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Articles

Measuring the labour efficiency in Andalusia (Spain): A DEA approach

Francisca J. Sánchez-Sánchez[a], *Ana M. Sánchez-Sánchez*[b], *Noemí Pulido*[c], *Diego V. Borrero*[d]

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Abstract:

This paper analyses the labour efficiency in Andalusia, and takes into account labour and demographic characteristics of the Andalusian municipalities. Data Envelopment Analysis (DEA) is the methodology employed. The results obtained indicate differences at the municipal level that depend on the geographical arrangement, with the provincial capitals being the least efficient. An inverse relationship is established between the size of the municipality (in terms of number of inhabitants) and its labour efficiency: the smaller the size of the municipality, the greater the efficiency. The distance to the capital is also important in establishing the efficiency: the greater the distance to the capital, the greater the efficiency.

Keywords: Efficiency; Employment; Municipalities; Andalusia; DEA.
JEL classification: O18; R11; R12.

Medición de la eficiencia laboral en Andalucía (España): una aproximación DEA

Resumen:

Este trabajo analiza la eficiencia laboral en Andalucía, atendiendo a características laborales y demográficas de los municipios andaluces. La metodología empleada para obtener las mediciones de eficiencia es el Análisis Envolvente de Datos (DEA). Los resultados obtenidos indican diferencias a nivel municipal dependiendo de la disposición geográfica, siendo las capitales de provincia las menos eficientes. Se establece una relación inversa entre el tamaño del municipio (en términos del número de habitantes) y su eficiencia laboral: cuanto menor es el tamaño del municipio, mayor es la eficiencia. La distancia a la capital también es importante para establecer la eficiencia: cuanto mayor es la distancia a la capital, mayor es la eficiencia.

Palabras clave: Eficiencia; Empleo; Municipios; Andalucía; DEA.
Clasificación JEL: O18; R11; R12.

1. Introduction

Historically, unemployment rates have been higher in Andalusia than in the rest of Spain, and the economic crisis of 2008 was no exception. According to the Labour Force Survey (LFS), unemployment

[a] Universidad Pablo de Olavide. fsansan@upo.es
[b] Universidad Pablo de Olavide. amsansan@upo.es
[c] Universidad de Sevilla. npulido@us.es
[d] Universidad de Sevilla. dborrero@us.es
Corresponding author: fsansan@upo.es

rates of Andalusia and Spain at the beginning of 2007 were 12.5% and 8.5%, respectively; this gap increased during the economic crisis by nearly 10 points in 2013 and it is presented from all perspectives: sex, age, levels of studies, sector, etc. (Usabiaga, 2004).

The high and persistent unemployment in Andalusia, and its worst relative situation with respect to the rest of the Spanish economy explain the choice for the study of the Andalusian labour market (Álvarez et al., 2011).

One way of dealing with this issue is through the analysis of the labour market efficiency, which can be defined as the achievement of *"a maximum number of hires with a given stock of job openings and unemployed"* (Sheldon, 2003:50). This typology of study is usually developed from an approach of public employment services and policies (Sheldon, 2003; Althin and Behrenz, 2004; Vassiliev et al., 2006; Koning, 2009; Agovino et al., 2013). Hence, *"efficiency pertains to the speed with which the unemployed find jobs and vacancies attract job seekers"* (Sheldon, 2003: 49). This paper extends the field of study by analysing the efficiency of the labour market while taking into account both public and private actions.

The observation of the different territorial units that shape a province, region, or country, and the different features of each area are fundamental in determining the potential disparities between these units (Beccatini et al., 2003), and hence spatial economy takes on a special importance. The progress of territorial cores is explained by means of interacting and their geographical layout (Feria et al., 2015).

It is necessary to ascertain the situation of a specific area in order to change it; this can foster the formulation of proposals that may improve the located problems. The first level for the formulation of active policies that can solve labour and economic disparities is the municipal level (Stimson et al., 2001). Clinch and O'Neill (2009) highlighted the importance of space for the evaluation of employment policies with a high level of decentralisation, as in the Andalusian case. Ramírez and Vassiliev (2007), Elhorst (2003 and 2008), Elhorst and Zeilstra (2007), and Longhi and Nijkamp (2007) study the labour market at a territorial level.

Some papers find a link between the size and the regional location of municipalities (Sánchez et al., 2018, Caravaca et al., 2014, 2017); the results indicate that large urban areas have the best economic, business results and a more dynamic labour market. Caravaca et al. (2009) studies the relationship between the size of municipalities and the degree of incidence of the economic crisis: in economic boom the most significant economic growth occurs in "medium" municipalities (population between 20,000 and 100,000 inhabitants), but this trend does not happen in recessive stages. This paper focuses on this idea and it analyses if smaller municipalities have more efficient labour markets in a stage of economic crisis. According to Muñiz et al. (2008)[1], the distance from the capital will be used in order to explain the municipal labour efficiency. Thus, the main goal of this paper is to analyse the labour market efficiency at Andalusian level, and the spatial approach is assumed as a relevant factor in this study.

To this end, the methodology used in studies of efficiency measurement is applied, which uses a non-parametric method based on mathematical programming, known as Data Envelopment Analysis (DEA). This analysis has proved useful in a wide variety of contexts and applications (Gémara et al., 2018; Gkiza and Nastis, 2017; Ramírez-Hurtado and Contreras, 2017; Caro-Vela et al., 2013; Balaguer-Coll and Prior, 2009; Sheldon, 2003). The DEA methodology was developed by Farrell (1957), who defined a frontier or reference point of the best practices composed of the most efficient units of the sample in order to obtain efficiency measures for each productive unit. In this context, efficiency is associated to the minimal use of resources (inputs) to achieve a certain production (output).

