Efficiency of social expenditure levels in reducing poverty risk in the EU (28)[1]

Abstract

We evaluate the efficiency of social expenditure (SE) to reduce poverty in the European Union between 2007 and 2015. The data are provided by the EU-SILC and the ESSPROS programmes. Incorporating efficiency analysis improves the results of the analysis of that complex relationship. We found that the level of SE has not a clear correlation with levels of poverty and with their capacity to reduce poverty, while its correlation with levels of poverty or inequality before SE is not significant.

Our analysis of the efficiency identifies four groups of countries. The first group has a correspondence with the Continental and Nordic Welfare models (Esping-Andersen, 1990). They have a great level of SE and their efficiency is above UE28 average. The second group presents the highest efficiency values. The third group is formed by the Mediterranean welfare states, which present a moderate level of expenditure, but have low efficiency. A fourth group composed by non-EU-15 countries presents a low SE with under/on average efficiency.

We also observe that SE in family/children, housing and sickness/healthcare are significantly and positively correlated with efficiency measures. Likewise, in UE15 also social exclusion (pensions) expense exhibit a great positive (negative) relationship with the efficiency in poverty reduction.

1. Introduction

In this paper we evaluate the efficiency of social expenditure in reducing poverty in the European Union between 2007 and 2015. Our aim is to establish a taxonomy of the effort made to provide social protection, considering not only the volume of expenditure on social benefits but also the effectiveness of this expenditure in reducing poverty levels. Likewise, we assess the effectiveness of every item of social spending to reduce poverty from the correlation of that expense type with the value of efficiency measures. A wide range of studies have evaluated the efficiency of public interventions, both from the fiscal policy perspective (taxes and direct monetary transfers, Bárcena-Martín et al., 2018, Smith & Shone, 2016, Vaalavuo, 2013, Marchal et al., 2014) and the perspective of non-monetary social benefits such as health and education (Gupta and Verhoeven, 2001; Clements, 2002; Afonso and St. Aubyn, 2005 and 2006; and Kapsoli and Teodoru, 2017). The effectiveness of social policies and the efficiency of social expenditures to reduce inequality and poverty indexes have also been investigated: Hermann et al. (2008) in the context of EU-27 countries (EU-28 less Croatia), Afonso et al. (2010) for OCDE countries and Lefebvre et al. (2011) in a EU-15 countries. Our analysis shows a different perspective on this topic given the different period, sample of countries and data base used in this paper.

The key question we addressed here is the relationship between the volume of social expenditure on the one hand and indicators of vulnerability, such as the poverty rate, and indices of income inequality on the other. Numerous empirical studies, e.g. those by Ferrarini et al. (2016), Cantillon et al. (1997), Bradbury & Jäntti (2001), Atkinson (2000), Beblo & Knaus (2001) and Oxley et al. (2001), have indicated that there is a negative relationship between the volume of social expenditure and levels of poverty and inequality.

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Cantillon & Vandenbroucke (2014) recognized the importance of redistribution in poverty reduction but also emphasized the need to study the impact of social expenditure. Ayala & Bárcena-Martín (2018), using Spanish data, confirm that focusing only on adequacy or only on coverage of protection provided by minimum income programs may introduce bias to identify differences in terms of social welfare among programs. Cantillon et al. (2002) showed that despite the strong negative correlation between social expenditure and poverty rates in several European countries, we cannot conclude directly that increases in social expenditure lead to reductions in poverty. In a simulation based on data from the Luxembourg Income Study, the above authors suggested that investing more resources in social transfer systems generates unequal results when it comes to poverty risk reduction, so convergence in social expenditure would not lead automatically to convergence in poverty rates. For Lefebvre et al. (2010: 22), "the link between public spending and most of our social inclusion indicators is not clear and does not reveal a clear-cut production technology". Moreover, this phenomenon would be more evident in countries such as Spain and Italy, where increases in social transfers could end up benefitting middle income households rather than lower ones. An uneven distribution of wages or a large volume of low wages could also make income redistribution more difficult from both the political and technical points of view.

Indeed, European Economy (2018) warned that while the tax system and cash-based benefits tend to positively impact reductions in income inequality, they may also trigger distorting indirect effects. For example, benefits for the elderly generally have a low redistributive impact. However, although family and housing allowances are more progressive, they have an even lesser impact because they are smaller**.** On the other hand, the impact of unemployment benefits depends on how they are specifically configured in each country.

