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EXPLICATIVE FACTORS FOR THE DIFFERENCES IN POPULATION AND EMPLOYMENT AMONG THE ARAGONESE TOWNS.

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Abstract

The main objective of this paper is to analyze the determinants of population and employment (and their densities) in the towns of the aragonese region (North-East of Spain). The theoretical models, due to Steinnes and Fisher, and Carlino and Mills, permit simultaneous determination of population and employment (and their densities). These models are applied to the 727 towns of the aragonese region in order to analyze the effects of geographic, economic, demographic and location variables on the distribution of population and employment in the first years of the 90´s. The study of these magnitudes in the aragonese region is interesting for explaining the municipal differences among the three provinces (Huesca, Teruel and Zaragoza) which integrate Aragón. The introduction of variables such as the distance to the capital, the borderland situation or other variables related to the kind of communications, may result useful in the interpretation of these differences.

1. INTRODUCTION

The unequal accumulation of people in urban areas with respect to rural areas and among different urban and/or rural areas, is a theme that has been studied in economics associated to the location of industries in different areas.

This disequilibrium can be appreciated since the industrialization era, when people left rural areas and move to the cities, where they could find a job and a way of life.

Nonetheless, during the last years, we are observing a process of concentration of population in rural areas close to large cities. In general, this rural areas become dormitory towns for the people who work in the city. The development of communications seems to help this phenomenon, making it less time costly to go from towns to big cities. So it seems that an increasing tendency of the inhabitants to set their home in rural areas close to large cities without losing labour or consumption links with those cities can be verified.

But, as we say, citizens do not leave their jobs in the big city to go to work in rural areas. Large cities offer most of the available employment, what leads to great differences between urban and rural areas, and even among different urban areas.

A need for good communications, industrial descentralization, local development actions or sinergies, should be possible in adjacent areas, as these would be factors which favour a higher territory equilibrium.

In this paper we try to analyze what are the factors that affect employment and population concentration (densities) in the different areas and what is the relationship that links both variables.

As Carlino and Mills (1987) say, most of the studies that have taken into account this themes, assume that employment growth is exogenous and determinant for population growth. But there exist some other papers (Steines and Fisher, 1974; Mills, 1983; Steinnes, 1977; Mills and Price, 1984) that use models of simultaneous determination of population and employment growth.

We are going to follow the latter and will use a simultaneous equation model to determine population and employment densities.

This work is centered in a specific region of Spain, the region called Comunidad Autónoma de Aragón. This region has special geographic, economic and social circumstances that have made the region suffer, for a long time, an important process of

desintegration, what can be appreciated if we pay attention to the differences in population and employment densities among rural and urban areas, as well as among different urban areas.

Aragón is a vast region (47.650 squared kilometres, km2) located in the north-east of Spain. It borders on important spanish regions such as Cataluña, Navarra or Valencia, and it is a border way to Europe.

This region is made of three provinces, each of them with very different characteristics. The biggest province is Zaragoza, located geographically just in the middle of the others (Huesca in the north and Teruel in the south). From the begining of the century, Aragón is losing most of its popultaion (1985: 1.233.172; 1991: 1.188.817), specially in rural areas, where there exists a great amount of deserted villages, in favour of the adjacent regions, specially Cataluña. But not all the migration goes away the aragonese borders. It can be observed that there exists a migration from Huesca and Teruel to Zaragoza. This area, in contrast to the others (Huesca and Teruel), is continously growing, and the capital (Zaragoza) is the aragonese city with the highest population and employment densities.

The objective of this paper is to analyse the determinants of employment and population in the aragonese towns, giving a special attention to economic and social aspects, and introducing factors, that we consider to be of great important, such as the existence of communication roads among towns or the possibility of dynamic areas which enhance the growth of their towns.

For accomplishing this work we have a sample of 724 towns of the region which will allow us to study the effects of geographic, economic, demographic and location determinants over the variables under study. This work takes into account the first years of the nineties.

The results show the importance of infrastructures in determining population and labour patterns of the region, and the existence of centers which concentrate labour force that tends to live in near areas.