This methodology is applied to Andalusian municipalities containing over 30,000 inhabitants, since economic, industrial, and business activity is focused therein. Furthermore, these areas foster economic growth in times of economic boom, but they are also the most affected in recessions. Since these municipalities contain a concentration of the population and economic and business dynamism, many

[1] This study uses criteria based on the distance to the CBD (Central Business District) and to each candidate of sub-cores for identifying employment sub-cores.

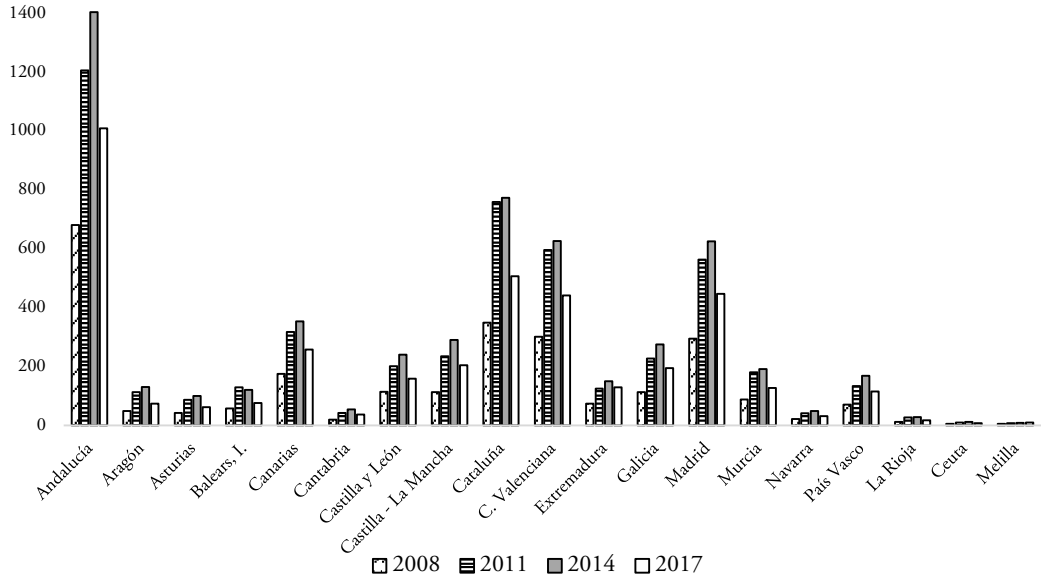
authors have focused on these areas to carry out geographical studies on the economic crisis in Spain (Sánchez et al., 2018; Caravaca et al., 2014, 2017; Subirats and Marti Costa, 2014; Méndez, 2013a, 2013b).

The present paper is structured as follows. In Section 2, the situation of the Andalusian labour market is studied. Section 3 presents the data and the DEA methodology. Results are reported in Section 4. Finally, in Section 5, a summary of considerations is made.

2. Context of Andalusia labour market

In the last decades, unemployment has been one of the most important socio-economic problems for occidental economies, this problem has increased since the bursting of the financial-real estate bubble, begun in 2007. In this context, Spain -which had oriented its economy to the construction sector with the creation of unstable and precarious employment (Fernández Tabales, 2012; Burriel, 2014; Fernández Tabales y Cruz, E. 2014)- experienced the highest unemployment rates in the OECD; which evidenced the weaknesses of its economic model (García Bellido, 2005; Fernández Durán, 2006; Naredo, 2010). The increase in unemployment rates was unequal along Spain territory (Figure 1).

Figure 1.
Unemployed population by region (thousands of people)



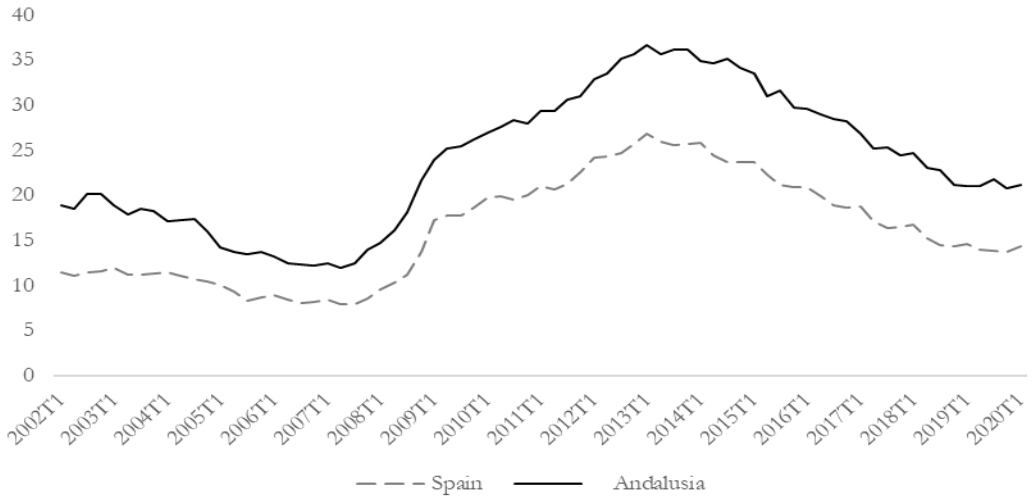
Source: Authors' own based on the Spanish National Statistics Institute.

