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Unemployment, spell duration and the burden of unemployment in Spain during the XXI Century

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Abstract

This paper presents the families of unemployment indexes sensitive to unemployment duration developed by Sengupta (2009) and Shorrocks (2009a, 2009b). They pick-up in a single index the 3 dimensions of unemployment: incidence, intensity and inequality. An application with the Spanish Labor Force Survey for the period 2001-2017 is offered, and some interesting results arise. In particular, when unemployment duration is taken into account, a less optimistic view of the recent recovery appears, since one of the consequences of the Great Recession has been the huge increase in the very long-term unemployed. Moreover, vulnerable groups in the society should also be measured taking into account not only the incidence of unemployment, but also intensity and inequality, and when we do so other highly vulnerable groups emerge.

Keywords: measurement of unemployment, spell duration, Spanish labour market.
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1. Introduction.

In a path breaking paper, Sen (1976) argued that a poverty index should take into account three aspects of poverty: (*i*) the number of people below the poverty line, **incidence**, (*ii*) the extent of the shortfall of income of the poor from the poverty line, **intensity**, and (*iii*) the **inequality** among the poor. Accordingly, any poverty measure should be expressed as a function of these three dimensions.

The same could be said about unemployment. An unemployment index should take into account three aspects of the labor market: (*i*) the number of unemployed, **incidence**, (*ii*) the time they have been looking for a job, **intensity**, and (*iii*) the **inequality** in spell duration among the unemployed. Yet policy oriented indicators only focus on incidence in both cases, the share of the poor in the case of poverty and the unemployment rate in the case of the labor market performance.

This paper focus on unemployment in Spain along the XXI century, during the Great Recession, but also some years before, as well as the recent years in which the economy is growing again and employment is being created. But we go beyond the unemployment rate and consider the spell duration of unemployed as well as its distribution. The Great Recession has had a tremendous impact on the Spanish labor market, the unemployment rate rose up to 26% in 2013, and began to fall slowly in the following years; however, this is not the only significant change that has taken place in the labour market, as we shall see the structure of the spell duration in unemployment has changed completely from the years before the crisis to the present days. Mean duration of unemployment has increased substantially, but also inequality, which is consistent with the present concern about long-run unemployment and the precarization in labor market conditions.

It is certainly true that, for policy purposes, the unemployment rate is sometimes supplemented with information about mean unemployment duration, but inequality in spell duration is absent in any discussion about labor market performance. We may wonder, why should the distribution of the burden of unemployment be of interest to us? According to Sen (2000), the costs of unemployment do not only entail the income loss, but also the loss of output, a damage of skills and human capital, deprivation of freedom, social exclusion, psychological and health problems. Unemployment and

poverty are closely related (Goerlich 2016). The importance of the duration of unemployment resides in the fact that these losses are an increasing function of the time spent unemployed. In fact, the duration of unemployment has received attention in the 70s and 80s (Kaitz 1970; Akerlof and Main 1980, 1981; Carlson and Horrigan 1983; O'Mahony 1983) and the distributional concern in the 90s (Sengupta 1990; Shorrock 1992, 1993; Paul 1992) of the previous century. But the key papers in adding the distributional dimension to unemployment measurement passed unnoticed until Lambert (2009) rediscovered them for the *Journal of Economic Inequality* (Sengupta 2009; Shorrocks 2009a, 2009b). Fundamentally, the underlying reason why inequality in spell duration matters is that longer unemployment durations entail a higher welfare loss, hence an unequal unemployment distribution concentrated on longer durations must imply a more acute unemployment problem, and this should be reflected in the way we measure unemployment.

Distributional worries in economics began long ago with the analysis of income distribution and poverty, so the preoccupation about the distribution of the burden of unemployment is not specific to labour economists. In fact the analytical apparatus developed to tackle this problem is very similar to the one used in the income distribution literature and welfare economics, and has a clear correspondence with poverty measurement, where the unemployed are the poor and the employed the non-poor. But besides its importance, empirical applications of these ideas are very scarce. To our knowledge, only a few recent papers (Bazen, Joutard and Niang 2014; Niang 2014; Motiram and Naraparaju 2014) use the approach developed by Sengupta (2009) and Shorrocks (2009a, 2009b) to analyze labour market outcomes, and only Gradín, Cantó and del Río (2015) includes Spain for the recession years in a comparisons among some European countries.

