

The efficiency of public employment services: a matching frontiers approach

Efficiency of
public
employment
services

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Abstract

Purpose – This paper aims to model the efficiency of labour offices belonging to the public employment services (PESs) in Spain using a stochastic matching frontier approach.

Design/methodology/approach – With this aim in mind, the authors apply a random parameter model approach to control for observed and unobserved heterogeneity.

Findings – Results indicate that when the information criteria of the estimates are analysed, it improves by controlling both, observed and unobserved heterogeneity in the inefficiency term. Also, results suggest that counsellors improve the productivity of labour offices and that the share of unemployed skilled persons, unemployed persons aged 44 or younger, as well as the share of unemployed persons in the construction sector, all affect the technical efficiency of PESs offices.

Originality/value – The model extends the previous specifications in the matching literature that capture only observed heterogeneity. Moreover, as far as the authors know, it is the first paper that estimates a matching frontier for the Spanish case. Finally, the database they use is at the office level and includes the work carried out by counsellors, which is a novelty in the analysis of this type of studies at the Spanish level.

Keywords Technical efficiency, Labour offices, Matching functions, Observed and unobserved heterogeneity, Job seekers

Paper type Research paper

1. Introduction

In all European countries, public employment services (PESs) are the authorities that connect job seekers with employers. Although the governance of PESs is different in each country, the aim of all PESs is to improve the matching of supply and demand within the labour market through information, placement and the provision of active support services.

With respect to the Spanish case, the activity of the PESs has been conditioned by the particular characteristics of the Spanish Labour market. In fact, according to the Labour Force Survey, the unemployment rate has increased from 13 per cent in 2008 to 25 per cent



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in 2013. This upward trend in unemployment in Spain has resulted in both, reforms of labour market policies and new labour market programmes and, it is also affecting the PESs capacity and the quality of the services offered since the recession of 2008.

However, despite the increase in unemployment in Spain, the budget dedicated to the PESs has not followed a similar path. To the contrary, and according to EUROSTAT, the expenditure reserved for PESs and training saw a reduction passing from €2,420.6 m in 2008 to €2,138.7 m in 2013. That is, the budget diminished by 11.6 per cent with respect to the previous five years, although the unemployment rate increased by 15 per cent.

Faced with this adverse scenario, the problem of managing efficiently the relatively scarcer resources available to the employment offices becomes a crucial issue when confronting improvements in active employment policies. For this reason, the analysis of the efficiency of the PESs offices, object of this study, could prove a key factor as well as an aid towards understanding the activity of these offices. In this line, active labour market policies (ALMP) are tools addressed to either increasing the probability of re-employment for unemployed workers or to reducing the probability of losing a job in the case of employed workers. In Spain, its provision is characterised by the decentralisation of ALMP, which means that autonomous communities are (now) responsible for the orientation and training of workers. With respect to the competent authorities for passive policies, it is worth mentioning that the State is responsible exclusively for the latter.

The basis for the decentralisation and shift of ALMP in Spain is to be found in the text of the Spanish Constitution, the Statutes of the autonomous communities and in the Employment Law of 2003, where employment policy is included within the framework of economic policy[1].

The start of the shift of authority with respect to ALMP dates back to the transfer of responsibility for professional occupational training to Catalonia in 1991. Likewise, in 1997, Catalonia was the first autonomous community to obtain competence in work, employment, and training issues. Currently, the process of decentralisation and the change in management of the entire ALMP system culminated in 2010 with the handover of competences to the Basque Country. The creation of the PESs as bodies responsible for the management and/or execution of the ALMP at the autonomous level has been conducted on an uncoordinated time scale, following different schedules linked to the policies of each autonomous community. With this regulatory framework, the regional PES assumes the functions of regulation, which is reflected in labour market control activities such as management of the employment offices. According to [Cueto and Suárez \(2014\)](#), in a single employment office, there is staff of the Central Administration (managing the benefits) and staff hired by the Autonomous Administration (managing the ALMP). In this regard, the PES Capacity Survey of the European Commission (Assessment Report on PES Capacity 2016) noted that the average caseload per PES counsellor in EU-28 is 140 but the average caseloads are strongly influenced by PES in Spain. The special plan for job counselling, professional training and work placement has led to a significant increase in staff since 2008, although current staff numbers are far (in Spain 596 in 2014-2016) from meeting the counselling and mediation needs of the unemployed, especially at employment offices that have to attend to a high number of jobless.