As can be seen in Figure 1, unemployment data in Andalusia is worse than in the other regions. This phenomenon has not been circumstantial, the average gap between the unemployment rate in Andalusia and the rest of Spain during the period 1978-2003 has been around 10% (Gómez and Prieto, 2003; Álvarez et al., 2006). Figure 2 shows the gap was reduced during the economic boom period (2003-2007) but it increased again since the outbreak of the crisis[2]. According to the previous analysis (Herce et al. (2001); Usabiaga (2004); Rodríguez, 2009; Ramón, 2011; Felgueroso, 2012; Cabrales et al., 2013; Dolado et al., 2013; ILO, 2013), the main factors that explain the gap between Andalusia and Spain are the followings: a) greater growth of the active population in relation to the employment rate; b) greater relative

[2] In 2014 Andalusia managed to exceed the historical maximum of unemployment registered in 1994 with a rate higher than 35% and a differential of 11 points with respect to the rest of Spain.

weight of the population with low educational level; c) sectoral composition of employment (greater weight of the agricultural sector, which is the one that has experienced the most destruction of employment); d) less wage dispersion; e) greater wage rigidity; f) existence of the special agrarian protection regime.

FIGURE 2.
Unemployment rate gap between Andalusia and Spain (2002-2020)



Source: Author's own based on the Spanish National Statistics Institute.

Table 1 shows the evolution of Social Security affiliations between 2008 and 2013; as can be seen, the number of affiliations in Andalusia in the periods 2008-2011 and 2008-2013 decreased by 10.69% and 20.06% respectively, these reductions being higher than the national average (10.21 % and 17.87%). The Vulnerability Index to the crisis[3] (V.I.) has also been calculated (Sánchez Hernández, 2013), which reflects the sensitivity of the labour market of an economy (in this case Autonomous Community) to a situation of economic crisis. In line with table 1, employment is more sensitive to the crisis in Andalusia, Castilla la Mancha, C. Valenciana and Murcia.

These data show the greater vulnerability of the Andalusian labour market compared to the rest of the Spanish regions. The Andalusian socioeconomic reality is characterized by the presence of strong contrasts, with more dynamic behaviors than those of the Spanish average observed in expansion stages. Thus, in the period between 2000 and 2007, the macro-magnitudes of Andalusia evolved very favorably, reducing considerably the existing gap with other more prosperous regions. The Andalusian GDP registered growth rates above the national average, around 8.3% per year (IECA, 2014a), while the employment rate in 2007 was 49.2%, only 5.2 points below the national average (IECA, 2014b). On the contrary, in recession stages the propensity drastically changes, evolving more negatively than the national set (Castells-Hall, 1991; Aurioles, 1995; Zoido et al, 2001; Zoido-Caravaca, 2005; Pita-Pedregal, 2011).

Figure 3 enables the evolution of employment in Spain to be compared with that in Andalusia in the period 2008-2017[4]. As can be observed, the decline in employment is greater in Andalusia than in Spain. As previously mentioned, the Andalusian labour market is more vulnerable to recessions.

[3] The Vulnerability Index relates the evolution of employment in a region with respect to the national total. If the index exceeds unity, it means that employment has been less sensitive to the crisis than in the country as a whole, while if the index is lower than unity it evidences a greater vulnerability in the labour market. The Vulnerability Index was proposed by Martín (2012) for the United Kingdom, later was applied by Sánchez Hernández (2013) for the case of Spain.

[4] This study uses the employed population (%), this variable has been extracted to the LFS, by the Spanish National Statistics Institute.

TABLE 1.
Social Security affiliations by regions (2008-2013)

Region	Affiliates 2008	Affiliates 2011	Affiliates 2013	Evolution 2008-2011 (%)	Evolution 2008-2013 (%)	V.I. 2008-2011	V.I. 2008-2013
Andalusia	2.081.283,70	1.858.888,14	1.663.792,29	-10,69	-20,06	0,99	0,97
Aragón	456.780,47	405.973,70	371.054,52	-11,12	-18,77	0,99	0,99
Asturias	308.314,59	283.664,67	252.988,22	-8,00	-17,94	1,02	1,00
Balears I.	354.483,78	313.483,03	304.445,25	-11,57	-14,12	0,98	1,05
Canarias	629.787,96	550.862,79	515.542,95	-12,53	-18,14	0,97	1,00
Cantabria	177.067,70	163.465,39	146.366,23	-7,68	-17,34	1,03	1,01
Castilla y León	727.211,26	677.181,60	605.721,11	-6,88	-16,71	1,04	1,01
Castilla-La Mancha	560.667,97	490.103,13	412.911,33	-12,59	-26,35	0,97	0,90
Cataluña	2.726.650,63	2.446.235,70	2.270.530,87	-10,28	-16,73	1,00	1,01
Valenciana C.	1.482.638,17	1.246.153,43	1.138.282,06	-15,95	-23,23	0,94	0,93
Extremadura	255.474,79	239.360,55	213.821,61	-6,31	-16,30	1,04	1,02
Galicia	790.529,07	718.023,38	649.549,66	-9,17	-17,83	1,01	1,00
Madrid	2.566.349,96	2.352.154,04	2.199.750,83	-8,35	-14,28	1,02	1,04
Murcia	408.053,71	348.470,97	313.895,11	-14,60	-23,08	0,95	0,94
Navarra	225.442,19	208.233,18	190.176,97	-7,63	-15,64	1,03	1,03
País Vasco	764.689,06	725.024,00	667.424,55	-5,19	-12,72	1,06	1,06
La Rioja	98.772,75	90.554,25	81.300,03	-8,32	-17,69	1,02	1,00
Ceuta	16.514,47	16.745,84	15.575,37	1,40	-5,69	1,13	1,15
Melilla	14.448,41	15.107,78	14.731,56	4,56	1,96	1,16	1,24
Spain	**14.645.160,64**	**13.149.685,54**	**12.027.860,68**	**-10,21**	**-17,87**	**1,00**	**1,00**