The aim of this paper is to provide an in deep analysis of the evolution of unemployment in Spain for the period 2001 – 2017 taking into account **incidence**, **intensity** and **inequality**. The evolution of incidence is well known. The unemployment rate reached its minimum in 2007, 8.2%, after a long period of growth, its maximum in 2013, 26.1%, and has been falling since then, 17.2% in 2017. Along the period, it's notorious that intensity has grown, since long term unemployment has become one of

the major concerns of the labour market, but nothing is known about inequality, the distribution of the burden of unemployment among the unemployed. Dimensions will be studied separately, but also in an integrated fashion using one of the families of duration sensitive measures proposed by Shorrocks (2009b) that uses information on the spell length distribution of the unemployed and allows to subsume within a single measure the three dimensions: incidence, intensity and inequality. The index decomposes as the product of three terms, each one picking-up one aspect of interest. We shall also perform a decomposition analisis according to some classification variables, trying to identify what groups are worse-off and in what dimensions.

The structure of the paper is as follows. Section 2 discusses some questions related to the measurement of spell duration that are important for the interpretation of results. This section also explains the methodology used, based on the family of unemployment measures developed by Shorrocks (2009b), its properties and the similarities with poverty measurement. A partial ordering of spell length distributions through the so called unemployment duration profiles will also be introduced. Section 3 presents the data used, taken from the Spanish Labour Force Survey (LFS, *Encuesta de Población Activa*, *EPA*), and the empirical results obtained. The last section of the paper offers concluding comments. An appendix describes data treatment before the data file is ready for analysis and mentions some technicalities.

2. Measuring poverty and measuring unemployment: two heads of the same coin.

2.1. Measuring unemployment duration.

The conventional measure of unemployment is quite simple. Count the number of unemployed and express this figure as a proportion of the labour force, this is the well-known **unemployment rate** or head-count ratio. The unemployment rate is routinely computed by the statistical offices, and it's the key indicator to monitor the labour market. It is usually computed from Labour Force Surveys on a quarterly basis. However, this index is completely static, it is just a snap-shot at a given moment in time, and has no information about the individual histories of unemployment. To study intensity and inequality we should introduce the time dimension in the unemployment rate, because this index weights all spells equally, independently of their duration.

Measuring spell length is not straightforward, because we can think in different possible alternatives. Following time individual histories we should be able to record the so called 'completed spells' of unemployment, the full time someone has been unemployed until he has found a job or exit the labour force. Using this information we can calculate unemployment measures for the completed spell length distribution. However, given how labour market data is gathered, this information is not usually available. The information we have from LFS refers to the so called 'interrupted spells' of unemployment. Given the interview at a moment in time, the individual is asked for how long he has been looking for a job or how long has it been since the last job. For an unemployed, this means that what we have is an on-going spell, usually referred in the literature as an 'interrupted spell'.[1]

It is well-known that the mean unemployment duration using 'interrupted spells' is a biased estimation of the average unemployment duration for the population. Salant (1977) mentions two types of biases: 'interruption bias', as a consequence that the interview takes place in the middle of a spell, so on average the length of the 'interrupted spell' is half the length of the 'completed spell'; and the 'length bias' due to the fact that the probability of recording an unemployment spell is proportional to the length of the spell. As a result, longer unemployment spells will be over-sampled, whereas short unemployment spells will be under-sampled. These two biases are conflicting each other. On the one hand, the 'length bias' puts an upward pressure on the mean interrupted duration as compared to the mean completed duration. On the other hand, the 'interruption bias' exercises a pressure in the opposite direction. Because of this no final statement can be made about which of these effects dominates.

While recognizing its limitations we take the 'interrupted spells' available in the LFS as our source for duration analysis, and make no attempt to correct this, even if statistical methods do exists (Salant 1977; Bazen, Joutard and Niang 2014).[2] Our main

[1] There is also a third possibility asking each individual, for a given period of time in the past –a year–, the number of periods –weeks or months– he has experienced unemployment. Hence, at the moment of the interview, we have information on completed and interrupted spells, depending on each individual, who may be employed or unemployed. This type of information is not available in the Spanish LFS.

[2] The 'interrupted spell' question is not the only data problem we face in using the Spanish LFS for this exercise. Some additional problems, as well as the exact definition of 'spell length' used for practical purposes, given the information in the LFS, is provided in the Data Appendix.

interest is to supply information on the unemployment experience in Spain within the same information data set used to compute the unemployment rate; so the indices proposed can be routinely computed. We are not interested in providing unbiased estimates of duration statistics for the population, just in incorporating the time dimension to the unemployment rate, in a fully consistent manner and using the same information used to construct this index.

2.2. Distributionally sensitive measures of unemployment.

This section describes the family of distributionally sensitive measures of unemployment that will be used in the empirical application. These are due to Shorrocks (2009b), which we follow closely. Other approaches, based on an explicit welfare framework in which social welfare is the sum of individual utilities that depend on unemployment duration and have the standard properties are possible (Paul 1992; Sengupta 2009, Shorrocks 2009a), but the axiomatic approach of Shorrocks (2009b) is clearer, connects directly with the welfare approach in economics and has a direct correspondence with poverty measurement. In fact, from our approach, measuring unemployment and measuring poverty are just two heads of the same coin, as we shall see in the sequel.