The rest of the paper is organised as follows. In section 2 we review the theoretical model which will be used to explain the relationship between population density and labour density and the determinant factors of both magnitudes. In section 3 we present the data base and explain the main variables used in our study. In section 4, with the aim of illustrating the capacity of the proposed methodology, we apply it to the aragonese economy. Section 6 closes the paper with a review of the main conclusions.

2. THEORETICAL MODEL

In order to explain the determinants of population and employment densities, we depart from a model of general equilibrium, in which people and enterprises are geographically movile, that is, they can move from one city to another following different incentives.

Under this frame, people maximize their utility function, which depends not only on goods consumed but also on the different characteristics of the city where they live. Among these we can name the real or percived easiness to find a job, the level of salaries and the services the city has (for example: health, amusement, culture, and so on). According to this, people move from one city to another when the increase in their expected utility due to that change be higher than the costs incurred.

At the same time, enterprises try to maximize benefits. In order to do that, they buy productive factors to transform them into goods and services they sell afterwards in the market. We consider that they are in competitive markets (product as well as factor markets). Costs of production and distribution of the goods and services depend on the location of the enterprise, what can be due to differences in transport costs, easiness to find workers with no necessity to compensate them for geographical location, and so on.

Under this perspective citizens are suppliers of work and claimants of housing.

Enterprises and people´s decisions considered together determine the price of housing and salaries and, consecuently, population and employment of every city. That is the reason why, in this model, population and employment are determined simultaneously, so that both variables influence each other. On the other hand, there will exist a set of additional variables that influence on one or both of the equilibrium variables.

So people and enterprises can move an stablish in answer to changes in the explicative variables. Under these criterions we assume that the model can be resolved in the same way as Steinness and Fisher´s (1974) and Carlino and Mills´(1987), using a model of simultaneous equations:

$$E = E(P, X_1)$$

$$P = P(E, X_2)$$

Where E is employment, P population, X_1 and X_2 are two sets of explicative variables which have an affect on employment and population, respectively, and also, X_1 and X_2 may have common elements.

Assuming, as Steinnes and Fisher (1974) propose, that equations above can be treated as lineal, the system becomes:

$$E = \gamma_1 P + X_1 \beta_1$$

$$P = \gamma_2 E + X_2 \beta_2$$

Where γ_1 and γ_2 are two parameters which affect the endogenous variables and β_1 and β_2 are two vectors of parameters that correspond to the exogenous variables of each equation.

3. DATA

The aplication of the model presented in the above paragraph for the aragonese reality, has been developed according to a sample of 724 towns from that region. Most of the cuantitative variables have been taken from the Instituto Aragonés de Estadística (IAE). On the other hand, we have built cualitative variables related to aspects quantifiable with difficulty.

The variables try to come across a priori explicative aspects of population and employment concentration in a territory. In the first place, we must point out that the endogenous variables of the two equations are population and employment densities (DE and DP) in the towns (population and employment per Km2). Using densities we try to avoid the problem of size in the different places. Density seems to be a more appropiated measure of the phenomenon we try to explain: concentration in urban and rural areas.

As explicative variables we have included some magnitudes related to social-economic aspects of the town. Related to economic aspects we include per capita income (DI) or the Herfindahl indicators for employment in the three sectors: agriculture (HFA), industry (HFI) and services (HFS). Equally, we have built sectorial indicators such as the number of licences in the IAE that each sector had available or the weight of the agriculture (IAA), industry (IAI) and services (IAS) sectors in production and town´s value added.

Equally we have computed the migratory balance (MB) for each town and the density of migrations per square kilometre.

Another group of variables refer to the location of the towns in relation to the large settlements of the region (the provinces´ capitals). According to them, the variable "km" computes the number of kilometres that separates each town from its capital and we have constructed the variable "adjacent" to try to fix a limit for closeness from the towns to the capital. This variable wil take the value 1 when the town is less than 40 km away from the province capital and 0 otherwise.

On the other hand, we are interested in verify whether there exists a significative relationship between closeness of the towns to a main communication road and the biggest or smallest population or emplyment concentration in that town. With this aim we have constructed dummy variables for the main roads of the region, that is, the road Nacional II (NII) wich connect Zaragoza with Madrid, the road Zaragoza-Logroño (Logroño), the toll motorway and the road to Barcelona (Barcelona), the road Nacional 330 (N330) wich links Zaragoza and Huesca, the road Nacional 240 (N240) wich allows to go from Huesca to Lérida and the road Huesca-Navarra (N232). Those variables will take the value 1 if the town is less than 10 km away from the road and 0 otherwise.

