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LOCALIZATION ECONOMIES AND ESTABLISHMENT SCALE: A DARTBOARD APPROACH

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Localization Economies and Establishment Scale: A Dartboard Approach[1]

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Abstract

This paper reexamines the relationship between geographic concentration of an industry (localization) and establishment scale. We use an approach that builds on Ellison & Glaeser's (1997) dartboard location model to measure localization. Contrary to Holmes & Stevens's (2002) pioneering analysis based on employment location quotients, but in line with the predictions that follow from Alfred Marshall's concept of localization economies, we find evidence that plants located in areas where an industry exhibits concentration in excess are smaller than plants in the same industry outside such areas.

JEL classification: R12, R39, L11.

1 Introduction

It is a well established regularity that many individual industries are spatially clustered. Supporting evidence appears in the urban economic literature since Alfred Marshall's (1919) *Industry and Trade.* Subsequent work includes the famous study of Hoover (1937), which examined the shoe and the leather industries in the United States, and the classical work of Lichtenberg (1960), documenting the concentration of industry in the city of New York. Among the more recent studies that continue in this tradition, Krugman (1991) and Ellison & Glaeser (1997) provide evidence that this phenomenon is still prevalent for most industries.

The widely accepted explanation for industrial agglomeration, or localization, is grounded in Marshall's notion of external economies; that is, economic benefits external to the firm, but internal to the industry in a region. Marshall advanced localization economies in contrast to internal firm economies of scale. In the *Principles of Economics* (book IV, chapter XII) he wrote:

> Looking more closely at the economies arising from an increase in the scale of production of any kind of goods, we found that they fell into two classes - those dependent on the general development of the industry, and those dependent on the resources of the individual houses of business engaged in it and the efficiency of their management; that is, into external and internal economies.

Marshall proposed three sources of external economies to explain why firms agglomerate within the same industry. The first is the presence of an extensive array of input providers, allowing for productivity gains resulting from vertical disintegration and specialization. The second is related to labor market pooling, where agglomeration improves each firm's productivity because it facilitates the firm-worker matching process. The third is a firm's ability to capture industry-specific knowledge spillovers that take place when an industry is localized.

These localization economies have implications for plant (establishment) size. Because firms in areas where an industry agglomerates are more specialized (and benefit from the two other sources of Marshall's external economies) their input productivity will be enhanced. Hence, in industry equilibrium, when compared with isolated firms, those in an industrial cluster should operate at a smaller scale.[1]

Empirically, the relationship between industry agglomeration and establishment scale has been addressed for the first time in a paper by Holmes & Stevens (2002). Using different levels of geographic aggregation and U.S. data for 1992, the study looked at the correlation between (industry-standardized) plant size and a measure of agglomeration across regions. Surprisingly, and contrary to the prediction that can be deduced from Marshall's external economies concept, they found a positive association. Additional evidence for this result (that firms are larger in areas where industries cluster) was provided by Barrios, Bertinelli & Strobl (2006), which make use of panel data for Irish counties spanning from 1973 to 2000.

Subsequent work [Holmes & Stevens (2004) and Manning (2007)] pro-

[1] For a formalization of this argument see Manning (2007). The author develops several simple models (corresponding to the different sources of Marshall's external economies) and shows that if an external productivity bonus for firms inside areas of industrial agglomeration exists (as postulated by Marshall), then industry equilibrium requires firms inside industrial clusters to be smaller than isolated firms.

posed new explanations and models to bring together theory and stylized facts about firm size in areas of industry agglomeration. Holmes & Stevens (2004) use the ideas from the new economic geography to develop a theoretical model that can account for the regularity found in Holmes & Stevens (2002) and Barrios, Bertinelli & Strobl (2006). Coming from a very different area of research (labor economics) Manning (2007) tries to explain Holmes & Stevens (2002) result (which he calls the plant size-place effect) building a theoretical model that emphasizes monopsony in labour markets.

