Industrial Location and Local Incentive Policies in Brazil: an Empirical Investigation*

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Abstract

The paper econometrically investigates the determinants of industrial agglomeration in 2001, taking as reference recently developed measures. The considered explanatory variables comprised sector-level variables and local infrastructure and incentive policies variables. The evidence showed that variables reflecting input utilization and knowledge spillovers at sector-level had important impacts on agglomeration. Among variables at the municipality-level only infrastructure factors appeared to exert some effect on agglomeration (in terms of telephone availability). The local incentive policies pertaining tax exemptions and technical support for micro and small firms did not have any important effect on industrial agglomeration.

Key-words: industrial agglomeration, incentive policies, local infrastructure

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1. Introduction

The study of industrial agglomeration has gained a growing interest both in the theoretical and empirical literature. One important motivation for the interest in agglomerations is related to its expected effect in productivity. In fact, the positive effects of agglomeration in productivity have been extensively recognized [see e.g. Henderson (1986)]. In this sense, it is important to try to identify the microfoundations underlying economic growth and therefore the relevance of studies on the determinants of industrial agglomeration becomes evident.

Local specificities in terms of natural advantages (endowment of different factors of production) and agglomeration externalities may explain industrial agglomeration and make salient the potential for local incentive policies.

In the conceptual domain, we can highlight some influential lines of work pertaining explanatory factors for agglomeration. One should mention four main approaches summarized by Schimitz (1999): (a)the perspective of Economic Geography that emphasizes the interplay of market forces [see e.g. Krugman (1991) and Audretsch and Feldman (1996)]; (b)the perspective of Business Economics. It becomes clear that in the different perspectives the scope for local incentive policies is differentiated.

The conceptual discussion of agglomeration effects necessarily requires rigorous quantification efforts. In that sense, recent contributions attempt to provide sound probabilistic and economic foundations for the plant location decision. Influential examples include Ellison and Glaeser-EG (1997), Devereux et al (1999) and Maurel and Sédillot (1999). The aforementioned papers also considered empirical applications for the theoretically developed agglomeration measures, respectively for the United States, United Kingdom and France. For developing countries, however, one can observe a significant gap in terms of studies with these more rigorous measures based on industrial establisment data. An exception is provided by Resende and Wyllie (2003) that considered the Brazilian case.

Once a more precise quantitative measure is obtained for industrial agglomeration, the next natural step is to empirically assess the relevant explanatory factors. Rosenthal and Strange (2001) econometrically investigate the determinants of industrial agglomeration in the U.S. as measured by EG´s index. The referred measure is sector-specific and therefore the explanatory variables related to natural advantages and agglomeration externalities are also sector-specific.

A possible extension of the previous analysis is to explicitly consider the effect of local incentive policies that are often defined at the city-level and that are not sector-specific. The present paper intends to take advantage of recently released data that details local incentive policies for the state of Rio de Janeiro.

The paper is organized is organized as follows. The second section discusses the agglomeration measures to be used in the study. The third section presents the data construction procedures and presents the empirical measures of agglomeration for the manufacturing industry at the 4-digits level. The fourth section discusses the econometric issues involved in the estimation procedure and presents the related empirical results. The fifth section brings some final comments and suggestions for additional research.

2. Agglomeration Measures: Conceptual Aspects

Concentration indexes (for example the Herfindahl index) rely on some function of market shares in accordance with a particular weighting scheme. This type of measure can be conceived with reference to the industry (as traditional industrial concentration indexes) or with reference to localities (as spatial concentration indexes). In broad terms, industrial agglomeration measures capture the excess of spatial concentration relative to industrial concentration. Next we briefly discuss some recently proposed agglomeration measures. Maurel and Sédillot (1999) advance the following measure of industrial agglomeration defined foe each industrial sector:

$$\gamma_{MS} = \frac{G_{MS}/(1-X)-H}{1-H} \qquad (1)$$

where $G_{MS} = (\sum_{j=1}^{K} s_j^2 - \sum_{j=1}^{K} x_j^2)$, and $X = \sum_{j=1}^{K} x_j^2$, with x_j indicating the share of the j-th locality in the total employment of the manufacturing industry and H refers to usual Herfindahl industrial concentration index. The term G_{MS} intends to control for differences of size across localities taking as reference the share of each locality in total employment. This measure is similar to the one proposed by Ellison and Glaeser-EG (1997). The agglomeration index γ_{MS} can be motivated in terms of probabilistic model of plant location. Consider an industry with N plants and K possible distinct locations. The employment share of the industry located in area j can be written as:

$$s_j = \sum_{i=1}^{N} s_i u_{ij} \qquad (2)$$

where u_{ij} = 1 when plant i is present in locality j and equal to 0 otherwise. The index intends to capture the relationship between plant location decisions of different pairs of plants. The approach conceives a measure $\rho(u_{ij}, u_{sj}) = \gamma$ for $i \neq s$, such that $-1 \leq \gamma \leq 1$. In other words, the agglomeration measure may be interpreted as a correlation coefficient between the location decisions referring to pair of plants. The polar cases with values approaching –1 and 1, indicate respectively tendency towards separation and agglomeration. Another agglomeration measure is advanced by Ellison and Glaeser (1997)::

$$\gamma_{EG} = \frac{\sum_{j=1}^{K}(s_j - x_j)^2 / (1-X) - H}{1-H} \qquad (3)$$

where $G_{EG} \equiv \sum_{j=1}^{K}(s_j - x_j)^2$

If γ_{EG} = 0, one could postulate a situation where the firm location had been randomly generated as would occur if the employment distribution across locations is uniform. This agglomeration measure has a descriptive character, as it does not identify the underlying with explanatory factors that could be associated with agglomeration externalities and natural advantages pertaining specific localities. Econometric studies on the determinants of industrial agglomeration are relatively scarce. Rosenthal and Strange (2001) constitute an exception by considering the determinants of agglomeration in the U.S. as measured by γ_{EG}.

3. Measures of Industrial Agglomeration: Empirical Analysis

3.1- Data Description

The work makes use of different data sources for industrial establishments and also data at the sector and city level. The most important source is provided by the *Relação Annual de Informações Sociais*-RAIS (Ministry of Labor and Employment-Brazil) that comprises information regarding employment, education level and wages in all formally constituted industrial establishments. This source is used to construct the industrial agglomeration measures considered in this study and an education level variable foe each sector in a given city,

A second source was the joint survey by FIRJAN, CIRJ, SESI, SENAI and IEL that provided a descriptive assessment of local incentive policies in the state of Rio de Janeiro in 1998. These policies included different tax exemptions (including preferential treatment for small firms), land provision and technical support for the creation of new establishments.

The third source was provided by the statistical bureau of the state of Rio de Janeiro (Fundação CIDE). In fact, its main annual publication has information on social and economic conditions for the cities on that state including, for example, existence of basic infra-structure (telecommunications, energy, water and sewage and banking among others).

The fourth source comes from the input-output matrix for the state of Rio de Janeiro (Fundação CIDE) that will enable to generate sector-specific variables that are relevant in the determination of industrial agglomeration. One can consider explanatory factors related to natural advantages and spillover effects associated with given localities. For that purpose, we construct variables that approximate the input content for some basic elements (for example water and energy) and yet the importance of inputs with different degrees of elaboration.

The fifth source is Banco Nacional de Desenvolvimento Econômico e Social-BNDES that has information on the number and volume of credit operations by industry sector. The referred development bank provides funds at lenient interest rates for long-run industrial projects.

Finally, as a complement to the previous source, a national survey on technological innovation [Pesquisa de Inovação Tecnológica 2000-PIT/IBGE

(2002)] that provides information on technological innovation by type, R&D expenses and educational qualification at the sector level.

The variables used in the present study are listed below:

Sector-level variables:

. VBNDES – average value of loans by the Brazilian development bank [Banco Nacional de Desenvolvimento Econômico e Social-BNDES] during the 1998/2001 period divided by the average number of establishments in the period (annual averages).