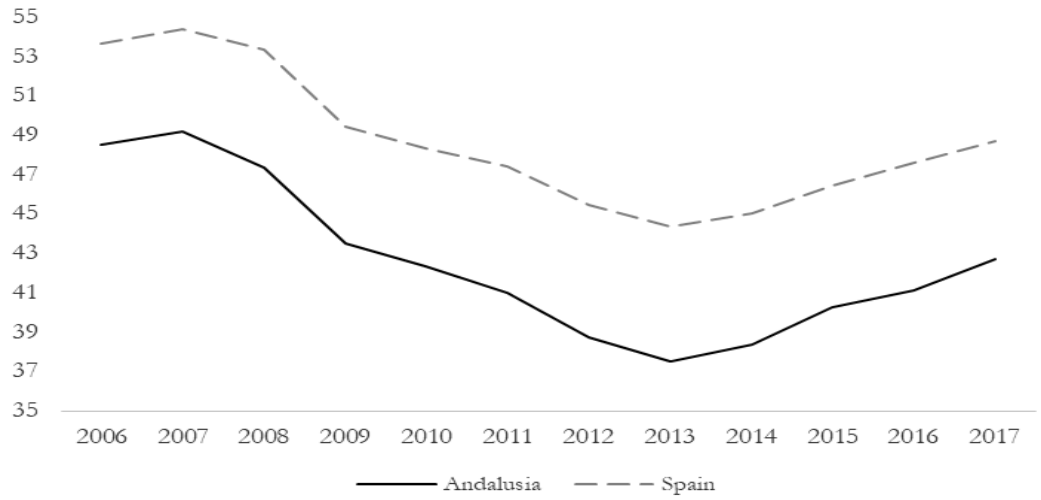
Source: Author's own based on Social Security Office of Spain.

However, within the Andalusian region there are also significant differences in terms of employment level. Figure 4 shows the density of employment in Andalusian municipalities for the years 2008 and 2017[5]. It can be observed that employment density is higher in provincial capitals; this result is in line with those of Sánchez et al. (2018) and Caravaca et al. (2014). These articles prove that provincial capitals concentrate labour dynamism, have a more favourable work environment, and are less vulnerable to economic crisis, while small municipalities are more affected by unemployment.

The complexity of the labour market in Andalusia and the plentiful supply of results of studies, such as those by Elhorst and Zeilstra (2007), Elhorst (2008), and Karlsson and Hayines (2002) (these proved the existence of differences in employment depending on their geographical level), both explain the choice for the analysis of Andalusian employment at municipality level.

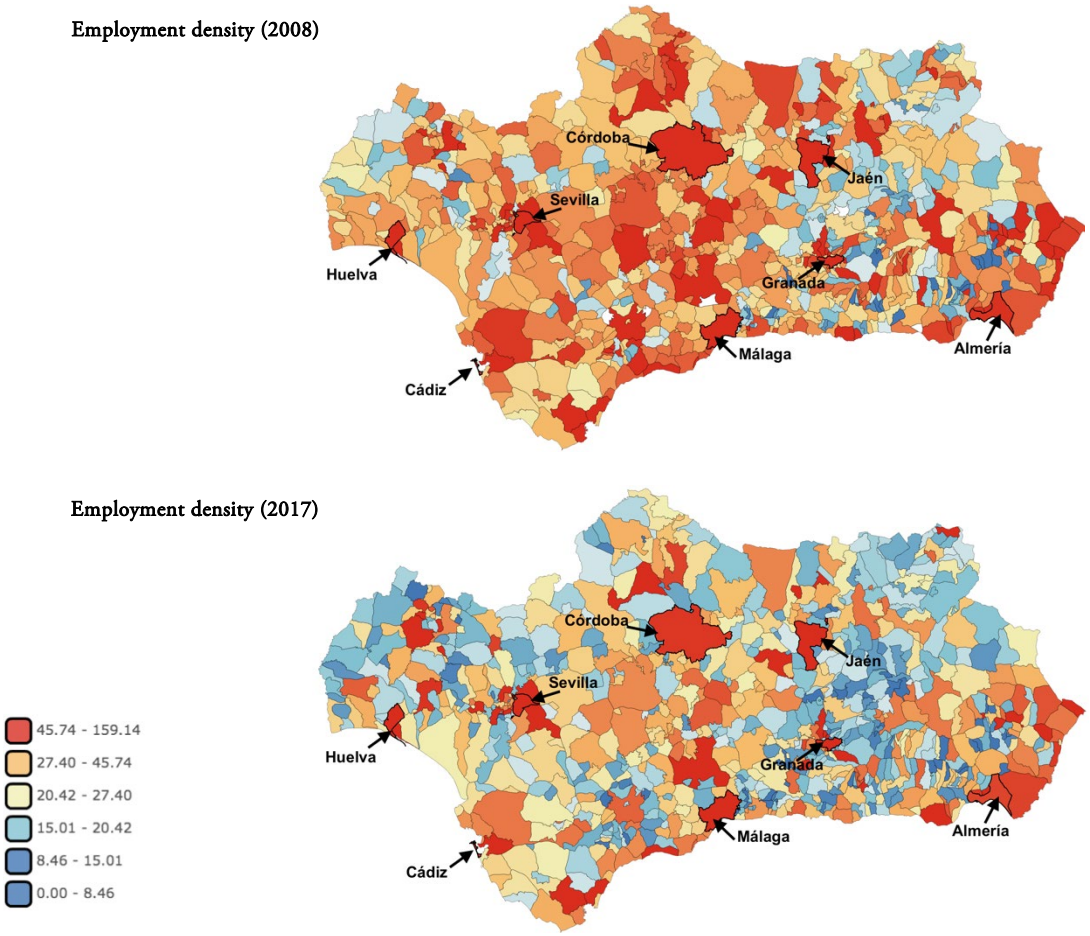
[5] This refers to the employment per 100 people between 16 and 64 years old. Data is from the Central Companies and Establishments Directory of Andalusia and Municipal Register of Inhabitants, by the Institute of Statistics of Andalusia and Spanish National Statistics Institute.

