THE DETERMINANTS OF SUPPLIERS' PERFORMANCE IN E-PROCUREMENT: EVIDENCE FROM THE ELECTRONIC PUBLIC ADMINISTRATION'S MARKETPLACE (MEPA)[1]

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ABSTRACT. Participation of small firms in the market for public contracts is a key policy issue. E-procurement is becoming a way through which such participation can be made more effective. Using a large sample of transactions completed through the MEPA (the Electronic Public Administration's Marketplace) in the period 2004-2007 we show that (very) small suppliers are arguably the most represented group of firms in the Marketplace, absorbing more than 60% of awarded contracts and 42% of total transactions value. Regression analysis, however, provides a more complete picture about the role of size and other factors potentially affecting the suppliers' success. Measuring performance with the frequency of awarded contracts (Y), the estimated predicted value of Y varies with the firm's *size* in a direction that is not in favour of the smallest suppliers (i.e., micro suppliers). *Location* and degree of *loyalty* with buyers emerge also as relevant explanatory variables. SMEs appear as successful as large suppliers. Surprisingly, micro suppliers appear less successful than all other suppliers. Success increases when suppliers are located in the most developed areas (North), and are more inclined to serve a restricted pool of purchasing administrations.

INTRODUCTION

E-procurement is increasingly recognized as an effective tool to reduce purchasing costs and streamline processes in both private and public[2] sector. According to the European Commission's estimates, "if

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online procurement is generalised, it can allow governments to save up to 5% on expenditure and up to 50-80% on transaction costs for both buyers and suppliers."[3]

The recent trend of demand aggregation (that is, centralization) in public procurement – witnessed by the several central purchasing bodies created in the early 2000 in Europe and in the U.S.[4] – is often accompanied by a more intensive use of e-procurement. Coupling centralization with e-procurement may, in fact, improve the efficiency of procurement processes (Somasundaram, 2004). Well designed e-procurement strategies, moreover, are able to soften potentially adverse effects of centralization – such as hampering smaller firms' access to the procurement markets – and therefore can encourage full participation of *all* firms in the competition for public contracts. One of the most pressing issues in the political agenda is indeed to reconcile (increased efficiency from) demand aggregation with a more extensive participation of smaller firms.[5]

After Consip S.p.A. (Consip, henceforth) was mandated by the Italian Government to operate as a central procurement agency in 2000, Italy has been among the first countries in Europe to raise the challenge, seeking for the most effective ways to pursue at the same time a greater demand aggregation and participation of smaller firms in the procurement market. The Electronic Public Administration's Marketplace (MEPA), launched in 2003, is arguably the most important e-procurement tool designed so far. By exploiting the benefits of web-based/internet procurement, Consip took the role of a "market maker", by setting up an e-marketplace for acquisitions below the EU threshold. The Marketplace connects thousands of public bodies (PBs) (both at a central and local level) distributed all over the Italian territory with a currently large set of micro and small, but also medium and large suppliers. Public bodies and suppliers have today access to a free trading platform – an "open market" – populated by many potential sellers/buyers other than those usually present in each geographical area.

The Marketplace enables PBs to purchase directly from e-catalogues of qualified suppliers or to compare products and prices by making Requests for Quotations (RFQs).[6] In 2007, the volume of all purchases completed through the MEPA since its launch in 2003 achieved €160 Millions. Pushed also by recent legislative modifications[7] – that made the use of the Marketplace compulsory for central public bodies – the MEPA

is playing a key role in the Italian public e-procurement scenario, absorbing about 80% of annual e-catalogue-based transactions of *all* Italian PBs.[8]

After five years of activity, the level of development of the MEPA is such that we can open the "black box" and start analyzing what has happened, especially in terms of structure of the supply and characteristics of most active suppliers. Looking at available data concerning RFQs, transactions appear rather concentrated in the hands of a restricted pool of suppliers. Despite concentration, data exhibit a great dispersion in the number of awarded contracts. This is essentially due to the fact that, despite active bidding, over 50% of suppliers is never awarded a contract, while the top 1% accounts for more than 20%.[9] One issue worth addressing is indeed the identification of the characteristics of this set of "top suppliers" and, symmetrically, what factors affect the low performance (in terms of awarded contracts) of many other suppliers. In more general terms, we look at the determinants of suppliers' success in the MEPA. In answering this question we will also be able to investigate whether (and in what direction) firm's size is a relevant characteristics for success, therefore providing some insights on the effective role of the MEPA in promoting the inclusion of smaller firms in the market for low-value public contracts.[10]

To this end, we analyze a unique, large sample of 3.360 RFQs completed through the MEPA n the period 2004-2007. Basic descriptive statistics show that "micro" suppliers, defined as those with at most 9 employees, are arguably the most represented group of firms in the Marketplace, absorbing 61% of RFQs and 42% of the volume of the overall transactions. However, when controlling for i) bidding for a RFQ, ii) location, iii) revenue and iv) other characteristics, the picture appears rather different. Measuring suppliers' performance with the frequency of awarded contracts (Y) over the sample period, estimations suggest that the predicted value of Y varies with the firm's size in a direction that is not in favour of the *smallest* suppliers (i.e., micro suppliers). Most performing suppliers are non-micro suppliers (small, medium and large) based in the North, more inclined to serve a selected pool of purchasing PBs. Small and medium enterprises (SMEs) appear as performing as large suppliers. Micro suppliers are, instead, significantly less performing than all other suppliers. Location, size and degree of loyalty with buyers emerge therefore as relevant factors explaining performance.

Descriptive statistics also suggest that public bodies located in historically less developed areas tend to award a large fraction of contracts to non-local suppliers. Public bodies tend to purchase from non-local suppliers only if they are more efficient or able to fit their needs. One possible explanation of this finding is that the efficiency advantage of non-local suppliers more that compensate higher transaction/transportation costs.

The rest of the paper is organized as follows. We first survey the economic literature on e-procurement and on-line trading. In Section 3, we describe the MEPA's institutional/legal framework and stated goals. Section 4, is dedicated to the evolution and the performance of the MEPA in the period 2004-2007. We focus more on the dynamics of transactions, volumes, and registered users (demand side). In Section 5, we look in more detail at the supply side, in terms of number, and size and performance of suppliers. After a brief description of the estimation methodologies, Section 6 presents the results on the determinants of suppliers' performance. Section 7 concludes.