. MANUF – manufactured inputs per shipment in 1996, defined at the 4-digits level (input-output matrix-CIDE);

. NMANUF – non-manufactured inputs per shipment in 1996, defined at the 4-digits level (input-output matrix-CIDE);

. GRAD – average number of workers with graduate degree at each 3-digits sector in 2000 (PIT/IBGE);

. PROCI – proportion of firms in each 3-digits sector that implemented process innovations in 2000 (PIT/IBGE);

. ENERGY – energy expenses per shipment in 1996, defined at the 4-digits level (input-output matrix-CIDE);

. EWATER – water expenses per shipment in 1996, defined at the 4-digits level (input-output matrix-CIDE);

. TRANSP – transportation expenses per shipments in 1996, defined at the 4-digits level (input-output matrix-CIDE);

Municipality-level variables:

. TEL – number of (fixed) telephone access lines per inhabitant in 2000, including public lines (CIDE);

. POST: number of post-office establishments per inhabitant in 2001 (CIDE)

. ROAD – roads´extension (in km) divided by the area of the municipality in 2001 (CIDE);

. BANK – number of banking branches per inhabitant in 2001 (CIDE);

, CRED: volume of personal financial investments per inhabitant in 2000 (CIDE);

. PINV: public investment at the municipality level in 2000 (CIDE);

. SCHOOL – number of schools (up to high school level)

per inhabitant in 2001 (CIDE);

. GDP – real gross domestic product per inhabitant at the municipality level in 2000 (CIDE);

. HOSP – number of licensed hospitals per inhabitant in 2001, including public and private hospitals;

. AMB – Number of ambulatorial units per inhabitant in 2001;

. PTAX: dummy variable for property tax exemption in 1998, that assumes value 1 in the case of exemption and 0 otherwise;

. STAX - dummy variable for service tax exemption in 1998, that assumes value 1 in the case of exemption and 0 otherwise;

. MICRO – dummy variable indicating the provision of technical support for micro and small firms in 1998, that assumes value 1 in the case of support and 0 otherwise;

, ELEC – number of electricity bills per inhabitants in 2001 (including household, industrial and retail consumption);

. WAT - number of water bills per inhabitants in 2001 (including household, industrial and retail consumption);

The summary statistics of the various variables are presented in table 1.

INSERT TABLE 1 AROUND HERE

As becomes evident, data on the explanatory variables are only available for different years with different lags relative to the dependent variable (available for 2001). In particular, as it would be expected, input-output data are usually available for few years (in the present application we had to consider 1996). A similar problem was encountered by Rosenthal and Strange (2001) that had also to combine different data sources. As the exact lag structure of the effects of the different variable on agglomeration is not exactly predicted by theory, the present study necessarily has an exploratory nature.

3.2- Empirical model

In this section we describe the empirical model considered in the econometric analysis, providing the basic motivation for the inclusion of the variables and indicating the expected signs for the related coefficients, especifically:

$$AGLO_{ij} = \alpha + S\vec{\beta} + M\vec{\delta} + D\vec{\gamma} + \varepsilon_{ij} \qquad (4)$$

The generic expression presented above partitioned the explanatory variables in two broad groups depending on whether one has sector-level variables (included in matrix S) or municipality-level variables (included in matrix M). Moreover, the D matrix includes a set of sector specific dummy variables and ε denotes a stochastic error term. The dependent variable $AGLO_{ij}$ represents an agglomeration measure for sector I and municipality j.

A major challenge of the present paper is to combine different levels of analysis. In fact, previous empirical efforts like Rosenthal and Strange-RS (2001) focused on sector-level determinants of industrial agglomeration and therefore one can identify a gap in the literature in what concerns the effects of local infra-structure and incentive policies. Since the agglomeration indexes are constructed at the sector-level it was necessary to uncover the weight of each municipality in the indexes, along the lines proposed by Ellison and Glaeser (1997) for a similar agglomeration index. The basic criterion is given by the following expression:

$$\gamma_{ij}^{MS} = \gamma_{i(m)}^{MS} \, . \, w_{ij} \qquad (5)$$

The agglomeration measure for the i-th sector can be associated to specific municipality by considering specific weights. In principle, an obvious choice would to define w_{ij} as the share of sector´s i employment in municipality j relative to the total employment of sector i. A shortcoming of the previous weighting scheme is that small weights applied on high-agglomeration sectors can generate distorted measures. The latter measure could have a smaller value in comparison with a situation where one has a high weight applied to a low-agglomeration sector. We intend to avoid situation where high agglomeration is not misidentified as low agglomeration due to the small weight of the municipality. In order to establish a criterion that preserves a sensible ordering property, the construction of our dependent variable is defined in terms of the adjusted weight w_{ij}^{*} as described in the appendix.

This procedure allows to combine sector-level and municipality-level variables within a same econometric model.