FIGURE 3.
Evolution of employed population in Spain and Andalusia (%)



Source: Authors' own based on the Spanish National Statistics Institute.

FIGURE 4.
Density of employment in Andalusia for 2008 and 2017 (%)



Source: Authors' own based on the Institute of Statistics and Cartography of Andalusia.

As a consequence of the above, Andalusian regional economic growth has never been self-centered because the Andalusian economy has been highly dependent of other regions, showing a greater inability to create employment than the Spanish average (Delgado Cabeza, 1981, 2002 and 2006; Ferraro, 1990; Aurioles, 1995).

2.1. Analysis of public and private interventions on the labour market

The Andalusian labour market has not yet recovered from the economic crisis; levels of employment and density of employment in 2017 are even lower than those in 2008 (see Figure 3 and 4) despite the two Spanish labour reforms (2010 and 2012), which were carried out in accordance with guidelines and suggestions of the European Union and the International Monetary Fund.

Employment policies must foster economic revival in a time of crisis. Specifically, active labour market policies set up programmes to promote employment. These programmes encourage opportunities of employment covered by the Government, and hence reflect the Government's commitment to the needs of the population in recessions.

The situation of economic crisis, where there is a greater rationalization and control of public spending, has contributed to the proliferation of studies that evaluate the efficiency of active employment policies at the national (Díaz and Iglesias, 2008; Cabrero et al., 2009; Ramos et al., 2009 and Neffa et al., 2010) and international level (Rosholm and Svarer, 2008; Card et al., 2010 y Crépon et al., 2012). Results are diverse; most reflect that the effect of these policies on the labour market is very small (Fertig et al., 2006; Fertig and Schmidt, 2000).

At the regional level the Blanco´s paper (2016) must be highlight; this paper analyses the efficiency and productivity of Andalusian active employment policies in the different provinces during the period 2006-2011 through the DEA model and the Malmsquist productivity index. The results indicate that the most efficient provinces are Almería, Córdoba and Huelva.

However, the impact of the private sector through private investment cannot be ignored; this kind of investment acts as a compensatory income and as a tool for the creation of new jobs and resources that encourages social protection. Despite this growing interest in this type of research, no study has been carried out on the efficiency of private actions in Andalusia.

The need to analyse the efficiency of public and private interventions together with the fact that there are hardly any studies in this regard, justifies the study of the efficiency of Andalusian labour market from both the point of view of public actions and that of private actions. This enables action to be taken towards improving the employment situation and is invaluable in decision-making at institutional level. If it is also considered the fact that at the municipal level no study has been carried out, the efficiency analysis at the municipal level takes on special interest in the literature[6].

3. Methodology and data

Data Envelopment Analysis (DEA) is a non-parametric methodology for the assessment of the efficiency of a set of Decision Making Units (DMUs) on the basis of data on the input consumption and the output production. DEA methodology assigns a normalized efficiency score to each DMU in order to compare efficient and inefficient units.

In this paper, the standard input-oriented CCR DEA model is used (Charnes et al., 1978), which is defined as follows. Suppose there is a set $D = \{1,2, \dots, n\}$ of independent DMUs, each of which consumes

[6] Andalusia has more population centers in each and every one of the levels of urban hierarchy than any other Spanish regional urban system (Feria, 2007).

a set $I = \{1,2,\dots,m\}$ of different inputs in quantities x_{ik} to generate a set $O = \{1,2,\dots,r\}$ of different outputs in quantities y_{jk}.

The efficiency score of a given DMU, $k_0 \in D$, can be computed as follows:

$$\begin{aligned} E(k_0) = \quad & \min \theta_{k_0} \\ & s.t. \quad \sum_{k \in D} \lambda_k x_{ik} \leq \theta_{k_0} x_{ik_0} \quad for\ all\ i \in I \\ & \quad \sum_{k \in D} \lambda_k y_{jk} \geq y_{jk_0} \quad for\ all\ j \in O \\ & \quad \lambda_k \geq 0 \quad for\ all\ k \in D \\ & \quad \theta_{k_0} \quad free. \end{aligned} \tag{1}$$

DMU $k_0 \in D$ is efficient if $E(k_0) = 1$ and the deviation variables in the reformulated model below, $s_{ik_0}^-$ and $s_{jk_0}^+$, are both zero:

$$\begin{aligned} \min \ & \theta_{k_0} - \varepsilon \left(\sum_{i \in I} s_{ik_0}^- + \sum_{j \in O} s_{jk_0}^+ \right) \\ s.t. \ & \sum_{k \in D} \lambda_k x_{ik} = \theta_{k_0} x_{ik_0} - s_{ik_0}^- \quad for\ all\ i \in I \\ & \sum_{k \in D} \lambda_k y_{jk} = y_{jk_0} + s_{jk_0}^+ \quad for\ all\ j \in O \\ & \lambda_k \geq 0 \quad for\ all\ k \in D \\ & s_{ik_0}^- \geq 0 \quad for\ all\ i \in I \\ & s_{jk_0}^+ \geq 0 \quad for\ all\ j \in O \\ & \theta_{k_0} \quad free, \end{aligned} \tag{2}$$

where ε is a non-Archimedian constant.