RELATED LITERATURE

Most of the economic and business research on e-procurement is concentrated on popular online platforms such as the one of eBay and Amazon. These marketplaces are today well developed. In the last ten years, they have been providing theorists with puzzling phenomena to ruminate, and econometricians with valuable data to analyze, IT experts/engineers with ideal environments to study technological evolutions and applications for e-commerce.

B2G and other public e-procurement marketplaces, instead, have been launched only recently by public authorities.[11] Economic research in this area is therefore only at its infancy. Nonetheless, economists and e-business researchers have already started addressing important issues. Some of the most fertile fields of research are across economics and business. One is the relationships between e-procurement and centralization (Somasundaram, 2004; Subramaniam and Shaw, 2003; Neef, 2001). Another field is the determinants of e-procurement (Moon, 2005). Dimitri, Dini and Piga (2006) present a survey on these topics.

Despite the economic literature on e-platforms being very recent, research has already produced insightful results. Most theoretical

research relates to the field of "two-sided markets". In this field, researchers have mainly focused on two main issues known as the "chicken and egg problem" (Armstrong, 2006; Gaudeul and Jullien, 2001; Rochet and Tirole, 2004; Jullien, 2005), and "competing e-platforms" (Caillaud and Jullien, 2003; Rochet and Tirole, 2003). The empirical literature on e-procurement focuses mainly on big B2B platforms for which valuable data are available. Most papers look at the issue of price formation in e-auctions (such as the ones performed by eBay and Amazon) and the effects of online reputation/feedback mechanisms on participation and bidding behaviour. The role of online feedback mechanisms has also been extensively analyzed. Jullien (2006), Dellarocas (2007) and Bajari and Hortacsu (2004) provide extensive surveys on the topic.

MEPA: THE INSTITUTIONAL CONTEXT

Italy was one the first EU countries to adopt an e-procurement regulation. With the Presidential Decree No. 101/2002 the Italian Government introduced the use of digital procedures in public procurement allowing the Italian public sector to perform acquisitions below the EU threshold through the Public Administration Marketplace. The MEPA was created to promote electronic-based procurement and to streamline purchasing processes. More generally, it aims at changing the culture in the current practice of public purchasing management.

The MEPA is conceived, at its core, as a complementary tool with the set of framework contracts that Consip awardes on behalf of PBs for acquisitions above the EU threshold. Very often, however, small firms[12] cannot handle high-value framework contracts, usually resulting from demand aggregation of many PBs.[13] As a result, the Italian policy makers created the MEPA in order to have micro and SMEs in a better position to be awarded public contracts below the EU threshold.

The Marketplace is open to qualified suppliers according to non-restrictive selection criteria. Suppliers can provide a non-binding geographical area of coverage for their business. After qualification, suppliers' catalogues are uploaded into the MEPA, displayed in a dedicated web site and thus made available to the entire community. Catalogues are presented in a standardized template in order to make easier for PBs the evaluation of different products. Any PB can freely

register to the Marketplace, browse catalogues, compare products and prices, make a request for quotation or purchase directly from e-catalogues. The entire transaction process is digital, using digital signature in order to ensure legal compliance and overall transparency of process. Figure 1 provides a conceptual scheme of the Marketplace. The MEPA is not fee-based. Business is financed through the Ministry of Economy and Finance's (MEF) transfers to Consip.

Potential advantages to PBs would include:

- Reduction of purchasing and transaction costs;

- Development of human capital;

- Broadening of suppliers base;

- Enhanced transparency and ease of comparison among different goods/services;

- Purchases logging and subsequent expenditure monitoring.

Potential advantages for suppliers include:

- Selling cost reduction (due to broadening of potential customers base, lower intermediation costs and inexpensive digital platform);

- Major visibility with respect to the span of PBs;

- B2G introduction in addition to existing B2B and B2C.

- Extending the platform of potential buyers.

FIGURE 1
MEPA: The Conceptual Scheme
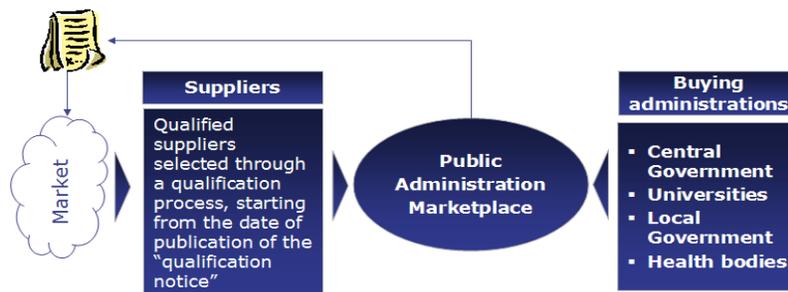
E-Procurement Tools in the MEPA

Public bodies can purchase goods and services on the MEPA by means of two alternative tools:

- Direct Purchase (DP), and

- Request for Quotation (RFQ).

The DP allows the PB to buy directly from the e-catalogue at a pre-fixed (i.e., posted) price. It is usually adopted to purchase very low-value items. It can also be suitable when the PB needs to satisfy urgent needs thus avoiding delays generated by a competitive procedure. The RFQ is a competitive selection procedure through which the PB solicits a certain group of suppliers to submit a tender. Responding suppliers provide both a price quotation and the details of technical/quality improvements when required. The contract is awarded to the most preferred price-quality combination without using an explicit, that is, publicly announced, scoring rule. Thus PBs have some discretionary power in awarding RFQs. Contracts may be awarded to a supplier who is not first in the *price ranking* of the product but, for instance, offers valuable services that are not offered by other suppliers (e.g., fast shipping) or is able to deliver it at lower costs. A RFQ is then conceived as a way to introduce some degrees of competition in the acquisition of relatively more valued product/services.

EVOLUTION OF THE MEPA (2004-2007)

Overview

At the end of 2007 the MEPA achieved the following results: 1.250 registered Purchasing Units (PUs),[14] more than 52.000 transactions (including both RFQs and DPs), for a total value of about €160 Millions (see Table 1). In 2007, all business indicators improved considerably. Transaction volumes doubled with respect to 2006 and the number of transactions became 2.5 time the value of 2006. The exponential growth of the last year is also due to the 2007 Financial Law that made compulsory the use of MEPA for some PBs (mainly central government). The average value per transaction was €2.640 in 2004 and 2.969 in 2007, which corresponds to a 12.5% increase over the same period. Cumulative data indicate an increase up to €3.048 (+15%) in the average awarded value 2004-2007.