The first group of explanatory variables (as represented by S) comprise two classes of factors as suggested by RS. First, one must emphasize *natural and cost advantages*. In the present application, these would include **ENERGY**, **EWATER** and **TRANSP**. Since the provision of these inputs has limited local availability, firms that operate in sectors that make intensive use of those inputs would tend to agglomerate. Therefore, one would expect positive signs for the corresponding coefficients.

The second class of explanatory factors is associated with *agglomeration externalities*. In this case, two main effects can be identified. In the one hand. agglomeration would have a positive association with the presence of knowledge spillovers. For example, in highly innovative sectors where joint R&D efforts and knowledge spillovers are relevant, one can expect a tendency towards industrial agglomeration. In the present context, **PROCI** and **GRAD** are expected to exert positive effects on agglomeration. On the other hand, it is possible to conceive effects pertaining bargaining power from large purchasers of manufactured inputs (which use is more sector-specific in contrast with non-manufacturing inputs). The associated volume discounts are more likely to be feasible in industries with significant economies of scale as the seller would be more capable of corroborating the price reduction pressure from the buyers. These arguments together imply that **MANUF** and **NMANUF** should respectively exert positive and negative effects on industrial agglomeration.

This paper intends to extend the analysis on the determinants of agglomeration by considering local infra-structure and incentive policies. The better the infra-structure at the municipality level, the stronger will the tendency to agglomerate.[1] (though with varying intensity of effects depending on the sector). The infra-structure variables **TEL**, **BANK**, **POST**, **AMB**, **HOSP**, **ELEC**, **WAT** and **CRED** are expected to produce positive effects on agglomeration. Additionally, among the municipality-level variables there are some that reflect the explicit decision of policy makers in providing incentives for industrlalization. The variables **PTAX**, **STAX** and **MICRO** should have a positive impact on industrial agglomeration.

Finally, we had mentioned sector-specific dummy variables. The inclusion of those can be potentially useful if significant unobserved heterogeneity becomes evident in the econometric analysis. This strategy was adopted by RS as the initial fit of the model showed a modest explanatory power of the original sector-level variables. It is worth mentioning, that in the present application (that combines sector-level and municipality-level explanatory variables) one manages to obtain non-negligible explanatory effects even without including sector-specific fixed effects.

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[1] The theoretical importance of local infra-structure in supporting industrialization has been recognized, for example, by Bjorrvatn (2000), especially in LDC countries.

4. Empirical Results

In this section, we present the results from the econometric analysis. First, we undertake estimation with ordinary least squares-OLS as reported in table 1.

INSERT TABLE 2 AROUND HERE

Three variants of the model are initially considered: the basic OLS formulation with an usual (single) intercept and two other formulations including sector-level dummy variables (at the 2 and 3 digits levels). In general terms, some specific results appear to be especially robust and sector-level variable tend to have more significant coefficients than the municipality-level variables. Among the sector-level explanatory variables it is worth mentioning the coefficients of NMANUF, PROCI, ENERGY and GRAD were significant and displayed the correct expected sign. These results hold for the three specifications with the exception of the coefficient for ENERGY when one considers sector-level dummies. The variable TRANSP exerted the expected effect on agglomeration with a significant coefficient in the two specifications with sector-level dummies.[2] For the municipality-level variables, on the other hand, the results are weaker. Among the infrastructure variables, only TEL displayed significant coefficients with expected (positive) sign, with exception of the model with 3-digits dummies. Finally, among the incentive policies variables, the results were poor as tax

[2] One can observe that factors related to both *natural advantage and transportation costs* and *agglomeration externalities* do play some role in explaining industrial agglomeration.

exemption variables (PTAX and STAX) had insignificant coefficients in all specifications.[3] The variable MICRO displayed a negative but insignificant coefficient for all the specifications except for the one with dummies at the 3-digits level. Some variables also displayed significant coefficients but with unexpected signs. Among the sector-level variables that was the case for MANUF, EWATER and VBNDES.