Vandenbroucke & Vleminckx (2011) warned that in the new welfare states factors such as re-commodification and resource competition may lead to questioning of the relationship between social expenditure and the war on poverty because of the new configuration of post-industrial societies and the roles of the State, businesses, and social entities as welfare providers. Similarly, Cantillon (2011) questioned the Lisbon strategy, arguing that financial aid for the unemployed has not had the desired effects and that redistribution policies have also not been sufficiently effective in reducing poverty. Numerous studies, e.g. those by Cincinnato & Nicaise (2009) for Belgium, Bogdanov & Zahariev (2009) for Bulgaria, Anker et al. (2009) for Denmark, Ruoppila & Lamminmäki (2009) for Finland, Legros (2009) for France, Radu (2009) for Romania, Moreno (2008) for Spain, Nelson (2003) for Sweden, and Finn et al. (2008) for the United Kingdom, have highlighted the limited impact of the benefits of social assistance policies.

So, we feel that above reflections justify evaluating the efficiency of social expenditure (SE) in reducing poverty in EU-28 countries. It seems logical supposing that a greater SE must imply a greater reduction of poverty-risk indexes. Our analysis tries to identify why a set of states from one unit of SE will obtain different reductions of poverty indexes because the unequal efficiency of their poverty policies.

The following section describes the methodological aspects of our paper: the variables used in the paper, our database and the methodology used to analyze the efficiency of social expenditure in poverty reduction. In section 3 we stablish a hierarchy of efficiency within EU-28 countries. Section 4 identifies patterns in EU-28 respect the pair

social expenditure/efficiency in reducing poverty and we also assess how the composition of social expending influences its efficiency in poverty reduction. We finish pointing out the main conclusions of the study.

2. Data, variables and methodological issues

The data we have used is provided by Eurostat as part of the EU-SILC (European Union Statistics on Income and Living Conditions) programme on income and living conditions and the ESSPROS programme (European System of Integrated Social Protection Statistics) for the availability of data on social protection. In this analysis we use data within 2007-2015 (EU-SILC 2008-2016) of the at-risk-of-poverty rate before social transfers (pensions included), PRB; the at-risk-of-poverty rate after social transfers (PRA), market income inequality (measured as the Gini Index before social transfers), GI, and the volume of social expenditure as a percentage of GDP (SE) (ESSPROS 2007-2015). We have not used "in cash" SE exclusively because spending on social services sometimes has an indirect impact on monetary poverty/inequality outcomes. For example, sickness or old age services in kind make it easier for citizens to strike a balance between their full time jobs or education and their family circumstances. So, data is a panel of observations on 28 countries within the period 2007-2015 and is practically balanced. There are only missed data from Croatia in the years 2007-2009.

Our analysis is done over the mean values of those variables during 2007-2015. We show them in Table However, due the availability of data, for Croatia average values are calculated for 2010-2015.

By analysing the efficiency of social expenditure, we aim to determine the extent to which the results in terms of poverty reduction (our evaluated output) correspond to the initial situation regarding vulnerability and social expenditure measured as a proportion of GDP (our inputs). Regarding the output, we use a poverty threshold corresponding to 60% of median equivalized disposable household income. We measure the results achieved by poverty reduction policies in relative terms as:

$$RRP = \frac{PRB - PRA}{PRB}$$

So, RRP ranges from 0% (social policy does not exists or it is completely inefficient, PRA=PRB) to 100% (social expenses eliminates completely poverty). Notice that the absolute variation/increment in the poverty rate is $PRA - PRB$. For example (see Table 1), in the case of Belgium this variation is -27.5. This value is always negative since after executing public transfers $PRA < PRB$. The output of social is expressed in a more natural way as diminution "social policy in Belgium decreases at-risk-poverty rate 27.5" than as a increment or variation "social policy in Belgium varies/increases at-risk poverty index in - 27.5". So, we express the output of social policy in absolute terms as diminution: $PRB - PRA$.