TABLE 1
Number of Transactions and Values (2004-2007)

Year	2004	2005	2006	2007	Cumulative
Transactions	3.143	9.675	11.467	28.168	52.453
Millions €	8,3	29,90	38,04	83,64	159,88

Source: Bertini and Vidoni (2007).

Table 2 illustrates the evolution of registrations to the marketplace. Registrations have been steadily growing over the three years. In early February 2008, PUs were almost 5.900, with an increase of about 457% with respect to 2004. One important indicator is the growth of "active" purchasing units. These are those PUs who have purchased at least once in the current year. Active users were 1.097 in December 2005, 1.253 in 2006. In 2007, they achieved 2.726 (+118% over 2006): about 50% of registered PUs adopted the MEPA for at least one purchase.

"Loyals", namely those users who have bought at least once in the current *and* the previous year, were 600 in 2006 and 714 in 2007. However, in 2007 the share of loyal PUs over active (714/2726) is 26%. In 2007 the fraction of loyal over active halved in 2007. This is because the number of registrations increased significantly and much more than the "loyals" because of the new rules making the MEPA compulsory for central bodies.

TABLE 2
Purchasing Units in the Period 2004-2007

	2004	2005	2006	2007	2008 (10/02)
Registered	1.288	1.038	601	2.185	228
Cumulative Registered	1.288	2.326	2.927	5.653	5.888
Active	-	1.097	1.253	2.726	-
Loyal	-	-	600	714	-
New Entry	-	-	653	2.012	-

On the supply side, 1.293 (active) suppliers are registered in the MEPA, accounting for 2050 e-catalogues (as of January 2008).[15] ICT and office supplies represent a large fraction of total catalogues (78%) as reported in Table 3.

TABLE 3
Distribution of Catalogues for Supplies, 2008

At January 2008: 1.293 Stayers; 2050 catalogues uploaded				
ICT	Office	Services	Health materials	Others
43.5%	34.5%	14%	1%	7%

THE SUPPLY SIDE: BASIC STATISTICS

Before investigating the determinants of suppliers' performance we provide an overview of the supply side of the MEPA. We look in more detail at the information contained in the large sample of transactions drawn from MEPA in the period 2004-2007. Table 4 reports a summary of the sample data. We focus our attention on purchases performed through RFQs. There are several reasons to have a closer look at RFQs rather than DPs:

- They cover 65% of total value in our sample;

- By looking at direct purchases we only observe the selling supplier (who is committed to sell at a predetermined price that is posted in the e-catalogue), whereas the analysis of RFQs reveals how all

TABLE 4
Summary of the Sample (January 2004 – May 2007).

	Volume	%	No. transactions	%	Average value
RFQ	**€50.557.040**	**65%**	**3.360**	**14%**	**€15.046,74**
DP	€ 26.997.540	35%	20.188	86%	€ 1.337,31
Total	€ 77.554.580	100%	23.548	100%	€ 3.293,47

invited suppliers respond and, most importantly, which bid is successful;

- The use of discretionary power by PUs may reveal the latter's purchasing patterns/preferences.

The dataset comprises detailed information on 3.360 RFQs and 1.351 invited suppliers. 1053 suppliers are invited to provide quotations for a "single" category of supply (e.g., ICT). 281 out of 1053 suppliers were invited to submit proposals for a "bundle" of supplies , 50% of which regarded the bundle ICT + office materials). 425 out of 1053 placed a bid after PUs invitation. Table 5 shows the distribution of suppliers by dimension as measured by the number of employees.[16]

Table 5-6 report that micro suppliers are 54% of total active suppliers in our sample, covering 61% of awarded RFQ and 42% of total transaction volume. Total transaction volume declines with size. Micro suppliers' volume is 7 times higher than large suppliers' (Figure 2). However, the average awarded contract value increases with the supplier's size (Figure 3). This suggests that small suppliers are awarded many low-value RFQs, while larger suppliers are awarded few but larger RFQs.

TABLE 5
Distribution of Suppliers (01/2004-05/2007)

Firm Size	Freq.	Percentage	Cum.
Micro	529	53.87	53.87
Small	287	29.23	83.10
Medium	103	10.49	93.58
Large	63	6.42	100.00
Total	982	100.00	

TABLE 6
Distribution of RFQs by Suppliers' Size

Size	N. of awarded RFQ	Average value of awarded RFQ	Total Value of awarded RFQ
Micro	2060 (61,3%)	€ 10.241,9	€ 21.098.232 (41,8%)
Small	850 (25,4%)	€ 18.289,6	€ 15.546.192 (30,7%)
Medium	361 (10,7%)	€ 29.678,3	€ 10.713.869 (21,2%)
Large	89 (2,6%)	€ 35.940,9	€ 3.198.747 (6,3%)
Overall	3.360	€ 15.046,7	€ 50.557.040

FIGURE 2
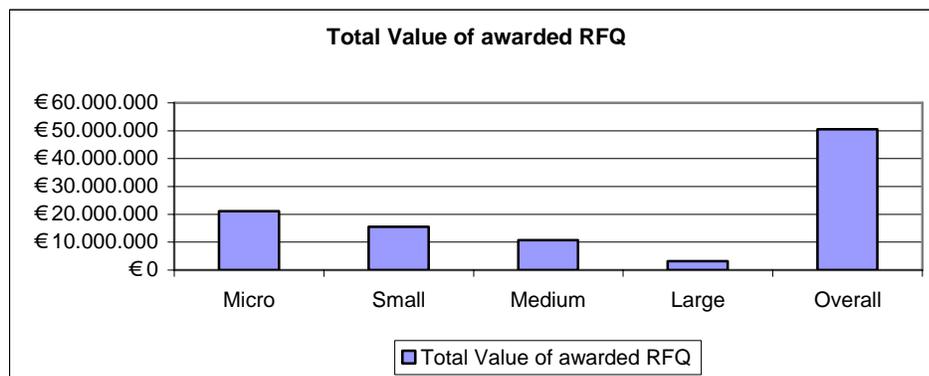**Distribution of awarded RFQ value by suppliers' size**

