204577-en](https://doi.org/10.1787/9789264204577-en)

Piga G. (2011), A Fighting Chance Against Corruption in Public Procurement, in Rose-Ackerman S., Soreide T. (eds) *International Handbook of the Economics of Corruption*, Volume II, ch. 5, 141-175, Edward Elgar, Cheltenham, UK.

Reed T.S., Bowman D.E., Knipper M.E. (2005), The Challenge of Bringing Industry Best Practices to Public Procurement: Strategic Sourcing and Commodity Councils, in Thai, K.V., Araujo, A., Carter R.Y., Callander G., Rabkin D., Grimm R., Jensen K.R.E., Lloyd R.E., McCue C.P., Telgen J. (Eds.) *Challenges in Public Procurement: An International Perspective*, Boca Raton, Florida: PrAcademic Press.

Sorenson C., Kanavos P. (2011), Medical Technology Procurement in Europe: A Cross-Country Comparison of Current Practice and Policy, *Health Policy*, 100, 43-50.

Tella E., Virolainen V., (2005), Motives Behind Purchasing Consortia, *International Journal of Production Economics*, 93–94, 161–168.

Thai, K.V. (2009), International Public Procurement: Concepts and Practices, in Thai, K. V. *International Handbook of Public Procurement*, ch. 1, 1-24. CRC Press, Boca Raton, Florida.

Vagstad, S. (2000), Centralized vs. Decentralized Procurement: Does Dispersed Information Call for Decentralized Decision-Making?, *International Journal of Industrial Organization*, 18, 949–963.

Vellez M. (2011), Auctions versus Negotiation: Evidence from Public Procurement in the Italian Healthcare Sector, *CEIS Research Paper Series*, 9, 4, No. 191, Rome.

Table 1. The Three Purchasing Systems

	Number of procurers	Number of Items Acquired
Decentralized	34	933
Centralized	10	666
Hybrid	8	744
Total	52	2343

Table 2. ATC Prices and Procurement Method

ATC price range (ATC codes)	Decentralized			Centralized			Hybrid		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
0-10 € (ATC codes: 12, 38, 34, 10, 35, 28, 17, 26, 33, 5, 7, 27)	3.04	0.03	21.00	2.72	0.00	28.47	2.76	0.03	23.80
11-50 € (ATC codes: 24, 16, 30, 22, 15, 29, 39, 3, 21, 18, 19)	25.04	1.76	243.66	18.91	1.35	119.10	24.58	1.72	220.00
51-200 € (ATC codes: 25, 36, 14, 40, 13, 11, 20)	94.57	9.02	825.00	84.90	8.02	675.00	90.69	8.50	750.00
201-500 € (ATC codes: 6, 1, 4, 23, 2)	348.51	104.60	507.57	347.66	78.37	507.57	352.90	145.00	507.57
501-1534 € (ATC codes: 41, 8, 37, 9, 31, 32)	869.14	263.69	1534.25	768.54	250.68	1450.25	839.09	263.68	1534.25
Total	149.51	0.03	1534.25	120.76	0.00	1450.25	131.44	0.03	1534.25

ATC codes are listed in order of increasing drugs' prices.

Table 3. Descriptive Statistics

Variable	Description	Mean	St.dev.	Min	Max	Nobs
PRICE	Price paid per item (euro)	131.263	284.029	0.003	1534.250	2343
Ln PRICE	Log of price paid per item	2.492	2.724	-5.878	7.336	2343
DECENTR	Decentralized procurer	0.398	0.490	0	1	2343
CENTR	Centralized procurer	0.284	0.451	0	1	2343
HYBRID	Hybrid procurer	0.318	0.466	0	1	2343
GOVERN	Governance Index of Province^a	0.634	0.214	0	1	2343
INSTQUAL	Institutional Quality Index of Province^a	0.612	0.225	0	1	2343
CORRUPT	Corruption Index of Province ^a	0.766	0.161	0	1	2343
NORTH-W	Dummy for North-West regions	0.278	0.448	0	1	2343
NORTH-E	Dummy for North-East regions	0.123	0.329	0	1	2343
CENTER	Dummy for Central regions	0.216	0.412	0	1	2343
SOUTH	Dummy for Southern regions and Islands	0.382	0.486	0	1	2343
YEAR2009	Dummy for 2009	0.032	0.175	0	1	2343
YEAR2010	Dummy for 2010	0.256	0.437	0	1	2343
YEAR2011	Dummy for 2011	0.510	0.500	0	1	2343
YEAR2012	Dummy for 2012	0.202	0.402	0	1	2343
Ln DSO _{med}	Log of Payment delay (days) of procurer: mean 2013	5.264	0.577	4.402	7.262	2343
POLIT	Right-wing regional coalition	0.394	0.489	0	1	2343
ΔPOLIT	Change of majority in the previous 12 months	0.043	0.203	0	1	2343
RP	Dummy for regions involved in repayment plans	0.099	0.299	0	1	2343
GDP	Per capita GDP (euro)	23845	6476.917	13122	43688	2343
Ln GDP	Log of per capita GDP	10.043	0.272	9.482	10.685	2343
Ln POP	Log of inhabitants	14.488	1.085	11.749	16.088	2343