In this paper we step back and reexamine what are the facts that need to be explained. Common to the empirical studies of Holmes & Stevens (2002) and Barrios, Bertinelli & Strobl (2006) is the use of Florence's (1939) employment location quotient to measure the level of agglomeration of an industry at a given location. This statistic has an intuitive appeal but it lacks a theoretical underpinning. Importantly, as we argue in this paper, the location quotient does not accurately measure industry localization. A particular problem is that the measure encompasses both internal scale economies and Marshallian external economies. Below, we develop a new measure grounded on the dartboard location model of Ellison & Glaeser (1997). We then use this alternative measure to reexamine the link between geographic concentration of an industry (localization) and establishment scale. Applied to Portuguese data, the results show that the predictions that can be deduced from Alfred Marshall regarding firm size in industrial districts are supported by the empirical evidence.

The plan of the rest of the paper is as follows. In the next section we review measures of industry localization and attendant conceptual and measurement problems. In section 3, we present our methodology and discuss econometric issues. Section 4 summarizes the empirical findings and section 5 concludes.

2 Measures of Localization

Florence's (1939) employment location quotient remains the most widely used measure to evaluate agglomeration of an industry at a given location. Once the spatial scale of analysis is identified, location quotients may be calculated for each industry by computing the ratio between the regional employment share for the industry and the industry's national share of total employment. The main advantages of the measure are computational simplicity and the availability of regional employment data by industry, which means it can be applied in many contexts. Despite its popularity, however, the location quotient lacks a theoretical foundation. Moreover, it is not a precise measure of localization in the Marshallian sense. One fundamental problem is that the employment location quotient is unable to differentiate between external and internal scale economies. The location quotient will be the same whether industrial employment in a region results from a single large establishment or from a cluster of smaller establishments. Clearly, a large employment location quotient that results from one large plant does not reflect external agglomeration economies of any type. In that case, we do not have an industrial cluster. Thus, geographic concentration (as measured by the employment location quotient) is entirely explained by industrial concentration and then by internal returns to scale.

Another problem stems from the potential inability of the location quotient to capture the randomness of the underlying plant location decisions, which alone can account for some degree of spatial concentration. Because of the discrete nature of the phenomenon being measured it is possible to observe spurious concentration, that is, concentration that occurs by chance alone. It is unclear whether the location quotient is able to account for this type of clustering.

Ellison & Glaeser (1997) developed a measure of localization of an industry that overcomes these pitfalls. Primarily, they provide a theoretical foundation for their measure, proposing an index that is based on the firm location model of Carlton (1983). This location model builds on McFadden's (1974) random utility (profit) maximization framework and has been the workhorse for empirical research on industrial location decisions. Secondly, because the index is based on a probabilistic model it naturally accounts for the inherent randomness (lumpiness) that will be observed if location decisions are determined by chance alone. Ellison & Glaeser (1997) also claim that their method expurgates the effect of internal scale economies from the industry localization measure. However, more recently, Guimarães, Figueiredo & Woodward (2007) showed by example that application of the employment based Ellison & Glaeser's (1997) index could lead to counter-intuitive results because the index does not completely purge the effect of industrial concentration. That paper demonstrates that applications of the Ellison and Glaeser statistic relying on employment data instead of plant count data (as proposed by Ellison and Glaeser) offered no statistical advantage and would lead to increased imprecision in the measure of localization.[2]

[2]The use of plant counts can also be justified from a theoretical point of view. In the location decision model of Carlton (1983), the starting point for Ellison & Glaeser's

Guimarães, Figueiredo & Woodward (2007) proposed an alternative statistic (based on plant counts) that is consistent with the theoretical framework of Ellison & Glaeser (1997) but removes the effect of internal scale economies. Their proposed index has the added advantage of offering a statistical test of significance for the existence of localization economies. Recent developments on the measurement of industrial localization include the D-index of localization of Mori, Nishikimi & Smith (2005) and the approaches of Marcon & Puech (2003) and Duranton & Overman (2005) that deal with the modifiable areal unit problem.

At this point we should remark that all of the above mentioned papers have dealt with the question of measuring *an industry* level of localization but not with the problem of quantifying (such is the case for the location quotient) the intensity of agglomeration of an industry at *a given location*.[3] Thus, despite these recent developments, we still do not have an adequate method to evaluate localization at a specific locality. In the next section we develop such measure, building on the dartboard location model of Ellison & Glaeser (1997).

(1997) dartboard model, individual workers do not scatter according to a pattern. It is the location of plants or establishments that is chosen by decision makers.