FIGURE 3
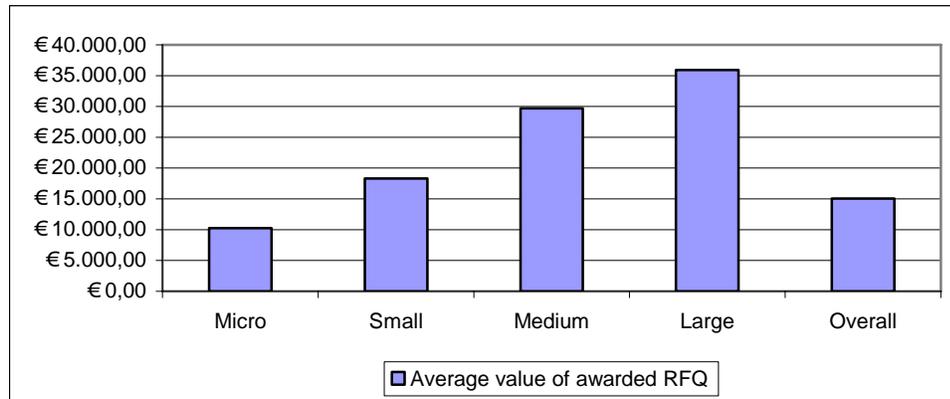**Distribution of RFQ average value by suppliers size**

Table 7 reports the distribution of firms by size and localization. Several things are worth noting. Suppliers are more concentrated in the Center/North of Italy (75%). Table 6 shows that the major contribution of suppliers is provided by the Center-North with about 40% (722 firms). Firms located in the north (east + west) provide a significant contribution to participation for any given size: 35%, 49%, 53% and 43%, respectively from small size towards large size. Micro, small and medium suppliers represent 85% of total firms. Micro firms are the most represented in any geographical area (ranging from 45% to 74%).

Northern regions contribute more to suppliers participation, but this contribution is more focused on medium/large suppliers. Overall, the presence of medium-large and very large firms is modest and rather concentrated in the more developed areas of the country (Center and North-West).

These numbers suggest that the MEPA seems to achieve its important target of "hosting" a large number of micro and small suppliers.

TABLE 7
Firms' Area vs. Firms' Size

Suppliers' location	Suppliers' Size				
	Micro	Small	Medium	Large	Total
Center	185 (59%)	82	32	13	312
Islands	76 (74%)	21	2	4	103
North-East	72 (46%)	56	20	8	156
North-West	114 (45%)	86	35	19	254
South	82 (56%)	42	14	7	145
n.a.	0	0	0	12	12
Total	529 (53,8%)	287	103	63	982

In Table 8, we match localization of suppliers with that of PUs. We thus obtain a sort of "regional business balance". The North is the area awarding the highest fraction of contracts (through RFQs) to local suppliers (approx. 74%). It is interesting noting, however, that Southern regions and Islands are those most purchasing from non-local suppliers, 27% and 32%, respectively.

SUPPLIERS' PERFORMANCE

Plot 1 and Table 9 show the frequency distribution of RFQs among suppliers. Two things the reader can note: dispersion and concentration. Out of 425 "interested" suppliers, namely those who placed a bid at least one RFQ, roughly 90 were awarded no contracts, while 3 suppliers were awarded more than 100 RFQs, suggesting a clear dispersion in the distribution of RFQs. While 10% of suppliers is awarded no RFQs and 50% of them are awarded just 2 RFQs, the "top" 25% of them win the biggest fraction of the contracts. Although the average number of RFQs is 7.9, variance is extremely large (453.5). The frequency of suppliers declines with the number of awarded contracts. Data indicate, on the one

TABLE 8
Business Balance (awarded RFQs from 01/2004 until 05/2007).

PBs' location	*Suppliers' location (Italy)*					
	Center	*Islands*	*North*	*South*	*n.a.*	*Total*
Center	**1.085**	46	738	86	2	1.957
	(55.4%)	(2.4%)	(37.7%)	(4.4%)	(0.1%)	(100.0%)
Islands	107	**147**	159	44	4	461
	(23.2%)	**(31.9%)**	(34.5%)	(9.5%)	(0.9%)	(100.0%)
North	263	25	**907**	27	9	1.231
	(21.4%)	(2.0%)	**(73.7%)**	(2.2%)	(0.7%)	(100.0%)
South	150	24	224	**156**	1	555
	(27.0%)	(4.3%)	(40.4%)	**(28.1%)**	(0.2%)	(100.0%)
Total	1.605	242	2.028	313	16	4.204
	(38.2%)	(5.8%)	(48.2%)	(7.4%)	(0.4%)	(100.0%)

TABLE 9
RFQ in percentiles (when RFQ participation >0)[17]

| *Percentiles*		*N. Suppliers*	*Smallest*		
1%	0	4.25	0		
5%	0	21.25	0	*Obs.*	425
10%	0	42.5	0	*Sum of Wgt.*	425
25%	1	106.25	0		
50%	2	212.5		***Mean***	**7.9**
			Largest	*Std. Dev.*	21.29
75%	6	318.75	86		
90%	19	382.5	151	***Variance***	**453.5**
95%	28	403.75	188	*Skewness*	7.2
99%	85	420.75	268	*Kurtosis*	71.9

hand, that many suppliers actually competing in the market for RFQs are completely unsuccessful. On the other side, data indicate that RFQs are rather concentrated in the hand of few suppliers (the first 25%, roughly 106) among which 4 suppliers (1%) are awarded the 20% of total RFQ (693/3.360), with 3 out of them exhibiting outstanding performance (above 100 RFQs each).

As anticipated in the introduction, our main goal is to identify the characteristics of top 25% of suppliers most performing in the MEPA. To this end, we exploit information on suppliers' characteristics (such as size, location, loyalty, revenue from the MEPA etc.) that preliminary statistics seem to indicate as the most relevant factors in explaining the differences in the number of awarded contracts.