^aSource: Nifo and Vecchione (2013)

Table 4. Estimates of Models [1] and [2]

VARIABLES	Ln PRICE (1)	Ln PRICE (2)
CENTR	-0.230*** (0.030)	-0.201*** (0.045)
HYBRID	-0.072*** (0.024)	-0.087*** (0.029)
NORTH-E	0.030 (0.031)	0.031 (0.031)
CENTER	0.206*** (0.037)	0.202*** (0.039)
SOUTH	0.178*** (0.023)	0.179*** (0.041)
YEAR2010	-0.094 (0.059)	-0.093 (0.061)
YEAR2011	-0.213*** (0.058)	-0.197*** (0.059)
YEAR2012	-0.334*** (0.063)	-0.284*** (0.068)
Ln DSO _{med}		-0.059* (0.033)
Ln GDP		-0.118* (0.063)
RP		-0.134*** (0.043)
ΔPOLIT		0.305*** (0.060)
Ln POP		0.007 (0.015)
Observations	2,343	2,343
R-squared	0.973	0.973

Dependent variable: Ln PRICE
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5. Estimates of Models [3], [4] and [5]

VARIABLES	Ln PRICE (3)	Ln PRICE (4)	Ln PRICE (5)
CENTR	-0.445*** (0.118)	-0.622*** (0.142)	-0.413*** (0.127)
HYBRID	-0.458*** (0.101)	-0.592*** (0.151)	-0.437*** (0.109)
NORTH-E	0.008 (0.037)	0.032 (0.031)	0.012 (0.038)
CENTER	0.178*** (0.044)	0.159*** (0.044)	0.186*** (0.044)
SOUTH	0.188*** (0.057)	0.143*** (0.049)	0.194*** (0.053)
YEAR2010	-0.077 (0.064)	-0.062 (0.062)	-0.078 (0.064)
YEAR2011	-0.196** (0.059)	-0.183*** (0.059)	-0.194*** (0.059)
YEAR2012	-0.307*** (0.069)	-0.291*** (0.068)	-0.298*** (0.069)
Ln DSO _{med}	-0.053* (0.032)	-0.048 (0.033)	-0.055* (0.033)
Ln GDP	-0.158** (0.075)	-0.150** (0.070)	-0.145** (0.062)
RP	-0.139*** (0.047)	-0.128*** (0.048)	-0.145*** (0.049)
ΔPOLIT	0.310*** (0.076)	0.318*** (0.067)	0.311*** (0.077)
Ln POP	-0.004 (0.015)	-0.022 (0.017)	-0.022 (0.015)
GOVERN	-0.421** (0.165)		
GOVERNxCENTR	0.407** (0.159)		
GOVERNxHYBRID	0.681*** (0.167)		
INSTQUAL		-0.601*** (0.149)	
INSTQUALxCENTR		0.584*** (0.183)	
INSTQUALxHYBRID		0.728*** (0.209)	
CORRUPT			-0.387** (0.183)
CORRUPTxCENTR			0.357** (0.169)
CORRUPTxHYBRID			0.640*** (0.180)
Observations	2,343	2,343	2,343
R-squared	0.973	0.973	0.973

Dependent variable: Ln PRICE
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 1. Effect of Centralization on Pharmaceutical Prices for Different Levels of Governance