We feel preferable measuring the diminution of poverty in relative terms instead absolute terms. As PRB is smaller, reducing poverty rate in a given absolute value is more difficult. So, reducing poverty rate in 27.5 units has a "greater merit" for Belgium (PRB=42.31) than for Hungary (PRB=50.39). A given absolute reduction of poverty rate

(e.g. 15) does not imply a success or a failure of social policy in itself. It will depend on the poverty rate before social expenses. If PRB were 15, then social policy leads to a complete disappearance of poverty risk in that country. On the other hand, if PRB were 60, poverty indicator only diminishes in a 25%, i.e., social policy has a weak influence on poverty risk diminution. So, in our paper Belgium output is 64.41%.

Public social spending is often considered as the principal input variable for the fulfillment of social objectives, particularly the reduction of poverty and income inequality. To measure the efficiency of public expenses in achieving RRP we consider as the main input, the public policies effort that we measure as the mean value of social spending over GPD within the period 2007-2015. We prefer quantifying social spending over GPD instead its value per habitant because feel that the first alternative reflects better the actual effort of the public policy by a given country, given its particular GPD achievement. A social expenditure of 2,000 € per inhabitant may be a great effort for a country as Bulgary, (GPD per capita around 20,000 €) whereas this may not follow in Germany (GPD per capita approximately 50,000€). In this way, Hermann et al. (2008), Afonso et al. (2010) and Lefevre et al (2011) also use as input social expenditure over GPD instead its value per capita. In this paper social expenditure is direct monetary expenditure in the form of social benefits, as stipulated in the EU's ESSPROS statistics. We consider eight items in total: sickness/healthcare, old age, survival, unemployment, disability, family/children, housing, and social exclusion. This definition excludes social expenditure in kind, such as spending on health or education systems.

In this paper we also consider using a second input variable to reflect the population social condition before executing SE. We use as a proxy variable the Gini Index before transfers (GI) despite it may be approximated by PRB. We choose GI because we have observed that it has a higher correlation with RRP than PRB. Of course, those indicators are not inputs, but contextual variables. It seems logical that the reduction in poverty rates and income inequality are greater in situations where the starting value of Gini's index or PRB is also higher. From the law of diminishing marginal returns we can deduce that an increase in social transfers will cause a smaller decrease in the index when we start from a better situation in terms of income inequality or poverty. Likewise, GI is decisively related with social needs, economic capacity, the priorities of public expense of each country that are determined by, e.g. per ages population structure, labour market context or the magnitude of public expense in education. A larger retired population will imply a larger population dependent on pension benefits, while a greater unemployment rate leads to a greater number of citizens with a low (or null) level of personal income. Likewise, De Gregorio and Lee (2002) shows that a greater public expenditure on education reduces income inequality. So, using Gini index before SE as an input variable lets us resuming contextual variables like those above-exposed and so, increasing the degrees of freedom and capability generalisation of regression models fitted in this paper.

To measure efficiency of public policy to diminish poverty we use an approach that has been widely used in statistical analyses of productivity. We have used regression models to establish two frontiers: a) an average, to quantify the output (reduction in poverty) expected of a State as a function of the vulnerability of its population before

the implementation of social transfers and social expenditures (in terms of GDP).; and b) what we term an efficiency frontier, to indicate the ideal value of the output for the same combination of inputs.

As far as efficiency assessment is concerned, we can differentiate two main types of methods. The first of these is Data Envelopment Analysis (DEA). DEA uses mathematical programming methods to evaluate whether a set of productive units is efficient as a function of the consumed inputs. A fundamental work in this context was that by Charnes et al. (1978). Afonso et al.(2010) and Lefebvre et al. (2011) use this method to evaluate public policies in the reduction of income inequality and/or poverty. The second type, which we have used in this paper, is closer to the theoretical works of Debreu (1951) and Farrell (1957). As Greene (2008, p.92) asserted, these methods involve the use of standard econometric instruments. For a set of productive units, regression methods establish a) what the expected output is (the expected frontier), that I estimated with conventional Ordinary Least Squares (OLS), or b) what the ideal level (efficient frontier) is for each function of the set of inputs consumed. It can be fitted with Corrected Least Squares Method (COLS), that comes from a slight refinement of OLS estimates.