PLOT 1
Frequency Distribution of RFQs – (participation > 0)
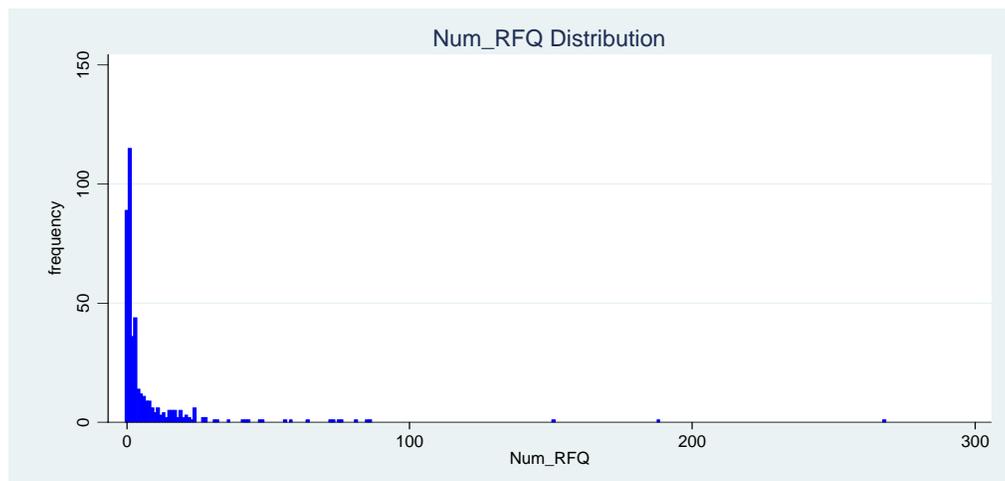
PLOT 2
Frequency Distribution of RFQs – (RFQ number < 100)
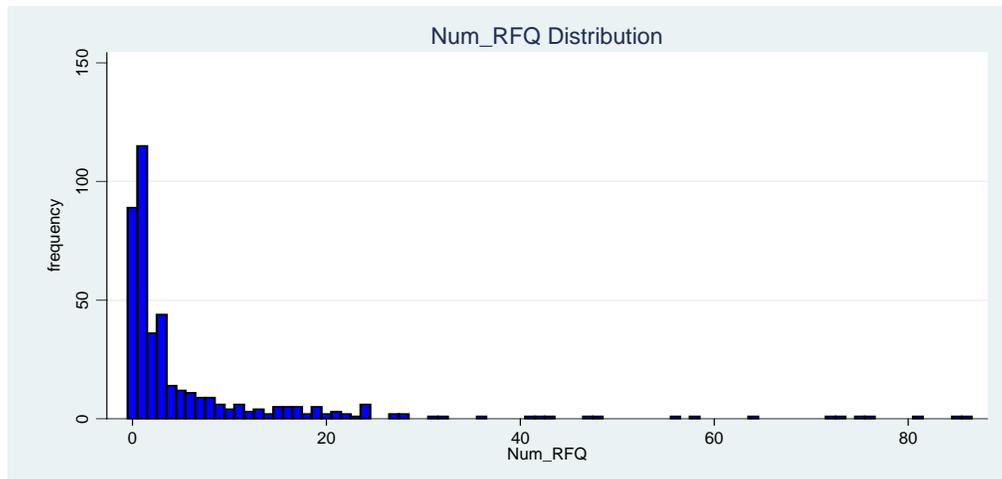
Methodology: The Count Data Approach

In many economic environments, the dependent variable of interest is a nonnegative integer or count which the researcher wishes to explain in terms of a set of covariates. With respect to the classical regression model, the dependent variable (y) is discrete with a distribution that assigns probability mass at nonnegative integer values only (Cameron and Trivedi, 1999). Standard OLS are no longer feasible to analyze these data. Regression models for counts, as well as other discrete models such as the logit and probit, become more suitable, as their properties are strictly connected to discreteness and nonlinearity.

Count data models are appropriate for measuring the "frequency" of occurrence of an event. A classical example comes from demography, in which fertility is usually modelled as the number of live births over a given age interval of the mother. The demographer is interested in analyzing how fertility varies with the mother's schooling, age, and household income, etc. Accident analysis studies model airline safety, for example, as measured by the number of accidents experienced by an airline over some period, and wishes to examine its relationship to airline profitability and financial health.

The analysis of frequencies implies controlling for the risk – exposure – that the event may occur. In the example of fertility, the exposure is the age of the mother, while in the case of airline accident is the number of flights in the period.[18]

Count data regression model are suitable to investigate the determinants of suppliers' performance in the MEPA. The dependent variable we are mostly interested in is the number of times (Y) each supplier is awarded an RFQ. This is a proxy of his performance. It is a non-negative integer number. Suppliers' performance is controlled for participation (exposure) to the RFQ. Exposure is then the number of times each supplier bids for a contract and, therefore, is exposed to the "risk" of being awarded a contract. That is, while analyzing the number of times each supplier is awarded a contract we control for the number of times he bids for a RFQ (winning 10 contracts would have a completely different meaning if bidding occurred 10 times instead of 100 times!).

Non-linearity and discreteness are key features of models for count data. Plot 1 clearly indicates this to be the case for our sample. Models for count data, such as Poisson[19] or Negative Binomial regressions, appropriately account for such features by working with the logs of dependent and of the (exponential) independent variables.[20] The Poisson model imposes the restriction that the conditional variance equals the expected value of the dependent variable. However, this restriction is often rejected in economic applications.[21] This is our case as shown in table 9: the variance is much greater than the mean (454.5>7.9). This is the "overdispersion" problem. In case of overdispersion, Cameron and Trivedi (1986) suggest to use the Negative Binomial (NB)[22] regression which relaxes the assumption about mean-variance equality. In the NB regression, the variance is equal to $\mu + k\mu^2$, where μ is the mean of the dependent variable and $k \geq 0$ is a dispersion parameter. The NB allows the econometrician to account for some unobserved heterogeneity among individuals that might explain high dispersion. As shown in the next section, the test does not reject the hypothesis of overdispersion, suggesting that the NB model is more appropriate for our data. Fitting NB regression is similar to fitting Poisson regression, therefore the log of the mean μ, is a linear function of independent variables.