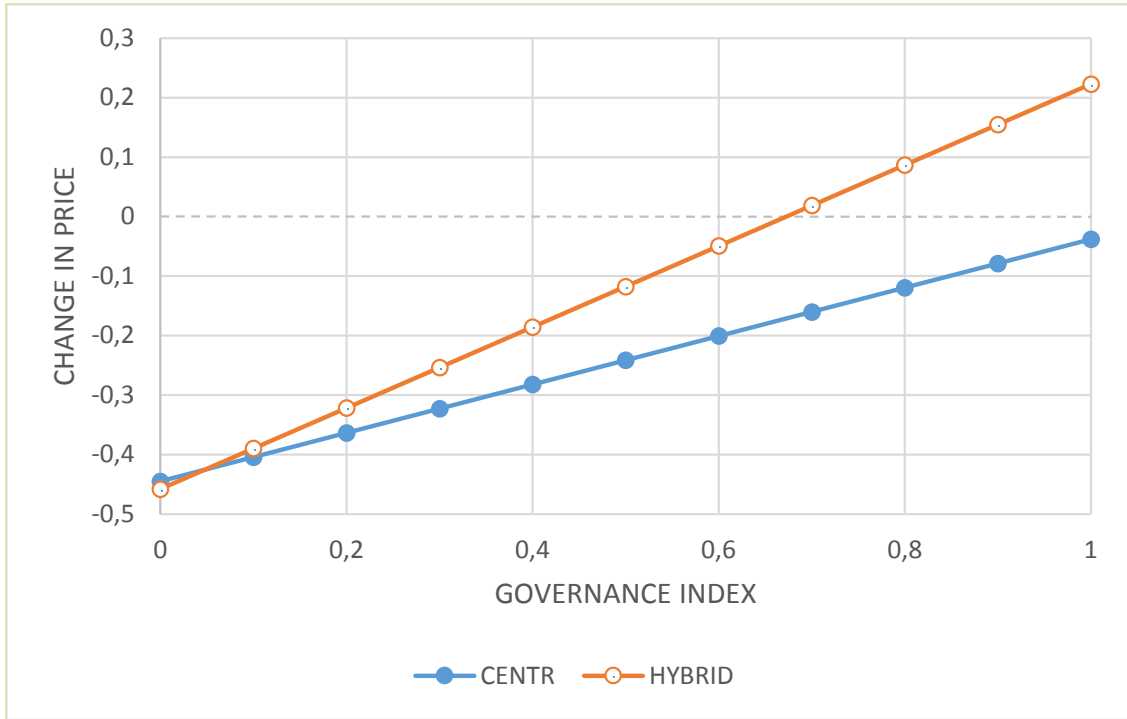


Figure 2. Effect of Centralization for Different Levels of Institutional Quality

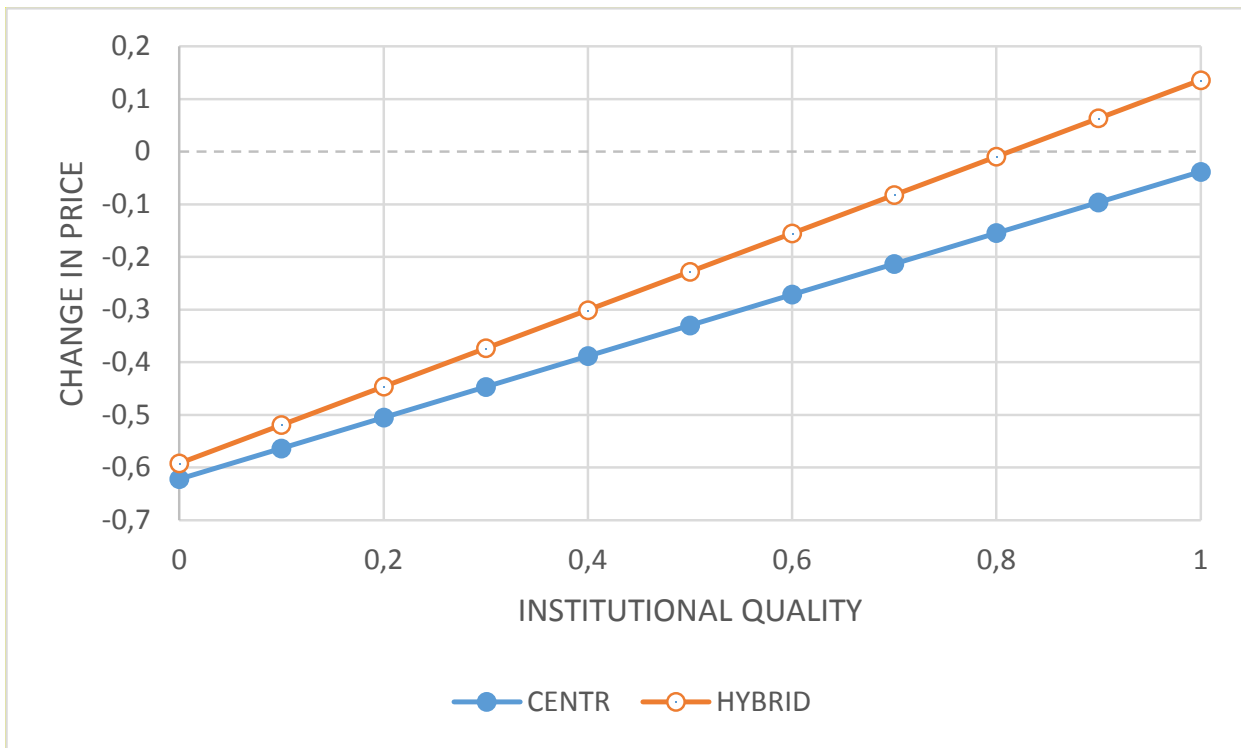


Figure 3. Effect of Centralization for Different Levels of Corruption