Equally, we try to see if there exist areas specially dynamic in population and employment. For this aim we construct dummy variables for the aragonese areas: Barbastro, Huesca, Sobrarbe, Jacetania, Bajo Cinca, Monzón, La Litera, Ribagorza, Teruel, Bajo Aragón, Cuencas Mineras, Albarracín, Mora, Maestrazgo, Calamocha, Calatayud, Daroca, Moncayo, Cariñena, Zaragoza, Belchite, Jalón, Cinco Villas, Prepirineo and Caspe. These variables take the value 1 if the town is in that area and 0 otherwise. On the other hand, we have constructed variables representative of the three analysed provinces (Huesca, Teruel and Zaragoza) in order to analyse whether there exist common behaviours in the towns that belong to each of them or not.

Finally, we have elaborated "frontier" variables that pick up the fact that the towns are close (less than 15 km) to one of the main frontiers of the region (France, Cataluña, Valencia, Rincón de Ademuz and Navarra). Using these variables we want to prove if the adjacent regions have any effect in employment and population of the aragonese towns and, if it exists, the way of that effect (that is, in the way of fixing population and employment or as areas that attract population and employment from the

adjacent towns). However, the frontier variables do not result significative in none of our estimations, in consecuence, we will not present them.

Table 1 shows a brief descriptive analyses of the two endogenous variables, that is, population and employment densities.

We can see that in the Comunidad Autónoma de Aragón the number of people per square kilometre in 1991 was around 15.5. This number is three times higher than the employment density, which is around 5 people per km2. This relationship is similar for the three provinces, although in Huesca the density of population is less than three times the employment density.

On the other hand, the study of the employment data per sector shows that the sector that generates less employment in the three provinces is construction. We have to notice that, although we can find similarities about the sector that generates less employment, there seems to exist more differences in the specialitation of each province. In this way, the sector that has a higher employment density in Huesca is the servicies sector, in Teruel agriculture and, logically, in Zaragoza industry.

4. EMPIRICAL RESULTS

The simultaneous equation model presented in the second section will be estimated, given the endogenous character of the two relevant variables, by the two-stage least squares method, that is, we will construct instrumental variables for population and employment densities.

In table 2 we show the estimations of the equation that explains population density. The four columns of the table pick up especifications depending on whether we introduce in the model dummy variables for the different provinces and towns or not. Likewise, for each of them we present the results obtained considering (or not) the influence of the migratory balance. A priori, this variable may be influenced by the endogenous varible, so it is interesting to analyse the robustness of the results after it exclution.

We can see that in all cases, employment density results a determinant factor in population concentration, appearing in all the estimations with a positive coefficient and very significative. That is, as it could be expected, population density will be increased by employment spatial concentration.

Another variable that influences positively population density is the town´s migratory balance. As we have noted before, there could exist endogeneity problems with this variable, so we have estimated the model without it. Doing this does not change, in general terms, the results.

Disposable income is also a population attraction factor to the aragonese towns, that is, people seem to move to towns with a higher income, due, probably, to the better life conditions associated to high income areas.

Likewise, given the importance of the rural area in this region, it seems to be interesting to introduce a variable that picks up employment concentration in the agriculture sector and analysing its influence on population. The Herfindahl index coefficient for this sector allows us to conclude, as we expected, that agriculture fixes population in towns.

Another group of variables may include those related to communication. In this case, there also exits concordance, in general terms, in the estimations obteined under the different specifications.

In general, big communication roads are a positive factor for the population to stay in a town. In this way, towns located near the main roads present higher densities than the rest. This result is obtained for the Nacional II (Zaragoza-Madrid), Zaragoza-Logroño, N240 and N232.

In this same group, a variable that reflects the influence in the metropolitan area of the capital of province in towns is the variable “adjacent”. According to the estimations, those towns located near Huesca, Teruel or Zaragoza (capital) have more population than those that are far away. The 40 km distance to the capital seems to mark the different behaviour of the population in the aragonese towns.