Specifically, this paper proposes throwing more light upon the work undertaken by the PESs offices in the process of matching supply and demand in the labour market. In particular, we wish to explore whether all labour offices have or not the same level of efficiency, taking into consideration that they operate under particular circumstances. Although it is understood that the success of PESs offices depends on local labour market conditions, we also expect differences between jobcentres due to the number of people

registered at a specific office and the number of job counsellors. [Álvarez de Toledo et al. \(2008\)](#) provide an excellent survey of most of the alternative models used in papers on this topic. This paper differs from that approach in that it is focused at the labour office level while [Álvarez de Toledo et al. \(2008\)](#) study the matching function of the PES at national level. With respect to their results, they conclude that policymakers should be encouraged to consider the redesign of ALMPs since PES offices were flooded beyond capacity by job seekers.

In this paper we use frontier methodology to construct a frontier that indicates the maximum (potential) activity for the PES offices given their resources and other specific and market characteristics that may influence their activity. Hence, the estimated frontier is a relative construct and not an absolute one. Thus, our measure of efficiency takes into account that we are working with public offices, which cannot choose the type of “clients” to deal with and which face supporting those unemployed workers with worse perspectives. We compare the activity of a PES office with another public employment office that is achieving the best performance (i.e. it is on the frontier) albeit bearing in mind that they share similar characteristics. This potential frontier is the upper frontier of observations in our sample. The inefficiency indices indicate how far PES offices are from their potential activity, once public offices’ characteristics have also been considered. Moreover, it is important to take into account that if the difference between potential and observed activity exists, the estimation of parameters describing technology will be biased. Hence, the use of frontier methodology could shed new light on PES’ potential activity, with the information obtained proving more accurate than that yielded by previous analyses based on average functions ([Lovell, 1995](#)).

Since the pioneer work by [Cavin and Stafford \(1985\)](#) published, several authors have studied the efficiency of employment offices using several methodologies. Employing DEA models, [Althin and Behrenz \(2004, 2005\)](#) and [Althin et al. \(2010\)](#) and [Anderson et al. \(2014\)](#) analyse efficiency using data for Swedish labour offices. [Torgersen et al. \(1996\)](#) analyse this issue for Norway. [Kthiri et al. \(2011\)](#) use this methodology for Tunisian labour offices. [Sheldon \(2003\)](#) or [Vassiliev et al. \(2006\)](#) apply a DEA to analyse labour offices in Switzerland.

In this paper, we propose an analysis of the labour offices’ efficiency within a theoretical matching framework based on the model of [Blanchard and Diamond \(1989\)](#) and using a parametric approach. Matching functions represent the flow of new jobs as a function, among others, of the job searchers and the number of vacancies (see for example, [Blanchard and Diamond \(1989\)](#), [Pissarides \(1990\)](#) or [Petrolongo and Pissarides \(2001\)](#) for a review). This kind of function can be interpreted as a production function where the output is the number of matches (flow of hirings) and the inputs are job seekers and vacancies. Because of this, and given that the idea behind the frontier models is to compare the activity of companies, a natural modelling strategy could be the comparison of several labour offices belonging to PESs to build a matching frontier that allows the observed activity of any office to fall short of their maximum potential level. To do this, a composite error term is included which is decomposed into two parts: a two-sided, idiosyncratic error and a non-negative one-side inefficiency component ([Ibourk et al., 2004](#)).

[Warren \(1991\)](#), was the first work that applied a frontier approach to matching functions using a US manufacturing sample over the period 1969-1973. However, in this pioneer study, heterogeneity was not taken into account in the one-side error component, that is, it is assumed that the error term has a constant variance. In many cases the error term may be heteroskedastic, with a variance positively correlated with several characteristics of the observations. While the consequences of heteroskedasticity are not particularly severe in an

OLS model (estimators are unbiased and consistent, although they are not efficient), the heteroskedasticity problem is potentially more severe in a stochastic production frontier context. Concretely, heteroskedasticity in the inefficiency term can affect inferences concerning production technology parameters as well as the parameters of either error component (Kumbhakar and Lovell, 2000).