The efficient units are assigned the score 1, whereas the inefficient units obtain their degree of inefficiency reflected by a score lower than 1. Therefore, a ranking of DMUs can be started according to the efficiency scores obtained. However, this ranking is incomplete since the efficient DMUs cannot be ordered in these terms. Various approaches are available that rank all the DMUs and not only the inefficient DMUs. One of the most widely used of these approaches is based on super-efficiency (SE). In this approach, the DMU being ranked is dropped from the initial set of DMUs and that can lead to SE scores larger than 1 which can then be used to rank all the DMUs. However, this method is applied to rank only the efficient DMUs, since, for inefficient units, these SE scores coincide with the efficiency scores.

For the standard input-oriented CCR DEA model, the super-efficiency score of a given DMU, $k_o \in D$, can be computed as follows:

$$\begin{aligned} E^{super}(k_0) = \quad & \min \theta_{k_0} \\ & s.t. \quad \sum_{k \in D \setminus \{k_0\}} \lambda_k x_{ik} \leq \theta_{k_0} x_{ik_0} \quad for\ all\ i \in I \\ & \quad \sum_{k \in D \setminus \{k_0\}} \lambda_k y_{jk} \geq y_{jk_0} \quad for\ all\ j \in O \\ & \quad \lambda_k \geq 0 \quad for\ all\ k \in D \setminus \{k_0\} \\ & \quad \theta_{k_0} \quad free. \end{aligned} \tag{3}$$

In order to carry out the study, official statistics published by the Statistics and Cartography Institute of Andalusia (IECA) and by the National Institute of Statistics (INE) have been used. Specifically, the information employed refers to variables published in the 2011 Census.

The unit of analysis of this research is that of municipalities with more than 30,000 inhabitants, amounting to 43 municipalities in total (DMUs of DEA), because, as mentioned earlier, the economic, industrial, and business activity of the Community is centred thereon. These municipalities are also areas that boost the economy in boom periods, but become the most punished areas in times of crisis.

In order to perform the data envelopment analysis, five variables have been considered (Table 2): one output, working population rate, and four inputs, which include the number of companies, number of labour contracts, distance from the capital, and industrial investment. These variables have been selected according to the study of Sánchez et al. (2018), in which the socio-labour reality of the Andalusian municipalities is analyzed demonstrating the usefulness of these variables to characterize the factor called Socio-Labour Dynamism. Some of these variables are also used by Caravaca et al. (2014) to study the effect of the crisis and territorial development in urban areas in the Andalusian region. Certain polycentric models of urban economy use variables that measure the distance to the CBD or to each of the candidates for employment sub-nuclei (see for example Muñiz et al., 2008). Based on this idea of distance, the distance from the municipality to the provincial capital will be used as an explanatory factor of labour efficiency.

TABLE 2.
Data description

Variables	Description	Metric	Average	Std. Deviation
Output	Working population rate	Working population/Working-age population (between 16 and 64 years old)	0.3250	0.0357
Input 1	Companies	Number	6,789.98	9,380.47
Input 2	Labour contracts	Number	47,416.16	57,012.71
Input 3	Distance from the capital	1-(distance from the capital/máximum municipal distance from the capital)	0.7878	0.1903
Input 4	Industrial investment	Euros	14,767,059.81	39,409,491.44

Source: Authors' own.

TABLE 3.
Pearson correlation coefficients and p-values

	Companies	Labour Contracts	Distance from the capital	Industrial investment	Working population rate
Companies	1	0.986*	0.369*	0.089	0.990*
		(0.000)	(0.007)	(0.284)	(0.000)
Labour Contracts	0.986*	1	0.393*	0.105	0.998*
	(0.000)		(0.005)	(0.252)	(0.000)
Distance from the capital	0.369*	0.393**	1	0.244**	0.400*
	(0.007)	(0.005)		(0.049)	(0.004)
Industrial investment	0.089	0.105	0.244**	1	0.103
	(0.284)	(0.252)	(0.049)		(0.256)
Working population rate	0.990*	0.998*	0.400*	0.103	1
	(0.000)	(0.000)	(0.004)	(0.256)	

*p<0.01 **p<0.05.
Source: Authors' own.

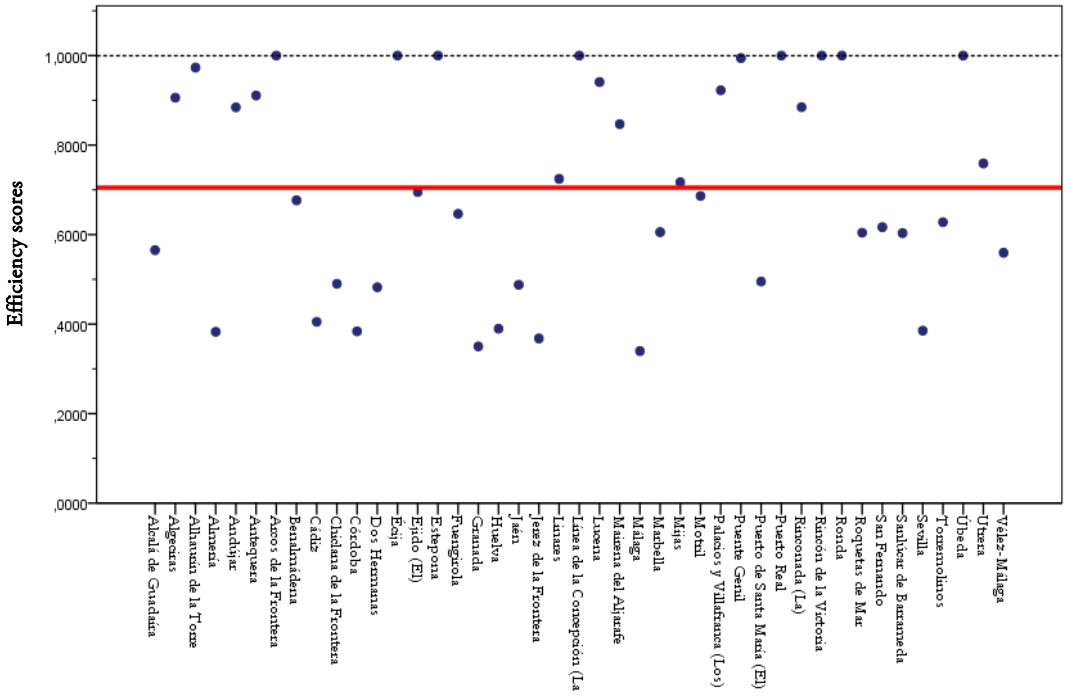
In order to verify the correct inputs and outputs selected, proof of isotonicity has been carried out (Sigala et al., 2004; Chiang, 2006). Isotonicity is based on positive correlations between inputs and outputs. Table 3 shows Pearson correlation coefficients between all the inputs and the output, and p-values which are used in the significativity contrast between two variables. All the inputs, except industrial investment, are significative, but all the inputs have positive correlations with the output, which enables all the variables to be considered in the model.