In our analysis we have used least-squares regression of the evaluated output (RRP) as a function of the input considered (SE and GI). We therefore adjust a function that estimates the expected output for the *i*th State, which as a function of the inputs used, is:

$$Y_i = f(X_i\,;\,\beta) \qquad (1)$$

where: Y_i is the value of the theoretical output of the *i*th EU state evaluated; $X_i = (X_{i1}, X_{i2}, \ldots, X_{in})$ is the vector of the level of inputs; and $\beta = (\beta_0, \beta_1, \beta_2, \ldots, \beta_n)$ is the vector of parameters. Normally, (1) is a linear function or can be transformed into one, so we can use a linear regression model to estimate (1):

$$Y_i' = \beta_0 + \sum_{j=1}^{n} \beta_j X_{i,j}{}' + e_i \qquad (2)$$

where Y_i' is an increasing monotone transformation of Y_i and $X_{i,j}{}'$ is an increasing monotone transformation of $X_{i,j}$, which allows (1) to be transformed into a linear expression (2). Finally, $\beta_0, \beta_1, \beta_2, \ldots, \beta_n$ are the same parameters that make up (1) and e_i is a white noise random error term. So, $\beta = (\beta_0, \beta_1, \beta_2, \ldots, \beta_n)$, $\hat{\beta} = (\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, \ldots, \hat{\beta}_n)$ can be estimated using ordinary least squares regression (OLS).

According to López-Casasnovas and Robert-Wagstaff (1991), by estimating the vector of parameters β, $\hat{\beta}$, we can obtain the expected output of the *i*th state $Y_i^* = f(X_i\,;\hat{\beta})$, where the value of the error is a measure of efficiency. This is the first measure we have used in this paper. For the *i*th state, this is symbolized as $ME1_i$ and is:

$$ME1_i = Y_i - Y_i^* \qquad (3)$$

This approach was used by Feldstein (1967) in a classic study that evaluated hospital management. According to Chung (2011), this approach is common in studies to evaluate energy production whereas Hermann et al. (2008) also use this approach to evaluate the efficiency of social spending to reduce poverty in UE27. So, if $ME1_i$>0 ith country is more efficient than was expected to be and $ME1_i$<0 implies that *i*th country reduces poverty above it was expected.

Also common are the so-called efficient frontier approaches, which for each possible combination of inputs aim to identify the maximum possible output, which is attributable

to the best practice and termed the frontier output. We apply a model based on minimum least squares regression (1)-(2), which is called corrected least squares (COLS). Specifically, we aim to obtain a function which, for the *i*th unit, identifies the value of the frontier output, Y_i^F, which is:

$$Y_i^F = f(X_i\,;\beta^F) \quad (4)$$

where β^F is a vector of parameters $\beta^F = (\beta_0^F, \beta_1^F, \beta_2^F, \dots, \beta_n^F)$ comprising the coefficients of the frontier productivity function. Therefore, $Y_i \leq f(X_i\,;\beta^F)$.

The COLS method was initially proposed by Winston (1957), while Greene (1980) showed that the method was econometrically efficient. Moreover, Banker *et al*. (1993) proved empirically that the method is also robust in comparison with methods such as DEA. For this reason, COLS has been widely used to measure productivity in industries such as medical provision (Lee et al., 2009), food production (Kousmanen and Kousmanen, 2009) and banking (Nguyen et al., 2018).

This method is based on estimating (2) with OLS in such a way that we firstly adjust the parameters the vector $\hat{\beta} = (\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, \dots, \hat{\beta}_n)$ and obtain a set of errors $\{\hat{e}_i\}_{i=1,2,\dots,m}$ whose mean is zero.

We then fit the parameters with COLS $\hat{\beta}^F = \beta^{COLS} = (\beta_0^{COLS}, \beta_1^{COLS}, \beta_2^{COLS}, \dots, \beta_n^{COLS})$ as:

$$\beta_0^{COLS} = \hat{\beta}_0 + max\{\hat{e}_i\}_{i=1,2,\dots,m} \quad (5)$$

$$\beta_j^{COLS} = \hat{\beta}_j,\ j=1,2,\dots,n \quad (6)$$

Once we have adjusted the vector of coefficients $\hat{\beta}^F$, the frontier output estimated by the *i*th unit evaluated is $Y_i^{*F} = f(X_i\,;\hat{\beta}^F)$. Finally, we obtain the Debreu-Farrell measure of efficiency, which is simply the ratio between the output achieved and the maximum output that is theoretically achievable:

$$ME2_i = \frac{Y_i}{Y_i^{*F}} \quad (7)$$

So $ME2_i$ measures the proportion of the ideal output that achieved by ith actual output.