[3] This is the same distinction as between the coefficient of location [proposed for the first time by Hoover (1936)] and Florence's (1939) location quotient. Ellison & Glaeser's (1997), Mori, Nishikimi & Smith (2005) and Guimarães, Figueiredo & Woodward's (2007) are developments of the former which give (for each industry) a single statistic measuring the respective degree of localization.

3 Methodology

3.1 A theoretical framework for measuring localization at a given location

Consider an economy with J distinct regions. In that economy firm location decisions are based on profit maximization behavior. As in Ellison & Glaeser (1997) dartboard model, we assume that a firm in a particular industry, say firm i, evaluates potential profits at every location, and selects the location with the highest profit. Profits (in log form) are given by,

$$\log \pi_{ij} = \log \overline{\pi}_j + \eta_j + \varepsilon_{ij} \ , \qquad (1)$$

where $\overline{\pi}_j$ reflects the expected profitability of locating in region j. The term η_j is a variable that captures the impact of external economies of the region in the profit function of firms for that particular industry. Finally, the ε_{ij} is a random effect that picks all other non-systematic factors affecting firm i's profits. Assuming that ε_{ij} is an identically and independently distributed random term with an Extreme Value Type I distribution then, conditional on a realization of $\boldsymbol{\eta} = (\eta_1, \eta_2, ..., \eta_J)$, we can apply McFadden's (1974) result to obtain an expression that gives the probability that a firm from that particular industry will locate in region j:

$$p_{j|\boldsymbol{\eta}} = \frac{\exp(\log \overline{\pi}_j + \eta_j)}{\sum_{j=1}^{J} \exp(\log \overline{\pi}_j + \eta_j)} \ . \qquad (2)$$

In their work Ellison & Glaeser (1997) assumed that the η_j were random variables with a distribution that satisfied the following assumptions:

$$A1 : E(p_j) = w_j \qquad (3)$$

and,

$$A2 : V(p_j) = \gamma w_j(1 - w_j) \tag{4}$$

where the w_j are the elements of a reference distribution of overall economic activity and γ is a parameter belonging to $[0, 1]$.[4] Following the suggestion of Ellison & Glaeser (1997) we assume that w_j equals the share of total manufacturing employment, that is,

$$w_j = r_j = \frac{x_j}{\sum_{j=1}^{J} x_j} = \frac{x_j}{x} \ ,$$

where x_j denotes total manufacturing employment in location j. [5] Assumption A1 conveys the idea that on average and across industries, the distribution of firms replicates the distribution of overall manufacturing activity. We retain this assumption and add a new one, assumption A3, requiring that the distribution of the random effects are such that

$$A3 : E(p_j) = \frac{\overline{\pi}_j}{\sum_{j=1}^{J} \overline{\pi}_j} \ , \tag{5}$$

meaning that on average the spatial distribution of firms also reflects the spatial distribution of expected profits. From a practical standpoint this assumption is equivalent to assuming a relation of exact proportionality between $\overline{\pi}_j$ and x_j. Note that assumption A3 is not incompatible with assumption A2.

[4] The Ellison-Glaeser index is a moment based estimate of γ. It is obtained by taking the expected value of an industry concentration index, $G_E \equiv \sum_{j=1}^{J}(s_j - r_j)^2$, where s_j denotes area j's share of employment in the industry and r_j is area j's share of total manufacturing employment.

[5] We can think of regions with more overall manufacturing employment as having higher expected profit levels. Ellison & Glaeser (1997) suggest that other variables, such as population, could also be used to "proxy" profit levels.

In fact, all three assumptions are equally valid in the alternative approach for estimation of γ proposed by Guimarães, Figueiredo & Woodward (2007).[6]

This means that we can now rewrite (2) as,

$$p_{j|\boldsymbol{\eta}} = \frac{\exp(\log x_j + \eta_j)}{\sum_{j=1}^{J} \exp(\log x_j + \eta_j)} = \frac{x_j \exp(\eta_j)}{\sum_{j=1}^{J} x_j \exp(\eta_j)} \ . \tag{6}$$