We define the *incidence rate* (i_r) as the average number the event occurred given the times it could have occurred:

$$(i_r)_i = \frac{\text{Count of events}}{\text{N. of times event could have occurred}},$$

where the denominator in previous is termed the "exposure" and is often measured in units. We model the logarithm of the incidence rate as a linear function of more explanatory variables:

$$\ln(i_r)_i = 'x_i \cdot \beta + \varepsilon_i.$$

Alternatively, the model describes logs of expected event counts:

$$\ln(\text{expected count})_i = \ln(\text{exposure}_i) + 'x_i \cdot \beta + \varepsilon_i,$$

such as: $\ln(\mu_i) = \ln(N_i) + 'x_i \cdot \beta + \varepsilon_i$.

NB regression finds the maximum-likelihood estimates of the β parameters. We recall that:

- $\ln(\mu_i) = \ln(N_i)$ is the log of the conditional mean of the number of awarded contract for each supplier "i";

- 'x_i is the vector of explanatory variables;

- β is the vector of estimated coefficients for each covariate;

- ε_i is an individual unobserved heterogeneity effect to control for variance. This component plays a double role of measuring both the specification error (as in the classical linear regression model) or the kind of cross sectional (i.e. cross-suppliers) heterogeneity.

The vector of explanatory variables is a set of variables capturing the individual characteristics of suppliers:

- **MEPA_revenue** measures the suppliers' overall turnover realized on the MEPA since their registration on the platform. This can be a proxy of the size of the supplier in the context of the MEPA, since it sums RFQ and DP values. We expect this number to be positively correlated with the number of awarded RFQs.

- **DP_Num** is the number of direct sales through DPs realized in the sample period. This variable proxies how performing is the supplier in the other selling tool available by the MEPA. The level of performance in DPs may help us to say something about the suppliers' performance in RFQs. A positive coefficient might

indicate that good performance in DPs may help being performing also in RFQ (the tools exhibits some *complementarities*). A negative coefficient might indicate that the supplier is more specialized in one of the two (the tools may be *substitutes*).

- **PU_Num**: number of different PUs served by each supplier. This variable measures whether the supplier sells to many different PUs rather than a restricted pool of PUs. It is exactly the number of different units the supplier interacted with in the sample period, including both RFQs and DPs. This variable can also be a proxy for *loyalty* between suppliers and PUs, thus measuring whether and how the degree of loyalty impacts suppliers' success in being awarded a contract. We expect more loyal suppliers to be more successful than less loyal suppliers.

- **Dummy_firm_nord**: this dummy equals 1 if the supplier is located in the North of Italy, 0 otherwise. The dummy captures the contribution of geographical location to success. As Figure 4 suggests, suppliers located in the North – the Italian most developed industrial area – appear more successful than those located in other areas (they experience higher awarding rates, i.e., higher number of awarded contracts/number of invitations to bid from PUs).

- **Dummy_Micro_firm**: this dummy equals 1 if the supplier is a micro firm [≤9 employees], 0 otherwise. This dummy variable is constructed following indications from Figure 5. Micro suppliers are awarded a lower number of contracts with respect to all other suppliers, while SMEs and large suppliers display comparable success rates. Awarding rates for micro firms appear much lower with that of all others' (about 0.2 vs. 0.3.)

- **Dummy_outlier_RFQ**: there are 3 suppliers who are awarded a significantly higher number of RFQs with respect to everyone else (over 100 RFQs each). It can be the case that these suppliers face with some very specific features that allow them to be much more performing than all other suppliers, thus we control for this *outlier factor*.

- **RFQ_Partec**: is the *exposure* variable in our model. This is the number of times each supplier bid/responded to an invitation to quote from purchasing units. This variable is not directly included

in the estimation of the parameters, however is taken into appropriate account for its calibration by the estimation procedure.

FIGURE 4
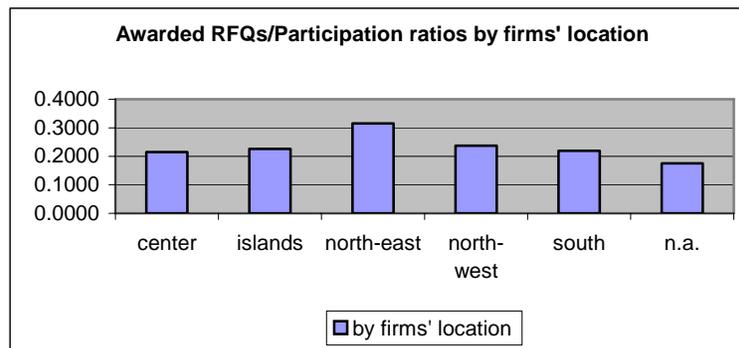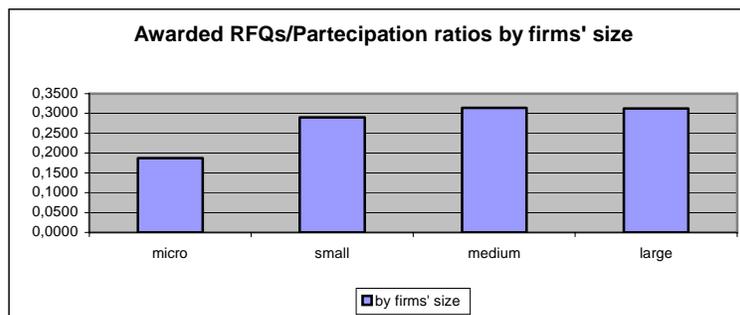**Awarding Rates by Firms' Location**

FIGURE 5
Awarding rates by firms' size

Results

Since the variance of awarded RFQs is roughly 56 times larger than its mean, the distribution of our dependent variable is clearly affected by significant overdispersion. The large value for χ^2 (1047) confirms this congecture and suggests that the Poisson distribution is not a good choice

for our data pattern.[23] However, we first treat overdispersion by adjusting standard errors with the square root of the Pearson χ^2 dispersion (see the second column of estimations in table 10). The coefficients are identical to the previous analysis, but standard errors are adjusted to compensate for the overdispersion in the Poisson distribution. Coefficients show a decrease in z-scores, but all keep a very high statistical significance. An alternative solution to scaling the standard errors would be to use the NB regression, which is usually appropriate as discussed above. Estimated coefficients still show a reduction in z-scores, but keep a very high statistical significance. The direction of correlations are confirmed all over the regression models. Estimation results are reported below in column 3 of table 10.

Estimated coefficients measure how the expected number of awarded RFQ vary as covariates vary. Coefficients indicate that revenue, location, size and loyalty significantly affect suppliers performance.