3. Results

Table 1 shows the wide ranges of the indicators used in our study. For example, countries such as Romania, Lithuania and Latvia spend the least on social benefits (less than 15% of their GDP), while France, Denmark, Finland, the Netherlands, Belgium and Austria allocate at least 30% of their GDP to such benefits. We believe this heterogeneity in the results of EU-28 makes it necessary to create more complex models than AP (absolute reduction of poverty) to evaluate efficiency.

[Table 1]

Table 2 shows the matrix of correlations (the Pearson correlation coefficient) between these indicators. We have found that we cannot reject that all the variables are normal according to the Shapiro-Wilk test. As expected, the data confirm a significant positive correlation between the volume of social expenditure and the degree of poverty reduction (0.540). However, they also show that this factor, by itself, does not determine entirely the capability of a State to reduce its poverty levels through social spending. In other words, an improvement in social spending does not always generate an equivalent improvement in poverty reduction. Moreover, the level of social expenditure does not have a significant correlation with levels of poverty or social

inequality before social benefits. It appears, therefore, that *ex-ante* situations of poverty and/or inequality are not really determining factors when it comes to planning social protection policies.
The poverty index after social transfers (PRA) correlates with almost every indicator. This is especially true of the correlation with RRP, which, as expected, is negative (RRP, -0.918). It also appears to be more relevant than the amount of social spending (DS: -0.450), which, also as expected, is negative.

[Table 2]

Obviously, the importance of these indicators on the final poverty results varies from country to country. For example, Germany, Sweden, Italy and Austria assign an almost identical proportion of their GDP to SE (between 28.6% and 29%) and have similar poverty risks prior to allocating benefits (between 43.8% and 44.9%). However, the impact of these benefits on poverty reduction is dramatically different. For example, in Austria, Sweden and Germany the percentage of the population that lie outside poverty is 67.2%, 65.5% and 63.4%, respectively, whereas in Italy it is only 56.8%. Divergences also exist within the same welfare system as defined by Esping-Andersen, (1990). For example, Portugal has managed to reduce poverty by 6.6 points more than Spain by investing only 1.5% more of its GDP in social benefits. With regard to Eastern European countries, which are generally placed in the same group in terms of social policy, Slovakia has managed to reduce poverty by almost 20% more than Bulgaria even though it allocates just 1.2% more of its GDP to social expenditure. These results show that the efficient use of SE plays a significant role in the final poverty statistics of European Union countries.

3.1. Efficiency of SE on RRP

We now evaluate how efficient EU countries are using social expenditure to reduce their poverty rates in percentages (RRP). As determinants of this reduction, we consider social expenditure (SE) and a contextual variable to reflect the population social condition before executing SE as we commented in section 2. In this sense Herrmann et al. (2008) points out that it is much easier to reduce poverty at very high initial levels, while it is more difficult to have a good performance for the countries characterized by initially low before taxation poverty rates". We prefer approximating this second variable is approximated by the Gini Index before social transfers (GI) instead PRB because the first index has a stronger correlation with RRP. To relate RRP with SE and GI we chose a logistic function rather than the usual Cobb-Douglas function. For one thing, we know that the interaction of RRP is not linear, especially with SE, but we also know that RRP must range between 0 and 1. Therefore:

$$RRP_i = \frac{1}{1+\exp(-\beta_0-\beta_1 SE_i-\beta_2 GI_i)} \quad (8)$$

We must therefore adjust the following linear model:

$$ln\frac{RRP_i}{1-RRP_i} = \beta_0 + \beta_1 SE_i + \beta_2 GI_i + e_i \quad (9)$$

Table 3 shows the results for the estimation of (9). We can see that the positive (negative) relationship of RRP with SE (GI) indicated in Table 2 is confirmed and that in

both cases is significant. We can also see that according to the F statistic, the adjusted equation is statistically significant. There also seem to be no problems of heterocedasticity since the errors are undoubtedly homocedastic according to the White test. Jarque-Bera test shows that the residuals follow a normal distribution.