Looking back at (1) we see that estimates of the realization of η_j would provide an ideal measure of the intensity of agglomeration economies of an industry at a given location. Based on expression (6) we can derive such estimator for η_j. The idea is to treat the realizations of η_j as constants that need to be estimated. To implement this approach consider a given industry with n firms spatially distributed as $(n_1, n_2, ..., n_J)$. Now, the likelihood of observing that particular distribution of plants is given by:

$$L = \prod_{j}^{J} p_{j|\boldsymbol{\eta}}^{n_j} \ .$$

Taking logs, maximizing with respect to $\exp(\eta_j)$ and solving the first order conditions, we obtain the following set of equations:

$$\exp(\eta_j) = \left(\frac{n_j/n}{x_j/x}\right) A = Q_j^z A \tag{7}$$

where $A = x^{-1}\sum_{j=1}^{J} x_j \exp(\eta_j)$ is a constant specific to each industry. Interestingly, the likelihood estimates of the $\exp(\eta_j)$ are equal to the product of a location quotient calculated in terms of plant counts, Q_j^z, and an unknown constant. This means that we can use Q_j^z as a measure of the intensity of agglomeration economies of an industry at given locations but those numbers are not comparable across industries. To emphasize this particularity

[6] Guimarães, Figueiredo & Woodward (2007) proposed a specific distribution for η_j, the gamma distribution, and used maximum likelihood methods to estimate γ.

of the location quotient we will henceforth add an additional subscript k for industry. Note that in expression (7) we could have obtained the traditional Florence's (1939) employment location Q_{jk}^{x} had we assumed that the location probabilities of firms in an industry were weighted by industry employment instead of number of plants. However, we argue here as we did in Guimarães, Figueiredo & Woodward (2007), that localization economies should be measured using plant counts - firms, not individual workers, are the ones who scatter according to a pattern and the use of employment leads to a statistic that picks both internal and external economies of scale. Rooted in the dartboard location model, the above expression provides a theoretically sound alternative to the traditional Florence's (1939) employment location quotient, the measure used in Holmes & Stevens (2002) to test the relationship between establishment scale and localization.

3.2 Econometric issues

To explore the relation between localization and establishment size Holmes & Stevens (2002) regressed an industry-standardized measure of establishment size on the employment location quotient. The study considered two levels of analysis: a "plant level," with individual data for each establishment, and a "location level," with data grouped by industry and region. The variables for the two levels of analysis were computed differently, because in the "plant level" regression the inclusion of the own plant employment on the variables on both sides of the regressions could bias the results.[7] After computing these

[7]For the "location level" regressions the measure of plant size and the location quotient were computed as $Q_{jk}^{x} = \frac{x_{jk}/x_j}{x_k/x}$ and $Q_{jk}^{s} = \frac{x_{jk}/n_{jk}}{x_k/n_k}$, respectively. In the "plant level" regressions the corresponding measures are $Qe_{ijk}^{x} = \frac{(x_{jk}-x_i)/(x_j-x_i)}{(x_k-x_i)/(x-x_i)}$ and

variables, the authors implemented simple log-log linear regressions. Like Holmes & Stevens (2002), we regress industry-standardized establishment size (Q^s) on the measure of agglomeration derived in (7). Thus, our regression for the "location level" analysis is:

$$\log Q^s_{jk} = \alpha + \beta \log(Q^z_{jk} A_k) + \epsilon_{ij}$$

which rearranged yields,

$$\log Q^s_{jk} = \alpha_k + \beta \log Q^z_{jk} + \epsilon_{ij} \ . \tag{8}$$

The specification above requires the introduction of industry fixed effects.[8] Since our agglomeration measure is based on counts of plants, in our "plant level" analysis we do not incur in the same problem as Holmes & Stevens (2002) (having the own plant employment on the variables on both sides of the regressions). Hence, when performing this level of analysis we use the regression in (8), replacing average for actual plant size.

4 Data

As in Guimarães, Figueiredo & Woodward (2000, 2007) and Cabral & Mata (2003), among others, we used a detailed annual survey provided by the Portuguese Ministry of Employment–the *Quadros do Pessoal* database. This survey collects information for all the firms operating in Portugal, except family businesses without wage-earning employees. The survey includes information on plant firm location, sector of activity, employment and (since

$Qe^s_{ijk} = \frac{x_i}{(x_k - x_i)/(n_k - 1)}$.

[8]Note that with the introduction of industry fixed effects the results will be the same whether or not the size measure is standardized.