If heterogeneity is more related to inefficiency and thus more likely to be under firms' control, then this should affect directly the one-sided error term. In this sense, heterogeneity is often modelled in the location or scale parameters of the inefficiency distribution which depend on a vector of covariates (Kumbhakar *et al.*, 1991; Huang and Liu, 1994; Battese and Coelli, 1995 or Galán *et al.*, 2014 for a review).

Similarly, using the Battese and Coelli (1995) model, Bodman (1999) explains labour market inefficiency for Australia during the period 1978-1997. This model was also applied in several research papers which estimated parametric matching functions: Fahr and Sunde (2002) using data for Western Germany in the period 1980-1995; Ilmakunnas and Pesola (2003) who estimate a matching frontier using regional panel data for Finland from 1988 to 1997; Ibourk *et al.* (2004) for French data from 1990-1995; Ramirez and Vassiliev (2007) for Switzerland for the period between November 2000 and December 2001 or Fahr and Sunde (2006) using Western Germany data over the period 1980-1997 who analyse, as a novelty, the spatial autocorrelation in hiring.

On the other hand, Hynninen and Lahtonen (2007) use a fixed effects model to analyse the matching of job seekers and vacant jobs using Finland data for the period 1995-2004. With the same data, Hynninen (2009) employs a true fixed-effects model to separate cross-sectional heterogeneity from inefficiency, and the inefficiency terms are modelled also following the Battese and Coelli (1995) model. Finally, Némec (2015) analyses Czech regional labour markets for the period 1999-2014 using a fixed effect panel stochastic model[2].

This paper continues and extends the empirical literature on matching functions in several ways. First, we follow Greene (2005) to present a model that explores both the observed and unobserved heterogeneity in the inefficiency component of the distribution. In this way, the model extends the previous specifications in the matching literature analysed above that capture only observed heterogeneity, which is the first contribution of the paper.

As Galán *et al.* (2014) point out, the literature on modelling unobserved firm characteristics in inefficiency is still scarce. Although heterogeneity in stochastic frontier models has also been studied in the Bayesian context [see Galán *et al.* (2014) for a review], we are not aware of any empirical example which applies a parametric approach. In this sense, this paper contributes to the empirical literature by modelling unobserved firm characteristics in the variance of the inefficiency term. Concretely, here we apply this model to explore empirically the technical efficiency of labour offices in Asturias (a province in northern Spain). As far as we know, it is the first paper that estimates a matching frontier for the Spanish case, this constituting the second contribution of our paper.

Moreover, given the limited knowledge about the role of employment offices in the Spanish labour market, our analysis could make a contribution to the field. First, the database we use is at the office level, which is a novelty in the analysis of this type of studies at the national level. Second, we include the work carried out by counsellors, which is also a novelty in the studies of this sector at a national level. Some PES offices choose to have counsellors dedicated to particular client groups, but this option may vary across labour offices since the decision is left to local discretion. Thus, the analysis of how the activity of the counsellors affects the PES offices is crucial to understand their activity. In some cases,

there was no complete information available on the total number of staff in the PES which means that some labour offices were asked to supply the data for this research.

The structure of the paper is as follows. In Section 2 we contextualise and explain our proposed model. In Section 3 we present our database sourced from a Spanish sample comprising monthly panel data from 25 local labour offices in Spain during the year 2013. In Section 4 we present the empirical results. Section 5 concludes, presenting a summary of the main findings.

2. Methodology

This paper designs a matching function as a frontier. With this aim, we use an inequality formula to permit the differentiation of observed output in a labour office with its maximum (potential) in the following manner:

$$M_{it} \leq Af(U_{it}, V_{it}, C_{it}, E_{it}, \beta) \quad (1)$$

where M is the output and represents the placements or jobs filled by a worker registered in the PESs offices using as the source of this information the contracts presented by businesses to employment; A is a constant; U are the demands for employment or workers registered in the labour offices on the last working day of the current month; V is the supply of registered job vacancies registered in the labour offices by businesses in the current month; β are parameters to be estimated; t is time and i are employment offices.

Moreover, in line with Sheldon (2003) or Suárez *et al.* (2014, 2019), it is important to understand that the work of the PESs goes beyond simple intermediation. For example, the aim of the PESs is also to offer assistance and orientation services for the unemployed. For this reason, it is important to take into account one more input called “job counsellors per unemployed”. In particular, we use the number of counsellors per job seeker in each office (C_{it}).