[Table 3]

Table 4 shows the ME1 values for each country and the ranking of these countries according to this measure of efficiency. ME1 measures the difference between the real level of poverty reduction and the expected level according to the inputs (expenditure on social protection and income inequality before social benefits). We can see that 16 countries have a negative ME1 value and 12 have a positive one. A negative ME1 indicates that the actual level of poverty reduction is lower than expected theoretically from the inputs, whereas a positive ME2 indicates that the real reduction in poverty is higher than expected. Bulgaria is the country whose results are furthest from those expected, and with a negative sign (-0.614), followed by Latvia (-0.511) and Spain (-0.554), while the Czech Republic has the best positive results (0.482), followed by Hungary (0.379) and the Netherlands (0.172).
We can see that the ranking with ME1 is similar to what it was for RRP, so no further information is provided from what we obtained in simpler fashion from the classification for RRP.
When we model RRP as a logit function, the frontier value of the relative reduction in poverty for the *i*th state is:

$$RRP_i^F = \frac{1}{1 + \exp(-\beta_0^F - \beta_1^F SE_{\ i} - \beta_2^F GI_i)}$$

By using COLS methodology, we find $\hat{\beta}_0^F$=1.557, $\hat{\beta}_1^F$=3.55 i $\hat{\beta}_2^F$=-2.595.
Table 4 also shows the estimated values for the RRP frontier for each state as well as the values of ME2 and the ranking when this measure of efficiency is applied. The rankings for ME2 are similar to those for ME1. The correlation between RRP and ME2 is high and positive but lower than that between RRP and ME1 (see Table 5). Although Hungary and the Czech Republic continue to show the highest levels of efficiency, the results of other countries are different from those they obtained for ME1 (and RRP). For example, the Netherlands fell from 3rd to 8th position, France fell from 5th to 14th, and Austria fell from 10th to 16th. On the other hand, ME2 demonstrates the efficiency of Ireland (up from 8th to 3rd), Luxembourg (up from 11th to 5th) and Romania (up from 23rd to 12th).
As we can see, the Czech Republic achieved the highest level of efficiency (output) (ME2 = 1) that could be achieved with this model taking into account the inputs (expenditure on social protection and the Gini index before social benefits). This was followed by Hungary (0.979) and Ireland (0.742). On the other hand, Spain is the country that lies furthest from this theoretical maximum (ME2 = 0.337).

[Table 4]

[Table 5]

Notice that the rankings are in accordance to those obtained by Herman *et al* (2008) and Lebebvre et al. (2011). When considering UE28, we observe that Visegrad pact countries as Czech Republic or countries with welfare systems of Nordic or Continental type as Sweden or the Netherlands present the higher levels of efficiency. On the other hand, countries with a Mediterranean welfare system or former Communist Republics as the Baltics present the lower values in ME1 and ME2[2].

3.2 Identifying patterns of efficiency

We now establish taxonomy of countries based on social expenditure as a function of GDP, and the efficiency achieved by this expenditure to decrease poverty. We will relate this taxonomy with that by Esping-Andersen (1990) about welfare states. Notice that we have calculated two measures of efficiency (ME1 and ME2) and we present in the dendrogram depicted in Figure 1 the result that come from using ME1 measure of efficiency. In any case, we have checked that the results achieved when considering ME2 instead ME1 are quite similar as it can be checked comparing Figures 2 and 3. This fact is not surprising, given the great correlation of ME1 with ME2 (see Table 5).

[Figure 1]

[Figure 2]

[Figure 3]

In the first group we identify countries that in Esping-Andersen taxonomy are labelled as Continental Welfare states (e.g. France or Germany) and Nordic Welfare States (Finland, Sweden and Denmark). They are characterised by the highest level of SE and in many cases an above average efficiency in poverty reduction.
We observe another group of countries (Hungary, Czech Republic, Slovenia, Slovakia and Ireland) with a great ME1 (and also ME2) achievement and generally with on average SE. The Czech Republic has the lowest poverty levels of EU-28 (9.3%) despite being only the 20th country in terms of expenditure on social protection (it allocates 19.4% of its GDP compared to an EU average of 27.8%). This is because its expenditure, though limited, is the most efficient of all EU member countries when it comes to eradicating poverty (it holds first position in the rankings for ME1 and ME2). Hungary SE is also highly efficient (it occupies second position) and although it invests