The estimated predicted number of Awarded RFQ is **2,199** for each supplier, on average over the independent variables. It is interesting noting how this number varies in response to variation of the independent variables (marginal effects,[24] column V). For instance, being located in the North allows the supplier to increase of 0.507 his expected number of awarded RFQ that is: +23% (= 0.507/2.199). Being a micro supplier, however, reduces the number of expected awarded RFQ of 0,505, more or less of 23%.

This last result on firm size is somewhat surprising given the preliminary statistics (see table 6) according to which micro firms absorb 61% of total RFQs. Our results indicate that, *despite absorbing more than 60% of RFQ, micro firms are not the most successful suppliers in the MEPA*. One possible explanation for this is that micro suppliers absorb a great part of the transactions simply because they are statistically more present in the marketplace than all other suppliers. This might also suggests that each (of the many) micro suppliers is awarded a very limited number of RFQs, while many RFQ are awarded to an arguably less represented group of larger suppliers.

The variable PU_Num has a negative (but weak) sign (-0,003). This suggests the existence of some loyalty effects in MEPA. The negative sign seems to confirm that firms interacting with a lower number of different PUs experience an increase in the expected value of awarded RFQs.

The overall transaction value (MEPA_revenue) is also significant in our estimations. Although the effect is very low (*3,55e-07)*, the sign is positive and it goes in the direction of higher revenues associated to higher number of transactions (instead of less transactions of higher value). Suppliers' transaction value is a proxy for their relative size with respect to the MEPA. High MEPA-revenue suppliers are also more performing than low MEPA revenue suppliers.

We run another estimations using the Log(MEPA_Revenue). This yields a significant coefficient (z score = 5.81) of **0.16** (with all other coefficients keeping substantial stability in signs and significance). This allows to interpret the coefficient as an elasticity. That is, 1% increase in revenue is associated to a 16% increase in expected number of awarded contracts.

The number of DPs – the proxy of performance with respect to the alternative MEPA selling tool – does not seem to influence suppliers' performance on the RFQ side. Its significance is not kept in the transition between Poisson Scaled regression to Negative Binomial. However, this does not necessarily exclude some complementarities between the two as long as the positive sign is maintained across the different estimation techniques.

Model 4 in Table 10 aims at capturing some potential bias effect of the three most successful suppliers (three suppliers collected over 100 RFQ each). The outlier dummy control, however, is not significant.

In summary, evidence suggests that most successful suppliers are non-micro suppliers, located in the most developed areas of the country (North of Italy), interacting with a limited (privileged) pool of administrations. Interestingly, a non-micro supplier located in the North can increase her expected average of awarded RFQ by 46%. This is computed as [(0.507+0-505)/2.199]. Revenue from MEPA and good performance on DPs side might also arise as additional factors of success.

CONCLUSIONS

In this paper we have analyzed the suppliers' performance in the MEPA. The regression analysis supports some basic intuitions about the

TABLE 10
Estimation of RFQ with Alternative Count Data Regression Models

RFQ_Num	RFQ Number Regression				
	I. Poisson Regression	II. GLM_Poisson Scaled (x2)	III. Negative Binomial (1)	IV. Negative Binomial (2)	V. Neg.Binomial (Marginal effects) (3)
MEPA_revenue	2,67e-07*** (7,48)	2,67e-07*** (4,54)	3,55e-07*** (3,01)	3,59e-07*** (2,84)	7,80e-07*** (3,04)
DP_Num	0,001*** (7,72)	0,001*** (4,69)	0,001 (1,53)	0,001 (1,51)	0,002 (1,51)
PU_Num	-0,004*** (-7,24)	-0,004*** (-4,40)	-0,003** (-2,23)	-0,003** (-2,20)	-0,007** (-2,19)
Dummy_firm_nord	0,328*** (8,62)	0,328*** (5,23)	0,226*** (2,87)	0,227*** (2,87)	0,507*** (2,80)
Dummy_Micro_firm	-0,146*** (-3,71)	-0,146** (-2,25)	-0,227*** (-2,79)	-0,226*** (-2,71)	-0,505*** (-2,74)
Dummy_Outlier_RFQ	-	-	-	-0,035 (-0,10)	-
Constant	-1,828*** (-47,57)	-1,828*** (-28,87)	-1,64*** (-21,47)	-1,643*** (-20,33)	-
RFQ_Partec	exposure = ln(RFQ_Partec)				
Obs.	425	425	425	425	-
LR chi^2	329,46	-	38,33	38,34	-
Pseudo R^2	0,134	-	0,021	0,021	-
Goodness-of-fit Chi^2	1047,144	-	-	-	-
(1/df) Deviance (1/df) Pearson	-	2,499 2,715	-	-	-
LR-test (α)=0	-		358,81 (α=0,223)	343,23 (α=0,223)	-

z-scores shown in parentheses; significant levels at *0.10, **0.05, ***0.01.
(x2) Generalized Linear Modeling for Poisson distribution scaled with standard errors using square root of the Pearson chi-square dispersion, in order to deal with the over-dispersion.
(3) Marginal effects after "nbreg"; y = predicted number of events (2,199) and dy/dx = marginal effects at the means of the independent variables.

direction of effects of the variables influencing suppliers' performance. Location, revenue and loyalty play a relevant role in explaining the expected number of awarded contracts. In particular, more performing firms are those located in the North, having large revenue in the MEPA and a more strict relationship with a selected pool of purchasing administrations. Quite surprisingly, expected number of awarded contracts varies with the firm's size in a direction that is not in favour of the most represent (and active) group suppliers. Micro suppliers appear less successful than all other suppliers, experiencing a 23% decrease in the predicted number of awarded contracts with respect to all other suppliers (small, medium and large). Matching this with descriptive statistics, we may conclude that micro firms absorb a great part of total RFQ not because they are effectively more performing but because statistically more represented than all other firms. This also suggests that each (of the many) micro suppliers is awarded a very limited number of RFQs, while many RFQ are awarded to an arguably less represented group of larger suppliers. Among this group, SMEs and large suppliers show similar patterns of performance.