Finally, we have to say that, in general, it does not exist a different pattern or fix effects significative for the different areas. Only Barbastro, Moncayo, Zaragoza and Jalón seem to be areas with a special population concentration. If we consider the fix effects by provinces instead of by areas, we find out that Zaragoza, with a higher population density, is the only one that presents a different behaviour.

For the second equation of the model, the estimation results are presented in table 2. According to them, the main determinant of employment density in the different towns is population employment, that is, those towns with a higher population tend to generate more employment.

Now, the Herfindahl index applied to the industrial sector reflects that the higher the weight of the industry in the town, the higher the employment concentration. In this way, the industrial sector is the one that appears to fix employment in the aragonese region. Nonetheless, the number of industrial licences does not seem to be a determinant factor for employment. As this variables could be correlated, we estimate the model removing both variables separatedly. This does not affect the results obtained, that is, the index has still an effect statistically positive but the number of industrial licences does not influence significatively employment density.

To explain employment, and in order not to estimate the same equation as before, it is necessary to include some other variables that influence labour force in the area. In order to achieve this objective we introduce the number of licences of the IAE for different sectors: industry, agriculture, construction and services. In all cases the number of licences of the services sector (indicative of the weight of this sector in the town) is significative.

We have also included the variable “distance to the capital of province”. In this case the variable is significative, althogh with a negative sign (contrary as when we were studying population), what would mean that the capital of province attracts the labour force of the adjacent towns. As a consequence the capitals of province fix population also in those towns which are close to them but with workers from the capital.

If we turn now to communications, only the roads named NII and Logroño are significative and with a negative sign, what would mean that those towns close to those axis tend to lose employment density. Again, the sign of these variables is different in the two equations of the model, what would show that communications favour the fixation of population even though that population does not work where they live. The result is similar to that found in the paragraph above. Because big roads are a way to reduce distances in time to large urban centers, they allow people to move to work to those centers.

On the other hand, as we can see in the table, it does not exist fix effects corresponding to the different provinces. The same can be observed if we introduce dummy variables for the areas, although we do not present those results.

5. CONCLUSIONS

The objective of this paper was to analyse the determinants of population and employment, and their densities, in the different towns of the aragonese region. Given the relationship that exists between the two variables we decided to use a simultaneous equation model to explain those variables. In the empirical model we tried to pick up different factors (economic, location and infrastructures) of the towns.

As a conclusion, we can say that the following are relevant aspects. In the first place, there exists a bidirectional causality between two dependent variables, that is, employment density and population density, and it is possible to explain part of the behaviour of each of them with regard to the other one. In this direction we can say that, as we could expect, a higher employment density attracts more population and, at the same time, this higher population is a decision variable important in the location of new enterprises.

In second place, there exist some variables that affect population as well as employment in the aragonese towns; variables that are specially linked to communications and access to large centers. In this way, roads and closeness to the capital tend to fix population. In the case of employment, the influence of these variables is on the other direction, what would mean that part of the population that fix their residence in this centers which are more accessible from the capital, tend to go to the capital to work.

Finally, even though we can find some difference in terms of population density per areas and provinces, we have not confirmed this behaviour for employment density.

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Table 1. Descriptive analysis of dependent

	Mean	SD
Population density	15.434	36.742
Employment density	5.095	13.096
Agricultural empl. density	1.362	1.912
Industrial empl. density	1.469	5.160
Construction empl. density	0.514	1.200
Services empl. density	1.751	6.395