A possible concern for the previous analysis refers to the possible endogeneity of some variables subject to policy makers´ decision. We believe that a concern of such nature could be relevant in the case of the variable MICRO. In fact, that kind of policy is typically implemented in less developed localities as a pro-active initiative. We undertake exogeneity tests along the lines of Hausman (1978). For that purpose we considered some basic local development variables (GDP, ELEC, WAT, AMB, SCHOOL) as explaining MICRO. The generated redisuals from the OLS estimation were then used as an additional regressor in the original equation. The inference on the exogeneity is made upon significance assessment of the corresponding coefficient. In all three specifications there is no evidence of the endogeneity of MICRO.[4] In order to additionally explore endogeneity concerns, we consider also an instrumental variable estimation as reported in appendix 2. The results appear to be very robust for different choices of

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[3] This result may possibly indicate that tax exemption policies carried out at other levels of government may be more powerful. Examples could include exemptions of state taxes (ICMS) or federal taxes (IPI).

[4] The relevant test statistic was – 0.0380 (p-value = 0.453) for the specification without sector-level dummies, - 0.0288 (p-value = 0.4837) for the specification with 2-digits dummies and – 0.0101 (p-value = 0.7477) for the model with 3-digits dummies.

instruments and results are remarkably similar to the ones obtained in the OLS estimation, especially if one focus on the significant coefficients of that specification.

The previous discussion allows to focus our attention in the estimates presented in table 1. The explanatory power of the included variables was non-negligible even without the inclusion of sector-level dummies (adjusted R^2 = 0.1949) and reasonable when 2-digit or 3-digits dummies were included. For that simpler specification, the result suggests that regressors only partially explain variations in the industrial agglomeration variable. In those cases , one obtained adjusted R^2 of 0.4109 and 0.6620 respectively. The analysis show that sector-level factors and local infrastructure aspects do seem to exert impacts on industrial agglomeration.

5. Final Comments

Recent contributions have devised sound measures of industrial agglomeration. The new empirical challenge is to construct econometric models to explain the determinants of industrial agglomeration. Previous efforts concentrated on sector-level explanatory factors. In the present paper we attempted to extend the analysis by considering the impact of local infrastructure and incentive policies.

The evidence indicated that local infrastructure also appears to play an important role in explaining agglomeration but no clear support was found for local incentive policies like tax exemption schemes and technical support for micro and small firms. In any case, it becomes clear that industrial agglomeration cannot be solely explained in terms of sector-level variables. The empirical literature had indeed recognized that the latter class of variables had only partial explanatory power but the analysis was not taken forward in terms of the inclusion of additional explanatory factors.

Avenues for future research include the consideration of better data sources. In fact, the main industrial state in Brazil is São Paulo. Should the sector-level data as well as the local infrastructure and incentive policies information become available, that state would provide a more representative picture of industrial agglomeration. Moreover, it is desirable to have more detailed information on incentive policies at the municipality-level so as to avoid entirely qualitative variables. Finally, it would be interesting to trace the effects of special credit programs for micro and small firms. In the present paper, we had some evidence on the effects of loans provided by the Brazilian development bank, but only recently there was a decision of increasing the scale of operations in that segment.

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Appendix 1

The dependent variable was constructed by means of a weighting scheme on the aggregate agglomeration measure by MS, with weights determined as a function of the municipalities´shares of employment in the relevant 4-digits sector

Statistics available:

γ_{K}^{MS} : MS agglomeration index for sector K

p_{KJ} : share of municipality j in employment of sector K

One aims at obtaining a measure agglomeration at the municipality-level and for given industrial sectors.

$\gamma_{KJ}^{MS} = \gamma_{K}^{MS} \cdot w_{KJ}$

where γ_{KJ}^{MS} : agglomeration index for sector K in municipality J, J = 1, 2, ….,R

w_{KJ} is the weight of municipality J in the agglomeration in sector K

The values of weights w are determined as follows:

$\gamma_{K(m)}^{MS}$: m order statistics of the calculated γ^{MS}

$p_{K(m)J(n)}^{MS}$: n order statistic for the municipalities´shares in the m-th sector

$$f_{K(m)} = (1/2).MIN\ \{(\gamma_{K(m+1)}^{MS} - \gamma_{K(m)}^{MS}), (\gamma_{K(m)}^{MS} - \gamma_{K(m-1)}^{MS})\}$$

Then:

$$w_{K(m)J} = 1 + \frac{(p_{K(m)J} - \overline{p}_{K(m)})}{(p_{K(m)J(R)} - \overline{p}_{K(m)})}.f_{K(m)},\ \ se\ \ p_{KJ} > \overline{p}_K$$

$$w_{K(m)J} = 1 - \frac{(p_{K(m)J} - \overline{p}_{K(m)})}{(p_{K(m)J(1)} - \overline{p}_{K(m)})}.f_{K(m)},\ \ se\ \ p_{KJ} < \overline{p}_K$$