[2] To test the robustness of our results in Table 4 we perform two supplementary analyses. The first one consists in running a pooled data panel as (8)-(9): $ln\frac{RRP_{i,t}}{1-RRP_{i,t}} = \beta_0 + \beta_1 SE_{i,t} + \beta_2 GI_{i,t} + e_{i,t}$ i=1,2,…,28; t= 2007,…,2015 with OLS. By using (3) we obtain the efficiency measure for the ith country in year t $ME1_{i,t}$ whereas with (5), (6) and (7) we calculate $ME2_{i,t}$ t=2010, 2011,…,2015. So we can include Croatia. Spearman correlations between years of $ME1_{i,t}$, and $ME2_{i,t}$ point out that the ranks in Table 4 are stable within the considered period. The correlations in the case of ME1 are rarely under 0.7 and increase notably in the case of ME2.
The second analysis is done by estimating the extension to the data panel model with fixed effects by Schmidt and Sickles (1984). The hierarchy of countries that we found with this method is highly correlated with those in Table 4 (around 0.85).

the equivalent of only 21.5% of its GDP in social protection, it moves up 20 places thanks to its efficiency. No longer is Hungary the EU member state with the highest risk of poverty before social benefits (50.4%), as it now occupies 8th position in the list of EU countries with the lowest risk (13.9%).

Mediterranean Welfare States (Italy, Spain, Greece and Portugal) are grouped in a specific cluster. The level of SE within the group is slightly heterogeneous but, in general, quite closed to that of countries in the first group. However, the efficiency in achieving RRP is clearly under EU-28 average.

Within the fourth group are nine southern and eastern European countries characterized by low levels of social protection and low or on average ME1. These countries have the highest rates of poverty in the European Union. Compared to the other six countries in this group, Cyprus, Malta and Croatia benefit from more moderate levels of poverty before social benefits and higher levels of SE (above 18%). Lithuania, Romania and Poland are the most efficient countries, with similar efficiency levels to those of several central European countries and higher levels than those of the Mediterranean EU-15 countries. However, given that their levels of SE are still poor, they are classified as belonging to this group according to the model. Finally, Bulgaria, Estonia and Latvia are located at the far end of the quadrant, with low expenditure on social protection (the highest of the three is Bulgaria with 16.5% of its GDP) and low efficiency. Bulgaria and Latvia also have the highest poverty levels in the EU. Estonia, on the other hand, benefits from a low risk of poverty before social benefits (39.5%), which makes the ultimate risk of poverty relatively low (19.3%, or 3.3 points above the average for the EU as a whole).

It could be relevant to analyse how the different composition of social spending in each country is linked with the efficiency of social policies. Concretely, we are interested to stablish the effectiveness of each type of social spending to reduce poverty risk:: sickness/healthcare, disability, old age, survivors, family/children, unemployment, housing, social exclusion.

To measure the effectiveness of each item to reduce RRP we use the correlation coefficient of the proportion that each type of expenditure supposes on total SE with ME1 and ME2. If a given SE type has a positive relationship with ME1 and ME2 then we must conclude that this kind of SE is efficient to reduce poverty. On the other hand, a negative relationship will mean that this item is inefficient. This analysis is carried out for EU-28 as a whole and, also, separately, for the countries of the EU-15, that have consolidated welfare systems, and non-EU-15 countries, composed essentially by former Communist Republics and small countries as Cyprus or Malta. In Table 6 we show the mean value and median value for SE for both kind of EU countries and the results of testing that the difference of their means and medians is zero. The results show that undoubtedly the value of SE is significant greater in EU-15 countries than in non EU-15 countries.

In Table 7 we show the correlation of ME1 and ME2 with the proportion that every kind of expense supposes over SE. We can check in the EU-28 countries that expenses for sickness and family/children and, to a lesser extent, in housing, disability and social exclusion have a positive significant correlation with the efficiency measures. So, our results are similar to those in Hermann et al. (2008). However, the patterns detected in EU-15 countries and non-EU-15 countries are slightly different. In the EU-15 countries the expenses in health, disability, housing, family and social exclusion have a significant positive relation while the expenses in survival pensions (significantly) and

unemployment and retirement (in a non-significant way) are negatively related with the efficiency measures. In non-EU-15 countries, health and family expenses also have a positive relationship with ME1 and ME2, and these relations have a clear statistical significance. On the other hand, the expenditure on retirement pensions does not present a negative relationship with the efficiency indicators but also that relation is positive and statistically significant with ME1. We also observe that the expenses dedicated to social exclusion, disability and housing do not present a statistical significant relationship with the indicators of ME1 and ME2. Even in the case of social spending the correlation has a negative sign, contrary to that observed in EU-15 countries. Notice that in all cases unemployment expenditure has no significant impact on ME1 and ME2 and so it reinforces the warning in Cantillon (2011) that criticises the Lisbon strategy, arguing that financial aid for the unemployed has not had the desired effects and that redistribution policies have also not been sufficiently effective in reducing poverty.