Table 2. Population density equation*

Variable	Coefficient	Variable	Coefficient	Variable	Coefficient	Variable	Coefficient
C	-8.422	C	-6.529	C	-5.620	C	-3.321
	(-2.428)		(-2.359)		(-3.364)		(-2.984)
DE	2.294	DE91	2.333	DE	2.593	DE	2.625
	(10.768)		(11.273)		(63.065)		(70.944)
MB	0.098	SM91	0.088	DI	0.000	DI	0.000
	(2.122)		(1.985)		(2.673)		(3.127)
DI	0.000	YD	0.000	HFA	3.225	HFA	1.900
	(2.260)		(2.460)		(2.054)		(1.311)
HFA	8.924	HFA	6.359	NII	2.001	NII	1.933
	(1.903)		(1.574)		(2.396)		(2.597)
NII	2.076	NII	2.359	Logroño	6.577	Logroño	6.206
	(1.638)		(2.017)		(3.980)		(3.984)
Logroño	9.865	LOGRO	10.099	N240	1.423	N240	1.930
	(2.478)		(2.447)		(1.419)		(1.996)
N240	4.951	N240	5.620	N232	3.178	N232	2.968
	(1.743)		(1.921)		(3.141)		(3.270)
N232	2.524	N232	2.722	BARC	-1.378	BARC	-0.818
	(1.691)		(1.918)		(-1.249)		(-0.792)
BARC	-2.980	BARC	-1.431	Adjacent	1.415	Adjacent	1.563
	(-1.801)		(-0.940)		(2.253)		(3.483)
Adjacent	2.117	Adjacent	1.186	Distance	0.013	Distance	-0.004
	(2.327)		(2.262)		(1.727)		(-0.946)
CBARB	2.321	HU	-0.708	CBARB	2.564	HU	-0.157
	(1.310)		(-1.129)		(2.199)		(-0.442)
CHUES	2.220	ZA	1.294	CHUES	2.354	ZA	0.804
	(1.209)		(2.127)		(1.918)		(2.407)
CSOBR	-1.256			CSOBR	-0.912		
	(-0.596)				(-0.640)		
CJACE	-1.935			CJACE	-0.585		
	(-0.940)				(-0.470)		

Table 2. (Continuation)

CBCINC	3.469	CBCINC	2.054
	(1.547)		(1.433)
CMON	3.102	CMON	2.570
	(1.485)		(1.876)
CLALIT	4.464	CLALIT	1.512
	(1.623)		(1.083)
CRIB	-0.358	CRIB	-0.272
	(-0.199)		(-0.220)
CTER	2.111	CTER	1.797
	(1.199)		(1.575)
CBAJA	1.781	CBAJA	-0.235
	(1.013)		(-0.172)
CCUEN	2.140	CCUEN	1.587
	(1.279)		(1.411)
CALBR	1.438	CALBR	1.485
	(0.791)		(1.236)
CMAES	1.195	CMAES	0.412
	(0.550)		(0.288)
CCAL	2.207	CCAL	1.449
	(1.247)		(1.260)
CCALA	2.484	CCALA	1.339
	(1.442)		(1.159)
CDAROC	1.697	CDAROC	1.087
	(0.954)		(0.930)
CMONC	6.791	CMONC	5.150
	(3.172)		(4.355)
CCARI	1.507	CCARI	1.628
	(0.773)		(1.263)
CZAR	4.736	CZAR	2.978
	(2.124)		(2.459)
CBELCH	1.754	CBELCH	1.717
	(0.834)		(1.239)
CJAL	5.349	CJAL	3.267
	(2.309)		(2.717)
CCINCO	1.068	CCINCO	0.892
	(0.562)		(0.704)
CPREP	-0.742	CPREP	-1.300
	(-0.346)		(-0.821)
CCASPE	1.257	CCASPE	0.956
	(0.517)		(0.576)

* the t-ratios are shown in parentheses.

Table 3. Employment density equation*

Variable	Coefficient	Variable	Coefficient
C	-0.906	C	-0.942
	(-4.712)		(-5.389)
DP	0.373	DP	0.372
	(90.801)		(92.583)
Adjacent	-0.552	Adjacent	-0.570
	(-4.280)		(-4.508)
HFI	1.640	HFI	1.663
	(5.607)		(5.779)
IAIN	3.915	IAIN	3.656
	(0.899)		(0.852)
IAA	-0.317	IAA	0.385
	(-0.112)		(0.146)
IASE	1.699	IASE	1.906
	(1.627)		(1.897)
IAC	9.190	IAC	9.734
	(2.536)		(2.734)
NII	-0.694	NII	-0.750
	(-2.712)		(-2.994)
Logroño	-1.647	Logroño	-1.621
	(-3.112)		(-3.114)
HU	0.040		
	(0.318)		
ZA	-0.094		
	(-0.821)		

* the t-ratios are shown in parentheses.