In addition, we include in the matching frontier an environmental variable (E) to encompass the existence of several circumstances which are beyond the control of the PESs offices.

In equation (1), M_{it} is the observed output and $Af(\cdot)$ is the deterministic matching function frontier that represents the optimal or potential output level. By formally expressing inequality inside the model, we allow the observations to deviate from their optimal (potential) values. To contrast the model, we transform the inequality above in to an equality (Aigner *et al.*, 1977) and Meeusen and van den Broeck (1977):

$$M_{it} = Af(\cdot) \exp(v_{it} - u_{it}) \quad (2)$$

where in equation (2) the error term has been divided into two parts: the term v_{it} is a random disturbance term included to capture the effects of statistical noise, and u_{it} allows the observed output of any office to fall short of the maximum potential output level (the negative sign meaning that all offices have to be on the frontier or below it). This potential output is determined not by the deterministic matching function frontier $Af(\cdot)$ but by the stochastic production frontier $Af(\cdot)\exp(v_{it})$. In this way, random differences (captured by v_{it}) are not confused with systematic differences between potential and observed output (captured by u_{it}).

By rearranging equation (2) we obtain:

$$\frac{M_{it}}{Af(\cdot)\exp(v_{it})} = \exp(-u_{it}) = TE \quad (3)$$

where $\exp(-u_{it})$ indicates the difference between the potential and the observed output (for the i office in the time t). We define this difference as the Technical Efficiency Index (TE) where $0 \leq TE \leq 1$ given that $u_i > 0$.

Taking logarithms of [equation \(2\)](#) we have:

$$\ln M_{it} = \beta_0 + \ln f(U_{it}, V_{it}, C_{it}, E_{it}, \beta) + v_{it} - u_{it} \quad (4)$$

Where $\beta_0 = \ln A$ and, as we have explained above, the matching function, M_{it} , depends on the inputs U , V , C and E . Finally, v_{it} is a two-sided, idiosyncratic error assumed to be independently and identically distributed to $N(0, \sigma_v^2)$ and u_{it} is a non-negative error assumed to follow some specific independently distributed distribution $N^+(\mu, \sigma_u^2)$.

However, in [equation \(4\)](#) heterogeneity is a priori not taken into account in the one-side error component, that is, it is assumed that the error term has a constant variance. Nevertheless, in many cases the error term may be heteroskedastic, with a variance positively correlated with several characteristics of the observations. Given that, as already explained, it could prove a severe issue in a stochastic frontier context, in this paper we contrast whether heteroskedasticity is present in u_{it} .

To do this, we present a model that explores both the observed and unobserved heterogeneity in the inefficiency component of the distribution. With this aim, we follow [Greene \(2005\)](#) who models the unobserved firm characteristics in the inefficiency term u_{it} . Concretely, the variance of the one-sided error component is modelled as an exponential function of time variant covariates. Besides, the coefficients of the observed covariates are allowed to be firm specific and vary randomly. With this in mind, we include a random parameter in the inefficiency distribution (concretely in its variance), with a view to capturing any unobserved heterogeneity. This parameter has two main characteristics ([Galán et al., 2014](#)): it can be included simultaneously with observed covariates in the inefficiency distribution to distinguish observed from unobserved heterogeneity; and it can indicate whether or not observed covariates do a good job in capturing the existing heterogeneity.

Concretely, the general model proposed for the stochastic matching frontier is as follows:

$$\ln M_{it} = \ln f(U_{it}, V_{it}, C_{it}, E_{it}, \beta) + v_{it} - u_{it} \quad (5)$$

$$v_{it} \sim \text{iidN}(0, \sigma_v^2) \quad (6)$$

$$u_{it} \sim \text{iidN}^+\left(0, \sigma_u^2 \cdot (\exp(z_i \gamma I_1 + \tau_i I_2))^2\right) \quad (7)$$

where τ_i is the random parameter that captures unobserved labour office effects in the inefficiency, γ is unknown parameter to be estimated, and I_1 and I_2 are indicator variables that can take the value 0 or 1. We will estimate three different models. First, we impose $I_1 = I_2 = 0$ in [equation \(7\)](#) to obtain Model I, a heterogeneity free base model. Model II assumes that the variance of the inefficiency must be expressed as a function of observed covariates z_{it} ($I_1 = 1$ and $I_2 = 0$). In addition to the observed covariates in the variance of the inefficiency, Model III considers a random parameter τ_i to capture information omitted by the former, and then imposes $I_1 = I_2 = 1$.