In essence, these weights generate measures of concentration (at the municipality-level)- for each one of the 4-digits sectors- that are distributed around the original measure by MS according to the municipality´s employment share relative to the total employment of the sector. Specifically, the statistic $f_{K(m)}$ is defined in such a manner that if the agglomeration index for a sector A is greater than the analogous measure for sector B, then municipality-level indexes for A will be larger than all municipality-level for B. Such order preserving in municipality measures is crucial to assure that the effects of sector-level variables are captured, without ambiguities, by the regression equation. Additionally, the use of the previous expressions avoid biases in the new concentration measures. In fact:

$$\mathbf{E[}\gamma_{KJ}^{MS}\ \mathbf{/\ K\ ]} = \gamma_K^{MS}$$

Appendix 2: Determinants of industrial agglomeration-econometric results (method: instrumental variables)

	Without Dummies			With Dummies Sectors 2D			With Dummies Sectors 3D		
Variable	**Coefficient**	**t-Student**	**p-value**	**Coefficient**	**t-Student**	**p-value**	**Coefficient**	**t-Student**	**p-value**
Constant	0.197102	4.788888	0.0000	-0.112966	-1.799246	0.0721	-1.059946	-19.75512	0.0000
PTAX	0.005174	0.251732	0.8013	0.010179	0.643229	0.5201	-0.003903	-0.319923	0.7491
STAX	0.008029	0.377455	0.7059	-0.004058	-0.243617	0.8075	-0.001132	-0.089653	0.9286
PROCI	2.725907	12.60065	0.0000	2.549071	2.332267	0.0198	7.422142	6.373477	0.0000
MANUF	-0.382452	-7.968695	0.0000	-0.217652	-2.623032	0.0088	1.031991	4.658486	0.0000
NMANUF	-0.287241	-8.335730	0.0000	-0.070116	-1.807735	0.0708	0.480045	15.38544	0.0000
ENERGY	1.575371	4.328946	0.0000	0.002343	0.005908	0.9953	3.789097	0.872110	0.3832
EWATER	-17.72329	-8.260804	0.0000	1.165086	0.375782	0.7071	-20.79641	-0.874891	0.3817
TEL	0.229785	2.775996	0.0055	0.175510	2.540230	0.0111	0.054214	1.062690	0.2880
MICRO	-0.066785	-2.192326	0.0284	-0.045456	-1.700966	0.0891	0.022161	1.070715	0.2844
VBNDES	-0.000275	-4.577572	0.0000	-8.57E-05	-1.139143	0.2547	-0.000301	-4.711048	0.0000
TRANSP	0.231836	0.730017	0.4654	1.077950	2.204909	0.0275	22.21024	15.09932	0.0000
GRAD	0.044466	2.959699	0.0031	-0.046387	-2.289197	0.0221	0.131976	1.746432	0.0809
BANK	5.098988	0.026189	0.9791	-88.74814	-0.535819	0.5921	-130.4740	-1.118368	0.2635
POST	-122.7359	-2.344921	0.0191	-116.1855	-2.685282	0.0073	-37.57265	-1.163553	0.2447
	R-squared		0.19078	R-squared		0.4146	R-squared		0.6744
	Adjusted R-squared		0.1864	Adjusted R-squared		0.4066	Adjusted R-squared		0.6611
	F-statistic		45.9703	F-statistic		52.5996	F-statistic		50.813
	p-value (F-statistic)		0.0000	p-value (F-statistic)		0.0000	p-value (F-statistic)		0.0000
	List of Instruments: AGLO C PROCI MANUF NMANUF ENERGY EWATER VBNDES STAX TEL PTAX CRED TRANSP GRAD SCHOOL BANK PINV GDP ROAD			List of instruments: AGLO C PROCI MANUF NMANUF ENERGY EWATER VBNDES STAX TEL PTAX CRED TRANSP GRAD SCHOOL BANK PINV GDP ROAD			List of instruments: AGLO C PROCI MANUF NMANUF ENERGY EWATER VBNDES STAX TEL PTAX CRED TRANSP GRAD SCHOOL BANK PINV GDP ROAD		