[Table 6]
[Table 7]

Conclusions

This paper evaluates the efficiency of the 28 EU countries using social expenditure to reduce the risk of poverty. We have used econometric models that are widely employed in economic literature to measure productivity. These models are based on least-squares regression, which enables us to establish average and efficient frontiers for quantifying the efficiency of social expenditure.

Social protection expenditure (SE) is one of the most common indicators for determining the types of welfare states and analysing the impact of social policies on people's living conditions. However, it is less common measuring efficiency of these measures analytically (we can point out: Hermann et al. 2008; Afonso et al. 2010; and Lefebvre et al. 2011).

Incorporating efficiency into the study helps to understand the relationship between SE and risk of poverty with greater analytical complexity. We observed, for example, the cases of Hungary and the Czech Republic (as well as of Slovenia and Slovakia), countries which are normally grouped in one block along with others in their area because of their low levels of social expenditure. However, explanations of this type are poor. The high levels of efficiency shown by these four countries (pointed out also in Herrman et al., 2008) provide a better perspective for understanding why they are all included in the list of ten countries with the lowest levels of poverty risk in the EU.

On the other hand, levels of efficiency are not necessarily high in countries where social protection benefits do not substantially focus on the population at risk of poverty. This may be because of the introduction of expansive universal rights policies, which have a high cost in relation to GDP and for which poverty is not a criterion for inclusion or exclusion. This model comprises many of the countries in Northern and Central Europe. Although in some of these countries (e.g. Denmark, France and the Netherlands) the level of efficiency is high, this is not true in others (e.g. Germany, Austria and the United Kingdom).

Several countries show symptoms of inefficiency that do not seem to be caused by expansions in social protection, since in many cases their SE is low, but by a

dispersion in their support programmes. For example, although the SE levels of the Mediterranean EU-15 countries are similar to those of the other EU-15 countries (especially Italy), their efficiency levels are clearly lower (especially Spain). Again, this conclusion is in accordance with Hermann et al. (2008) and Lefebvre et al. (2011). Consequently, these countries are among those with the highest risk of poverty – not only among EU-15 countries but in the EU-28 as a whole. The same occurs, though more intensely, in the other Eastern European countries.

The analysis shows that there is no lineal relationship between greater social spending and greater poverty reduction. Starting positions, regarding inequality and the at-risk-of-poverty rate, also count on efficiency. Anyway, we must add that "It is much easier to reduce poverty at very high initial levels, while it is more difficult to have a good performance for the countries characterized by initially low before taxation poverty rates" (Herrmann, et al., 2008: 21).

From our analysis it can be seen that there is a fuzzy correspondence between the resulting clusters and the classical grouping of states in welfare models (especially for the Nordic/Continental on one hand and the Mediterranean on the other). But, in terms of efficiency, the analysis hardly differentiates the countries of the Scandinavian continental model. However, it is necessary to define the position of non EU-15 (as, eg. Visegrad Pact countries or the Baltics) that have not been considered in any of the groups of welfare states.

The implications of the cluster analysis are briefly: a) Non EU-15 countries present a classifying challenge to classical theory of welfare states; b) As it is stated in Lefebvre et al. (2010), in terms of efficiency, United Kingdom (Anglo-Saxon model) resembles the continental model; c) the continental and Scandinavian models are approaching, differing from other countries; d) there seems to be a convergence of countries that start from worse positions, but not a convergence between all countries towards the same efficiency.

We finally link SE items and efficiency of poverty policies by means of a correlation analysis. Whereas SE in family/children, sickness/healthcare and housing are significantly highly and positively correlated with efficiency measures, in UE15 also disability and social exclusion (pension) expenses exhibit a great positive (negative) relationship with the efficiency of poverty public expenditure. The negative correlation of the pension expenditure with ME1 and ME2 that we have registered in UE15 countries is in accordance with European Economy (2018) whereas the negative (despite with a low significance) relationship between unemployment wastes and efficiency is also in accordance with Cantillon (2011).

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