3. Data

This paper explores empirically the technical efficiency of employment offices in Asturias (Spain). In Spain, its provision is characterised by the decentralisation of ALMP, which

entails that Autonomous Communities are responsible for the management and/or execution of the ALMP. Our data belongs to the 25 employment offices in Asturias that were fully operational during the months January 2013 to December 2013, being the most recent time period with data available for our study.

In this paper we use information at office level from the register of job seekers (those subscribed to the services), comprising offers and placements for the year 2013. As far as we know, this is the first time that an article uses said information for a study of employment offices in Spain. The aggregated information of each employment office from the files (demand, offers and placements) will be used in a complementary manner together with the information derived from the microdata of persons registered in the PESs. The selection of said variables is based on a study conducted by Sheldon (2003) to analyse the efficiency of the PESs in Switzerland that takes into account the work done by counsellors to help unemployed persons. As Sheldon (2003) points out “even the most minor job hint offered by a placement office could result in a hire”. For this reason, it is important to take into account these intermediation activities. Given that in our sample there is no detailed information available on the placements that result from such intermediation activities undertaken by the PESs, we use the number of counsellors per job seeker in each office.

The efficiency of the offices will be conditioned greatly by the existence of demands for employment or the registered job seekers and the offer of registered jobs. As we expected, PESs-registered vacancies are much smaller in relation to overall vacancies. Companies seldom rely on the PESs, as they typically use other channels to select their staff (i.e. self-nominations, print ads, head hunters and contacts). Job seekers visit employment offices mainly in a voluntary way if they need to find out information about vacancies or to participate in active programmes. However, it is compulsory to visit PESs if they are requested to participate in active measures.

To have access to PESs services, job seekers must be registered at the public employment offices. At registration, regional PESs staff will interview job seekers to determine their labour status, their needs and career aspirations. The registered data are personal and contact details, level of education and qualifications, languages, professional experience, and positions requested. After the interview, PESs counsellors are able to recommend training courses, professional orientation actions or self-employment support.

To estimate equations (5)-(7) we need to define the output and the inputs of the matching function. As regards output, we model it as the placements or jobs filled by a worker registered in the PESs (M) with the source of this information being the contracts presented by businesses to the employment offices.

As regard the inputs used, these are represented by the demands for employment or workers registered in the PESs on the last working day of every month (U) and the supply or registered job vacancies registered in the PESs by businesses (V). But as explained above we consider an important issue to consider is one more input, namely “job counsellors per unemployed” (C). Job seekers visit PESs offices mainly in a voluntary way if they require information about vacancies (not only the ones registered in PESs but others announced in newspapers or online) or if they wish to participate in labour active programmes. However, it is compulsory to visit PESs if they are requested to participate in labour market programmes. To have access to PESs services, job seekers must be registered at the public employment offices. At registration, PESs offices staff will interview job seekers to determine their labour status, their needs and career aspirations. The registered data are personal and contact details, level of education and qualifications, languages skills, professional experience, and positions requested. After the interview, PESs counsellors are able to recommend training courses, professional orientation actions or self-employment

support. Because of this, we also use as input the percentage of number of counsellors per job seeker in each office. In some cases, there was no complete information available on the total number of staff in the PES which means that some labour offices were asked to supply the data for this research. Some PES offices in Asturias choose to have counsellors dedicated to particular client groups, but this option may vary across labour offices since the decision is left to local discretion.

We have also included the environmental variable (E) which is defined as the number of other placements not managed by the PESs but accounted for in their zone of influence. In this sense, it represents a proxy of the economic climate of the locality where the office is situated. For instance, if an area shows signs of recovery it would reflect an increasing number of vacancies and placements, notified to PES and not notified to PES.

Moreover, we have selected several variables that might explain the variance of the inefficiency of labour offices in Asturias given that it is possible that job seekers may possess different and peculiar characteristics that could affect the efficiency of the PESs offices.