Table 1: Summary statistics

Variables	Mean	Median	Maximum	Minimum	Std. Dev.
ENERGY	0.053474	0.04287	0.264218	0.007355	0.045589
EWATER	0.007036	0.004274	0.026994	0.001194	0.006471
TRANSP	0.007181	0.000151	0.366536	0	0.022541
MANUF	0.575985	0.568705	0.86732	0.018522	0.154345
NMANUF	0.152178	0.089822	1.89E+00	6.82E-05	0.278332
GRAD	0.035512	0.003761	11.16331	0	0.382629
PROCI	0.031731	0.03286	0.148256	0.00715	0.024236
VBNDES	53.78232	13.23474	3142.376	0.018475	181.692
MICRO	0.317186	0	1	0	0.46547
PINV	0.083806	0.044724	1.134397	0.003889	0.135501
PTAX	0.223376	0	1	0	0.416588
STAX	0.22722	0	1	0	0.419117
POST	0.000153	0.000109	8.97E-04	1.20E-05	0.000128
ROAD	3.483529	1.561814	35.16495	0.041765	5.621107
TEL	0.152439	0.129803	0.416869	0.025204	0.096683
WAT	0.16933	0.167293	0.607131	0	0.119897
BANK	4.73E-05	3.91E-05	0.000165	0.00E+00	3.43E-05
CRED	0.403376	0.242362	2.418564	0	0.622541
AMB	0.000468	0.000386	1.89E-03	4.97E-05	0.000372
SCHOOL	0.001004	0.000833	0.004583	0.0004	0.000597
ELEC	0.351912	0.344443	0.776716	0.073575	0.072548

Table 2: Determinants of industrial agglomeration-econometric results (method: ordinary least squares)

	Without Dummies			With Dummies Sectors 2D			With Dummies Sectors 3D		
Variable	**Coefficient**	**t-Student**	**p-value**	**Coefficient**	**t-Student**	**p-value**	**Coefficient**	**t-Student**	**p-value**
Constant	0.174877	4.400676	0.0000	-0.133102	-2.143196	0.0322	-1.058273	-20.02224	0.0000
PTAX	-0.007106	-0.353013	0.7241	0.002499	0.160103	0.8728	0.001666	0.138129	0.8901
STAX	0.002998	0.143478	0.8859	-0.008388	-0.513586	0.6076	-0.001484	-0.120013	0.9045
PROCI	2.754262	12.79350	0.0000	2.619384	2.420553	0.0156	7.392774	6.327675	0.0000
MANUF	-0.381067	-7.970996	0.0000	-0.219640	-2.650457	0.0081	1.031430	4.627359	0.0000
NMANUF	-0.288560	-8.287456	0.0000	-0.069668	-1.780768	0.0751	0.478709	15.47713	0.0000
ENERGY	1.596973	4.392471	0.0000	0.006902	0.017304	0.9862	3.757492	0.873704	0.3824
EWATER	-17.81640	-8.314412	0.0000	1.334361	0.427035	0.6694	-20.66260	-0.877501	0.3803
TEL	0.272750	3.480620	0.0005	0.212816	3.243416	0.0012	0.061011	1.254554	0.2098
MICRO	-0.010317	-0.948853	0.3428	-0.007002	-0.744322	0.4567	0.003451	0.483553	0.6287
VBNDES	-0.000281	-4.657633	0.0000	-9.03E-05	-1.226407	0.2202	-0.000306	-4.830413	0.0000
TRANSP	0.215190	0.674905	0.4998	1.076188	2.215932	0.0268	22.19506	15.25594	0.0000
GRAD	0.047228	3.138106	0.0017	-0.045154	-2.271592	0.0232	0.131289	1.735597	0.0828
BANK	-190.2326	-1.014082	0.3106	-229.9854	-1.441367	0.1496	-88.07289	-0.796245	0.4260
POST	-62.37577	-1.633198	0.1025	-59.07407	-1.876952	0.0606	-20.12041	-0.882092	0.3778
	R-squared		0.1992	R-squared		0.4188	R-squared		0.6753
	Adjusted R-squared		0.1949	Adjusted R-squared		0.4109	Adjusted R-squared		0.6620
	F-statistic		45.9643	F-statistic		52.8176	F-statistic		51.3536
	p-value (F-statistic)		0.00000	p-value (F-statistic)		0.0000	p-value (F-statistic)		0.0000