4. RESULTS

In the first place, the labour efficiency is determined at a municipal level, and then linear programming problems (1) and (2) are solved where the set of municipalities are $D = \{1,2, \dots, 43\}$, each of which consumes a set of four inputs $I = \{1,2, \dots ,4\}$ to obtain one output $O = \{1\}$. The results show that there are eight efficient municipalities in the set: $N =$ {Arcos de la Frontera, Écija, Estepona, La Línea de la Concepción, Puerto Real, Rincón de la Victoria, Ronda, Úbeda}, and the remaining municipalities have an inefficient score.

Figure 5 presents the efficiency scores for each municipality; the red line shows the average score of efficiency, which is 0.7049. There are 20 municipalities with scores above the average score of efficiency, but only 8 of these are in fact efficient. It should be borne in mind that the 8 Andalusian capitals (Almería, Cádiz, Córdoba, Granada, Huelva, Jaén, Málaga, and Seville) have efficiency scores below the average and are among the least efficient municipalities.

FIGURE 5.
Efficiency scores by municipality



Source: Authors' own.

The subsequent proposal involves establishing an efficiency order between efficiency municipalities. To this end, the linear programming problem (3) are used, and the super-efficiency of these municipalities are computed. Table 4 shows the municipalities ordered from the highest to the lowest super-efficiency

scores. The results obtained by this process show that the 8 Andalusian provincial capitals are among the 10 least efficiency municipalities.

TABLE 4.
Ranking and efficiency scores by municipality

	Ranking of municipalities	Super-efficiency scores		Ranking of municipalities	Super-efficiency scores
1	Ronda	1.420103	23	Benalmádena	0.6765699
2	La Línea de la Concepción	1.307948	24	Fuengirola	0.6463521
3	Rincón de la Victoria	1.249014	25	Torremolinos	0.6277320
4	Puerto Real	1.220543	26	San Fernando	0.6164955
5	Estepona	1.115426	27	Marbella	0.6054997
6	Úbeda	1.054386	28	Roquetas de Mar	0.6043595
7	Écija	1.051814	29	Sanlúcar de Barrameda	0.6033338
8	Arcos de la Frontera	1.006959	30	Alcalá de Guadaíra	0.5652342
9	Puente Genil	0.994286	31	Vélez-Málaga	0.5593689
10	Alhaurín de la Torre	0.9730696	32	El Puerto de Santa María	0.4950758
11	Lucena	0.9408859	33	Chiclana de la Frontera	0.4901635
12	Los Palacios y Villafranca	0.9223244	34	Jaén	0.4879087
13	Antequera	0.9107931	35	Dos Hermanas	0.4824536
14	Algeciras	0.9058710	36	Cádiz	0.4051473
15	La Rinconada	0.8846039	37	Huelva	0.3896829
16	Andújar	0.8843955	38	Seville	0.3854642
17	Mairena del Aljarafe	0.8467849	39	Córdoba	0.3839693
18	Utrera	0.7589450	40	Almería	0.3827987
19	Linares	0.7244672	41	Jerez de la Frontera	0.3679403
20	Mijas	0.7169358	42	Granada	0.3501146
21	El Ejido	0.6952964	43	Málaga	0.3397728
22	Motril	0.6863090			

Source: Authors' own.

Three of the efficient municipalities (Línea de la Concepción, Arcos de la Frontera, and Puerto Real) belong to Cádiz province, which is, traditionally, one of the most severely punished by unemployment at both Andalusian and Spanish level. However, these municipalities manage to optimize their available resources to achieve labour efficiency. As for the rest of the efficient municipalities, three belong to Málaga province (Estepona, Ronda, and Rincón de la Victoria), one belongs to Jaén province (Úbeda), and one belongs to Seville province (Écija). The remaining Andalusian provinces (Granada, Almería, Córdoba, and Huelva) have no efficient municipality.