Because of this, we have harnessed the information available to know how these characteristics can affect the efficiency of the PESs offices. These factors are defined as follow:

- z_1 = share of those 44 years or younger among job seekers;
- z_2 = share of unemployment in construction among job seekers;
- z_3 = share of unemployed skilled workers among job seekers (defined as job seekers with vocational training such as welding and metalwork, plastering, tiling and, so on; and job seekers with a degree from a university or the equivalent tertiary training); and
- z_4 = share of job seekers looking for a job 24 months or more.

Table I shows the descriptive statistics for the data. At the mean, the placements filled by a worker registered in the PESs were 363.17. Furthermore, each labour office had at the mean 612 unemployed per counsellor; managed on average more than 3,900 job seekers and 9.07 vacancies. The percentage of job seekers under 45 is 54.8 per cent, and 14 per cent are unemployed in the construction sector. Moreover, 18.5 per cent of the unemployed are skilled workers. Finally, the share of job seekers looking for a job during a period of 24 months or more is 9.1 per cent.

4. Empirical result

The estimation results of the selected models are summarised in Table II. We present two estimations for Model III. The first one (Model IIIA) does not include the variable z_4

Variable	Mean	SD	Minimum	Maximum
M	363.17	314.65	2.0	1400
V	9.07	9.61	0.0	65.0
U	3,938.50	3,209.23	88	10,988
E	477.96	437.91	3.0	2020
C	0.1633	0.1646	0.0645	1.1363
z_1	0.5487	0.0407	0.4380	0.6270
z_2	0.1457	0.0240	0.1090	0.1900
z_3	0.1851	0.0442	0.1190	0.2760
z_4	0.0919	0.0164	0.0640	0.1270

Table I.
Variables and
descriptive statistics

Note: Number of observations: 300

Variable	Model I (Base model)		Model II (Heteroscedasticity in the inefficiency)		Model IIIA (Random parameter in the inefficiency without z4)		Model IIIB (Random parameter in the inefficiency with z4)	
	Coeff	t-ratio	Coeff	t-ratio	Coeff	t-ratio	Coeff	t-ratio
<i>Production Frontier</i>								
Intercept	-0.534***	-2.90	-0.959***	-5.45	-0.243	-1.64	-0.316**	-2.16
ln U	0.076***	4.52	0.059***	4.37	0.059***	5.21	0.057***	4.55
ln V	0.347***	8.72	0.372***	10.26	0.275***	8.57	0.279***	8.45
ln C	-0.165	-1.50	0.751***	4.67	0.414***	2.73	0.437***	3.06
ln E	0.578***	16.85	0.582***	18.84	0.611***	20.20	0.617***	19.51
<i>Inefficiency</i>								
Intercept (σ^2_{μ})			24.916***	3.36				
z_1 (σ^2_{z1})			-45.927**	-2.34	-13.224***	-4.39	-12.049***	-3.63
z_2 (σ^2_{z2})			-20.498	-0.79	10.839**	2.25	10.879**	2.02
z_3 (σ^2_{z3})			-21.129	-0.66	-9.216***	-2.60	-12.517***	-2.35
z_4 (σ^2_{z4})							12.481	1.19
τ_1					6.981***	6.61	2.811***	6.04
$\sigma^2_{\tau_1}$					0.667***	4.39	0.696***	4.13
σ_u	0.195		0.204		0.169		0.153	
Mean efficiency	0.846		0.941		0.871		0.873	
SD efficiency	0.072		0.153		0.101		0.098	
Log likelihood function	30.275		71.997		76.538		76.798	
Number of observations	300		300		300		300	

Note: Significance code: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table II.
Parameter estimates
of the frontier
matching function

(share of job seekers looking for a job 24 months or more) and the second one (Model IIIB) includes said variable. Results indicate that all of the input variables that are included in the frontier (except the proportion of counsellors per job seekers -variable C- in Model I) are statistically significant and bear the expected signs. In contrast, and according to Models II and III, our findings indicate that the intensity of counselling also increases the productivity of the employment offices. In all the models, the environmental variable E (other placements not managed by the PESs in their zone of influence) was significant and positive at the frontier, which indicates that the economic climate of the locality where the office is situated improves the productivity of labour PESs offices.