Our paper is the first step to understand what is driving suppliers to be successful in the MEPA, and in general what can explain their success in MEPA-like marketplaces. A full analysis of this issue can be important for providing policy indications to both market makers (for market design) and suppliers (for business/selling strategies). The increase of suppliers' base constantly over time may not be sufficient to achieve well developed and functioning e-procurement platforms if contracts end up awarded to a very restricted pool of suppliers. Potential concern may arise if part of this phenomenon relates to factors other than suppliers' efficiency or ability to satisfy buyers' needs (e.g., local favouritism). One of the major risks associated to a concentrated market is the exit by those suppliers who are not (or are only rarely) awarded contracts, which, in turn, may lower the level of competition in the future.

Further research will be done to extend the analysis of performance to account for these and factors that we have not been able to include in the present paper and that may contribute to explain success in the MEPA.

NOTES

1. We thank Nicolò Di Gaetano, Head of the Unit for the Management of Innovative Purchasing Systems for providing raw data.

2. In the EU, the possibility for public administrations to use electronic procurement systems was formalized by the European Directive 18/2004 (Point 12 of introduction).

3. See the EU "Action plan for the implementation of the legal framework for electronic public procurement" (2004). See also Moon (2005) for a discussion on the determinants of e-procurement in centralized systems.

4. See Dimitri, Dini and Piga (2006) for a more detailed discussion of centralization trends in public (and private) procurement. See also Carpinenti, Piga and Zanza (2006) for an overview of central procurement agenciess in Europe, in the U.S. and the more recent patterns in Latin America.

5. In the U.S., for instance, the Small Business Act (SBA) in the U.S. promotes full participation of small firms in the federal (and non-federal) public procurement market. It also monitors that public agencies achieve the set-aside objectives set by the law.

6. The features of a Request for Quotation are described more in detail in Section 3.1. A more in-depth description of functionalities of the MEPA and the future perspectives of the Marketplace see the recent work of Bertini and Vidoni (2007) at http://www.consip.it/online/Home/Pressroom/QuaderniConsip/QuaderniConsip2007.html.

7. This is due to the recent Italian Financial Law for the 2008.

8. See the final Report of the Osservatorio B2B - Politecnico di Milano, for an analysis of e-procurement in the Italian Public Sector (www.osservatori.net).

9. Henceforth we will use RFQ and contract interchangeably.

10. As we will see, the low-value contracts awarded in the MEPA make it particularly attractive for SMEs.

11. Some of the most important public e-platforms in the USA, such as Myflorida Marketplace and North Carolina@yourservice, were built

up in 2002-2003. Consip itself were made active at the end of 2003. See Caripenti, Piga and Zanza (2006) for more on this.

12. Hereforth, we will use firms and suppliers interexchangeably.

13. The idea that big framework contracts represent an entry barrier to participation of smaller firms is a widely recognized point. However, empirical evidence supporting or confuting this is to our knowledge absent. First evidence of this effect are in Albano, Dini, Zampino (2008) who empirically test the relationship between participation and contract value in the context of IT services contracts awarded by a large public buyer. Results indicate that large contract value discourage participation and at the same time favours joint bidding.

14. Purchasing Units are departments, structures or other units belonging to the same public body. The Purchasing Unit is the lowest level of authority endowed with "budget power" in the Italian Public Administration.

15. Source: internal reporting system.

16. Since we do not have individual data on revenues, the classification by size is only based on the number of employees. We use the EUROSTAT classification: micro [0-9], small [10-49], medium [50-249] and large [≥250].

17. Here, only suppliers who placed a bid after invitation to quote from the PU are considered (i.e., participation >o). The same is for plot 1.

18. Applications of such models are quite common in the economic literature. Cameron A.C., P.K. Trivedi, Milne and Piggott (1988) apply the count data approach to analyze the determinants of the choice of health insurance type and types of health care services in Australia, using micro-level data from the 1977-78. Another application to heath care is due to Cameron and Windmeijer (1996). Jaggia and Thosar (1993) use a Poisson count data model to analyze target management resistance and the incidence of subsequent bids. The dependent variable represents the number of bids (count) received and the independent variables comprise target management actions and firm specific characteristics. An application to banking is from Davutyan (1989). He estimates the elasticity of bank failures with respect to a set of explanatory variables and treats bankruptcies

using a maximum-likelihood Poisson estimator, then comparing resulting estimates with their OLS counterparts.

19. The Poisson distribution is a discrete probability distribution that expresses the probability of a number of events occurring in a fixed period of time (distance, area, etc.) if these events occur with a known average rate (λ) and independently of the time since the last event.

$$f_y(y) = f_y(y;\lambda) = \frac{e^{-\lambda}\lambda^y}{y!} \text{ for y=0, 1, 2, …;}$$

$$f_y(y) = f_y(y;\lambda) = 0 \text{ otherwise.}$$

20. $E[Y/X] = e^{X\beta}$ where $E[.]$ is the expected count of the dependent variable conditional to the vector of covariates *(X)* and β is the vector of estimated coefficients. See Greene (2003) for a basic treatment of these models. See also Cameron and Trivedi (1986) and Cameron and Trivedi (1998) for an overview of standard models for count data.

21. According to Poisson model $E[Y] = \text{var}[Y] = \lambda$. Another assumption in the Poisson regression is that the events must be independent in the sense that the occurrence of one event will not impact the occurrence probability of another event. We are not able to assess how much this assumption holds in our case.

22. The Negative Binomial distribution is a discrete probability distribution that expresses the probability of a number of events occurring in a fixed period of time (distance, area, etc.) according to following distribution function: $f_y(y) = f_y(y;r,p) = \binom{-r}{y} p^r (-q)^y$ for y=0, 1, 2, …; $f_y(y) = f_y(y;r,p) = 0$ otherwise; where the parameters are r=1, 2, 3… and $0 < p \leq 1$ and $q = 1 - p$. Then, $E[Y] = \frac{rq}{p}$ and $\text{var}[Y] = \frac{rq}{p^2}$, assuming $k = \frac{1}{r}$.

23. The likelihood ratio test for α=0 (table 10, column III) is a test of the over-dispersion parameter α. When this parameter is zero the

negative binomial distribution is equivalent to a Poisson distribution. In the case, α is significantly different from zero and thus reinforces that Poisson distribution is not appropriate.

24. Marginal effects or elasticities are calculated at the means of the independent variables and with respect the predicted number of events (y). For dummy variable, dy/dx is estimated for discrete change from 0 to 1, not just for changes in means.

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