1995) plant start-up date. We restricted analysis to manufacturing plants and used data spanning from 1995 to 2005 (the most recent available year). Relying on the 3-digit (103 industries) classification of the Portuguese Standard Industrial Classification system (CAE rev.2) we make use of the 275 Portuguese *concelhos* as the spatial units of analysis.[9] Throughout this 11 year period we observe in our final dataset a total of 106,810 plants with an average size of 17.7 employees (standard deviation of 60.2).[10]

5 Results

In tables 1 to 5 we present our results. Table 1, reproduces Holmes & Stevens (2002) estimates for Portugal. We ran regressions at the plant and location levels. At the "plant level", the regression in column 1 implements the specification in Holmes & Stevens (2002). We obtain a positive and statistically significant coefficient.[11] Then, in the second regression, we introduce industry fixed effects that will also account for industry-specific characteristics that may affect establishment size. As can be seen, the results show only slight changes. Next, to account for the well-established positive relation between establishment size and age [see, for example, Mata, Portugal &

[9] The *concelho* is a Portuguese administrative region roughly equivalent to the U.S. county. Over time, there were some minor changes in the number of *concelhos*. To maintain compatibility, we used the spatial breakdown of 275 *concelhos* that was valid (for Portugal mainland) from 1995 through 1998. These have an average area of 322.5 square kilometers.

[10] Cabral (2007) notes that the size distribution of Portuguese manufacturing plants is similar to what is observed for other industrialized countries, even though plants are on average smaller.

[11] For comparability purposes we estimated regressions without industry fixed effects. However, as shown earlier, it is more appropriated to include these effects in the regressions because location quotients are not comparable across sectors.

Guimarães (1995) and Cabral & Mata (2003)], we introduce a fixed effect for age, categorized in five classes.[12] Again, the results remain unchanged. In the fourth regression, an establishment-specific fixed effect is introduced to control for all other establishment characteristics that may affect an establishment size.[13] Table 1 also displays, for comparison purposes, "location level" regressions. Here, as in Holmes & Stevens (2002), the magnitude of the estimated coefficients experiments substantial changes, indicating the possibility of an aggregation bias. Nevertheless, the regressions still point for a positive association between localization and scale.

[insert Table 1 about here]

Table 2 displays regression results using the location quotient based on plant counts as derived in (7). Surprisingly, but in line with the predictions that can be deduced from Marshall's external economies concept, the estimates for the β coefficient turned out to be negative and statistically significant. As before, we tried several different specifications controlling for industry, age and plant-specific effects. Table 2 shows that the results are robust across specifications and remarkably stable even for the "location level" regression.

[insert Table 2 about here]

We also ran ours and Holmes & Stevens's (2002) type regressions using different levels of sectorial and regional disaggregation. These regressions are

[12] These five classes of age are: [0,1], [2,5], [6,10], [11,25] and more than 26 years.

[13] For example, it has been shown by Bernard & Jensen (1999) that exporting firms tend on average to be larger. Note that in this regression we are relying solely in temporal variation to estimate β.

shown in tables 3 and 4. In table 3, we use the 5-digit (325 industries) classification of the Portuguese Standard Industrial Classification system (CAE rev.2). As before, we make use of the 275 Portuguese *concelhos* as the spatial units of analysis. In the regressions in table 4, in turn, we maintain the 5-digit sectorial breakdown of the CAE but rely on a spatial breakdown in *distritos*, a higher Portuguese administrative region level composed of several adjacent *concelhos*.[14] As shown in these tables, the essential results still hold.[15]

[insert Tables 3 and 4 about here]

6 Conclusion

This paper reexamines the relationship between geographic concentration of an industry (localization) and establishment scale. To assess localization we propose an approach that is grounded on Ellison & Glaeser's (1997) dartboard location model. Our localization measure provides an alternative to the widely used Florence's (1939) employment location quotient that has several distinct advantages. Like the index in Ellison & Glaeser (1997), our statistic has a theoretical foundation. Because the measure is based on a probabilistic model, it can also account for spurious geographic concentration (that is, concentration that occurs by chance alone). Finally (and importantly), our method expurgates the effect of internal economies of scale

[14] The Portuguese mainland is divided in 18 *distritos* and the average area of each *distrito* in our dataset is 4,926 square kilometers.

[15] The only exceptions are in Table 4 regressions (3) and (4) for $\log Q^z$ were the coefficients are not statistically significant.

from the localization measure.