It is important to note that, from the results obtained for Models III (A and B) we observe that the random component is significant and thus it is capable of capturing part of the heterogeneity of the inefficiency even though in this case the three z_i variables (the share of unemployed persons 44 years or younger in U; the share of skilled workers in unemployment; the share of unemployment in construction; and time registered in the jobcentres searching for a job) are significant. In sum, the results obtained in Models III indicate that both observed and unobserved heterogeneity are present.

On the other hand, introducing the variable z_4 as a determinant of inefficiency (Model IIIB) does not result significant. To analyse which of the models III (A or B) is the most appropriate, we have carried out an analysis based on some information criteria (Fonseca and Cardoso, 2007 for details). According to the results shown in Table III, three of the four information theoretical criteria – the Akaike Information Criterion (AIC); the modified AIC criterion (AIC3); and the corrected AIC (AICc), indicate that when the unobserved component is included in the inefficiency distribution, the criteria for the comparison of the models improves. In sum, results show an improvement in the goodness of fit of the estimates when unobserved heterogeneity is addressed in the model through a random parameter model approach without introducing the z_4 variable (Model IIIA).

We have also tested other job-seekers characteristics such as the share of males, immigrants or the share of those willing to move to gain employment. However, results indicate that these variables are not significant in our model.

According to these results, hereinafter we focus on the results obtained from the estimation of the most efficient model (Model IIIA). In this model, we can interpret the estimated coefficient as elasticities given that the variables used in the estimation are defined in logarithms. In this sense, the number of workers registered (U variable) shows a positive and significant elasticity meaning that, as expected, a larger number of job seekers would generate an increase in the productivity of the labour offices.

Model	Log-likelihood	AIC	AICc	AIC3	BIC
I: Base model	30.27	-46.55	-46.27	-39.55	-20.62
II: Heteroscedasticity in the inefficiency	71.99	-123.99	-123.44	-113.99	-86.96
IIIA Random parameter in the inefficiency	76.53	-129.08	-128.28	-117.08	-84.63
IIIB Random parameter in the inefficiency	76.79	-127.60	-126.67	-114.60	-79.45

Table III.
Model selection
criteria

Notes: AIC: the Akaike Information Criterion; AIC3: the modified AIC criterion; AICc: the corrected AIC; BIC: the Bayesian Information Criterion

Specifically, keeping constant the rest of the variables, if the U were increased by 1 per cent, the jobs filled (M) would increase by approximately 0.06 per cent. Similarly, the V variable shows a positive and significant coefficient indicating that increases in the registered job vacancies also increase PESs offices output. More specifically, a potential increase in the job supply would imply an improvement in placements of 0.27 per cent. Finally, the C variable (number of counsellors) also presents a positive elasticity indicating a direct relationship between counsellors and jobs filled. Concretely, if C variable were increased by 1 per cent, the productivity of PESs offices would increase by approximately 0.41 per cent, *ceteris paribus*.

As regards the environmental variable (E), a larger number of other placements not managed by the PESs offices but accounted for in their zone of influence are indicative of more productive PESs offices. According to this result we can say that if E increase by 1 per cent, labour offices productivity would rise by approximately 0.61.

On the other hand, as already explained above, to explain the variance of the error term u [equation (7)], we have included a set of variables with the aim of controlling the differences between the job seekers administered by the PESs offices. Table II displays the estimated coefficients. Let us recall that increases in the variance of u represent increases in the distance to the frontier (and vice versa). Results indicate that if a labour office has both, a high percentage of workers aged 44 years or younger and a high percentage of skilled workers, it reduces the distance to the matching frontier, that is to say, inefficiency decreases. In contrast, a high share of unemployed in construction significantly increases inefficiency.

As regards the technical inefficiency index, as mentioned previously and in accordance with equation (3), from Model IIIA we observe that the mean value of efficiency is around 87 per cent, with little variability among the observations, except for the minimum value of 58 per cent.

Figure 1 confirms the result obtained in Table II as regards the inverse relationship between average technical efficiency indices (TE) of each employment office and the unobserved inefficiency heterogeneity coefficient (τ_i).