Caravaca et al. (2009) relate the impact of the crisis and the size of the population, they associate the greatest growth to smaller municipalities in stages of economic expansion and less growth in stages of

recession. This relationship motivates the research hypothesis of this work, from which it is studied whether the smaller municipalities have more efficient labour markets. Hence, is proposed the evaluation of the possible relationships between this efficiency measure and the size of each municipality, expressed in terms of its population. For this analysis, the Kruskal-Wallis test is used (Kruskal and Wallis, 1952; Brockett and Golany, 1996). This involves determining whether or not there are significant differences in the average values obtained in the efficiency scores, among the various groups into which the sample of municipalities has been divided, in terms of their population size. To this end, four groups of municipalities are considered according to their size: between 30,000 and 75,000 inhabitants; between 75,001 and 100,000 inhabitants; between 100,001 and 200,000 inhabitants; and over 200,000 inhabitants. Table 5 shows the efficiency score of the municipalities for each population size.

TABLE 5.
Municipal efficiency score according to population size

Number of inhabitants	Efficiency score
30,000-75,000	0.9942857-1.0069590-1.054386-1.4201030-0.9730696-0.8846039-0.9223244-0.8843955-1.0518140-1.2490140-1.2205430-0.9107931-0.9408859-0.8467849-0.7589450-0.6863090-0.7244672-0.6765699-1.1154260-1.3079480-0.6277320-0.6033338-0.6463521-0.5652342-0.7169358
75,000-100,000	0.5593689-0.4901635-0.6952964-0.6043595-0.4950758-0.6164955
100,000-200,000	0.4879087-0.9058710-0.4051473-0.4824536-0.6054997-0.3896829-0.3827987
More than 200,000	0.3679403-0.3501146-0.3839693-0.3397728-0.3854642

Source: Authors' own.

Taking Table 5 as a reference, the Kruskal-Wallis test (Chi-squared=27.143; p=0.000) leads to the rejection, with a significance level of 5%, of the hypothesis of equality of means for efficiency scores in the four groups of municipalities proposed according to their population size. Through examining the average values for each group, municipalities with a smaller population size are more efficient (0.91156860) compared to larger municipalities (0.36545224).

Given the importance of achieving labour efficiency at the municipal level, the next question involves the identification of the variables that could be linked in some way to this efficiency. For this identification, the methodology based on the analysis of variance is used. Two groups of municipalities are distinguished: those with efficiency scores that show values above the average of the sample; and those that register values below the average.

TABLE 6.
Variance analysis: variables and results

	Companies	Labour contracts	Distance from the capital	Industrial investment
Mean group A	2,545.150	20,607.250	0.677	3,226,619.600
Mean group B	10,481.130	70,728.260	0.884	24,802,225.217
Statistic F	9.141	10.049	17.688	3.389
P-value	0.004*	0.003*	0.000*	0.043*

Group A: efficiency index greater than mean for the whole sample: 20 municipalities.
Group B: efficiency index smaller than mean for the whole sample: 23 municipalities.
*p<0.05.
Source: Authors' own.

In all cases, and with a 5% level of significance, the null hypothesis of equality of means between the two specified groups is rejected (Table 4); therefore, it is accepted that the differences observed between the two groups in terms of mean values for the variables mentioned above are not random. In order of importance, the most relevant variables to explain the more or less efficient functioning of a municipality are: (1) distance to the capital; (2) number of labour contracts; (3) number of companies; and (4) industrial investment (see Table 6).

5. Conclusions and discussions

This article is focused on Andalusia, a region that was severely affected by the economic crisis. Specifically, it analyses the urban areas that carry substantial weight in this region.

As in Elhorst and Zeilstra (2007), Elhorst (2008), and Karlsson and Hayines (2002), this study shows there are major differences at municipal level, and highlights the relevance of the spatial perspective. The most significative factor in the determination of the efficiency of municipalities is that of distance from the capital, and hence territorial framework is essential.

Although urban municipalities enjoy a better employment record, jobs that are created in the capital of a province remain insufficient to reduce unemployment levels since none of these areas is efficient. There is a negative relationship between efficiency of municipality and population size, and therefore the most efficient municipalities are those that have smaller populations. This means that high rates of employment are not synonymous with high efficiency: there are municipalities with low employment rates which rank among those with the highest efficiency of Andalusia.

It is necessary to highlight the relevance of local agents that have enabled entrepreneurship and innovation actions that foster the efficient use of their resources to be promoted. The objective of employment policies involves the reduction of unemployment. However, the existence of high unemployment rates has remained a universal problem for the past two decades, which throws into doubt the real impact of the employment promotion measures. Active labour market policies fail to improve the efficiency in Andalusia: municipalities with the largest population receive greater investment but they are the least efficient. This result is a new finding and is contrary to the findings in Fertig et al. (2006), where the authors show that these policies contribute towards a reduction in the local unemployment rates.

The results obtained will allow to extract knowledge and experience in order to face possible future crises in the Andalusian region. Additionally, these results allow to refute some traditionally admitted results, such as, that in periods of crisis the large municipalities resist these situations better at labour level. This work has evidenced the different behavior of Andalusian municipalities in the labour market. The latter suggests the need to apply non-homogeneous employment measures for the entire Andalusian territory with the aim of contributing to the design of labour policies that generate a more efficient labor market at the regional level.

For future research, another study could be carried out to compare the results obtained during the economic crisis with those attained after said crisis. This would enable to determine whether the economic crisis has influenced the findings achieved herein or, on the contrary, they are general and consolidated conclusions across Andalusia.

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Compliance with Ethical Standards

Author Sánchez, F.J. declares that she has no conflict of interest. Author Sánchez, A.M. declares that she has no conflict of interest. Author Pulido, N. declares that she has no conflict of interest. Author Borrero, D.V. declares that he has no conflict of interest.

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ORCID

Francisca J. Sánchez-Sánchez http://orcid.org/0000-0001-5325-3667

Ana M. Sánchez-Sánchez http://orcid.org/0000-0002-6591-954X

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