Using this new measure, we tested the relationship between localization and scale with Portuguese data. In contrast with Holmes & Stevens's (2002) analysis (based on employment location quotients), but in line with the implications of Marshall's original concept of industrial districts, we find evidence that plants located in areas where an industry exhibits localization are smaller than plants in the same industry outside such areas. Our results are robust to several tests. Hence, we conclude that previous work on establishment scale has been misleading because it has not adequately measured localization—combining internal scale economies and local industry externalities. While our findings uphold the predictions of Marshallian industrial districts, further analysis of this relationship is needed to confirm our results in other contexts.

Our findings can also be related to the large body of literature that compares the productivity of plants in concentrated areas with the productivity of plants outside these areas [for example Henderson (1986), Ciccone & Hall (1996) and Ciccone (2002)]. These studies found a positive effect of density of economic activity on productivity across regions. Our results also indirectly show that plants inside industrial clusters benefit from an external productivity bonus over plants in other areas.

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Table 1: **Regression estimates with Q^x**

	Plant Level				Location Level	
	(1)	(2)	(3)	(4)	(5)	(6)
$\log Q^x$	0.039 (29.4)	0.047 (33.6)	0.052 (37.4)	0.016 (7.0)	0.398 (184.9)	0.445 (208.2)
Fixed Effects						
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	No	Yes	Yes	-	No	Yes
Age	No	No	Yes	-	-	-
Plant	No	No	No	Yes	-	-
N	470,920	470,920	453,469	470,920	73,069	73,069

Note: t-statistics associated with heterocedastic-robust (white) standard errors in parenthesis.

Table 2: **Regression estimates with Q^z**

	Plant Level			Location Level
	(1)	(2)	(3)	(4)
$\log Q^z$	-0.051 (-33.0)	-0.039 (-25.4)	-0.036 (-10.6)	-0.075 (-22.1)
Fixed Effects				
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	-	Yes
Age	No	Yes	-	-
Plant	No	No	Yes	-
N	500,841	482,446	500,841	73,069

Note: t-statistics associated with heterocedastic-robust (white) standard errors in parenthesis.

Table 3: **Regression estimates (*concelho* level and 5-digit SIC industries)**

Estimates with Q^x

	Plant Level				Location Level	
	(1)	(2)	(3)	(4)	(5)	(6)
$\log Q^x$	0.029 (22.9)	0.045 (31.5)	0.048 (34.1)	0.020 (9.1)	0.361 (209.2)	0.438 (254.9)
Fixed Effects						
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	No	Yes	Yes	-	No	Yes
Age	No	No	Yes	-	-	-
Plant	No	No	No	Yes	-	-
N	439,092	439,092	422,719	439,092	109,788	109,788

Estimates with Q^z

	Plant Level			Location Level
	(1)	(2)	(3)	(4)
$\log Q^z$	-0.046 (-30.8)	-0.036 (-24.5)	-0.043 (-14.4)	-0.051 (-18.9)
Fixed Effects				
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	-	Yes
Age	No	Yes	-	-
Plant	No	No	Yes	-
N	495,766	477,627	495,776	109,788

Note: t-statistics associated with heterocedastic-robust (white) standard errors in parenthesis.

Table 4: **Regression estimates (*distrito* level and 5-digit SIC industries)**

Estimates with Q^x

	Plant Level				Location Level	
	(1)	(2)	(3)	(4)	(5)	(6)
$\log Q^x$	0.053 (27.1)	0.055 (27.1)	0.057 (28.4)	0.048 (13.3)	0.495 (148.5)	0.537 (165.9)
Fixed Effects						
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	No	Yes	Yes	-	No	Yes
Age	No	No	Yes	-	-	-
Plant	No	No	No	Yes	-	-
N	486,743	486,743	468,837	486,743	29,903	29,903

Estimates with Q^z

	Plant Level			Location Level
	(1)	(2)	(3)	(4)
$\log Q^z$	-0.059 (-27.0)	-0.051 (-23.7)	0.002 (0.4)	0.001 (0.2)
Fixed Effects				
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	-	Yes
Age	No	Yes	-	-
Plant	No	No	Yes	-
N	495,768	477,629	495,768	29,903

Note: t-statistics associated with heterocedastic-robust (white) standard errors in parenthesis.

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