Lastly, it is worth noting that in line with the parameters obtained with Model IIIA, the presence of scale economies is rejected. This result indicates that the matching process exhibits decreasing returns-to-scale. In tests for returns to scale the coefficient for Model III is 0.75[4]. Interestingly, similar results have been reported, e.g. Hynninen and Lahtonen (2007).

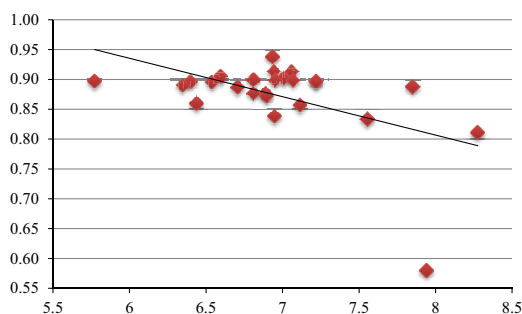


Figure 1.
Relationship between τ_i and TE indices

5. Conclusions

This paper explores empirically the technical efficiency of employment offices in Asturias, a region situated in Northern Spain. To do this, we present a model that explores both the *observed* and *unobserved* heterogeneity in the inefficiency component of the distribution. For this purpose, we follow [Greene \(2005\)](#) who models the unobserved firm characteristics in the inefficiency term u_{it} . Concretely, the variance of the one-sided error component is modelled as an exponential function of time variant covariates. Besides, the coefficients of the observed covariates are allowed to be firm specific and vary randomly. With this in mind, we include a random parameter in the inefficiency distribution (concretely in its variance), with a view to capturing any unobserved heterogeneity. Results indicate that when both, observed and unobserved components are included in the inefficiency distribution, the criteria for the comparison of the models improves. Concretely, when we analyse the goodness of fit of the estimates we find that it improves with the introduction of unobserved heterogeneity. In conclusion, a random parameter model approach that takes into account both observed and unobserved heterogeneity appears to be more appropriate for our aims.

Furthermore, our analysis allows us to identify the most efficient employment offices. The results indicate that the relative technical efficiency of the employment offices is of an acceptable level (87 per cent on average). Moreover, with respect to the relationship between vacancies, job seekers and placements, we find a positive and significant effect. As we explained above, the intensity of counselling in terms of the number of counsellors per unemployed person increases the productivity within PESs offices. Consequently, the implementation of policies by regional governments aimed at the management of human resources at the labour offices may serve to increase their efficiency.

Therefore, the reader should not conclude that some PESs offices are useless. To the contrary, results would appear to indicate that it is the different characteristics of the job seekers that prevent offices from providing the former with adequate job search assistance. In this sense, some factors such as the share of unemployed skilled workers or the share of unemployed persons aged 44 years or younger exert a positive influence in terms of reducing the degree of inefficiency.

In addition, we have seen that the economic climate of the locality is an important factor to understand the productivity of PESs offices. Here we observe something of a “worse-case scenario”, given that the data used for 2013, probably represents the worst year for the Spanish labour market since 2007, during which PESs offices were flooded beyond capacity by job seekers. Because the future prospects for the economy are rather bleak and unemployment is expected to remain high, there is an urgent need for reforms to improve the job search assistance that unemployed workers receive at PESs offices.

In summary, our analysis of the efficiency of PESs offices could help policymakers to redesign labour offices. No decision should be made without first conducting an exhaustive analysis of the strengths and weaknesses of each PESs office together with its environmental factors to improve the dismal behaviour of labour markets and alleviate the problems caused by high unemployment nationwide. The knowledge of the activity and the determinants of the efficiency of the employment offices of a region (in this case, Asturias) can have a positive impact on the knowledge and improvement of the activity of other offices.

Notes

1. Specifically, the management of professional education, support for employment, and a broad sense of labour intermediation are defined in article 149.1.7^a of the Spanish Constitution.
2. It is possible to apply DEA techniques to estimate a matching frontier. See for example, Sheldon (2003) that assess the efficiency of job placement services in Switzerland for the period 1997-1998 or Althin and Behrenz (2005) that analyse Swedish employment offices for the period 1992-1995.
3. Usually, it is assumed a half-normal, exponential, truncated normal or gamma distribution.
4. The $\chi^2(1)$ statistic for the hypothesis that $(\beta_{LnU} + \beta_{LnV} + \beta_{LnC}) = 1$ is 12.0643 with a p -value of 0.0051.

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