Consider a population of n economically active individuals at a given moment in time, which can be classified as either employed or unemployed.[3] Let the vector $\boldsymbol{s} = (s_1, s_2, ..., s_i, ..., s_n)$ represents a duration distribution, which collects the characteristic of interest, unemployment duration for each individual i, $s_i \geq 0, \ \forall i$. The set of all admissible finite dimensional duration distributions for any finite population of interest is denoted by $S = \bigcup_{n=1}^{\infty} \mathbb{R}_+^n$. Clearly, $\boldsymbol{s} \in S$ that we assume it has moments of every order.

Without loss of generality, we may consider that $\boldsymbol{s}$ is ordered in decreasing order, $s_i \geq s_{i+1}$ for $i = 1, 2, ..., n-1$. Obviously, for those who are employed $s_i = 0$. Referring to q as the number active individuals who are unemployed we may alternative write $\boldsymbol{s}$ as

[3] The analysis excludes inactive people, and the population of interest consists only on the economically active individuals, either employed or unemployed.

$\boldsymbol{s} = (s_1, s_2, ..., s_q, 0, 0, ..., 0) = (\boldsymbol{s}^+, \boldsymbol{s}^0)$, where $\boldsymbol{s}^+ = (s_1, s_2, ..., s_q)$ denotes the duration vector of the unemployed, and $\boldsymbol{s}^0 = (0, 0, ..., 0)$ the duration vector of the employed, a zero vector of length $n - q$. With this notation the unemployment rate, or head-count ratio, is given by $H = \frac{q}{n}$, which makes no use of the duration information. The unemployment rate picks-up **incidence** only.

The simplest way in which duration information can be incorporated into the unemployment rate is just considering the mean of the duration distribution, the so called *per capita duration*,

$$\mu = \frac{\Sigma_{i=1}^{n} s_i}{n} = \frac{q}{n} . \frac{\Sigma_{i=1}^{q} s_i}{q} \tag{1}$$

Notice that $\Sigma_{i=1}^{n} s_i = \Sigma_{i=1}^{q} s_i$, since the $\boldsymbol{s}$ vector is ordered, and for the employed $s_i = 0$. Hence, μ can be written as the product of the unemployment rate, H, and the *mean unemployment duration*, $I = \frac{\Sigma_{i=1}^{q} s_i}{q}$, the mean of the duration distribution among the unemployed only, $\mu = H.I$. The *per capita duration* index picks-up **incidence**, through the unemployment rate, H, and **intensity**, through the *mean unemployment duration*, I. In addition, it is proportional to the unemployment rate.

However, the *per capita duration* index does not take care of how the total unemployment time, $\Sigma_{i=1}^{q} s_i$, is distributed among the unemployed. In the terminology of the inequality literature we have just a mean, but not an inequality index.

A simple way, even not the only one, to incorporate distributional aspects into the measurement of unemployment is to consider the family of unemployment indices proposed by Shorrocks (2009b)

$$U_\alpha(\boldsymbol{s}) = \frac{\Sigma_{i=1}^{n} s_i^\alpha}{n}, \quad \alpha \geq 0 \tag{2}$$

For $\alpha = 0$ we have the unemployment rate, $U_0(\boldsymbol{s}) = H = \frac{q}{n}$,[4] while for $\alpha = 1$ we have the *per capita duration* index, $U_1(\boldsymbol{s}) = H.I = \frac{\Sigma_{i=1}^{n} s_i}{n}$. It follows that $U_\alpha(\boldsymbol{s})$ is a generalization of the previous measures.

The family $U_\alpha(\boldsymbol{s})$ was proposed by Foster, Greer and Thorbecke (1984) in the context of poverty measurement, where s_i represents the (normalized) poverty gap, the distance of the income of the poor from the poverty line, and is zero for the non-poor. In our context, the unemployed are the poor, they are poorer the longer the unemployment spell, and the employed are the non-poor.

For $\alpha > 1$ the family of unemployment measures $U_\alpha(\boldsymbol{s})$ satisfies five basic properties:

(A1) Normalization: $U_\alpha(\boldsymbol{s}) = 0$ if there is no unemployment.

(A2) Symmetry: $U_\alpha(\boldsymbol{s}') = U_\alpha(\boldsymbol{s})$ whenever $\boldsymbol{s}'$ is obtained from $\boldsymbol{s}$ by a permutation, so $\boldsymbol{s}' = \Pi \boldsymbol{s}$ for some permutation matrix, Π.

The symmetry condition (A2), also called anonymity, implies that what matters is the duration vector, but not the characteristics of the individual associated with a particular spell length, s_i. Personal features don´t enter into the aggregate unemployment index. Thus, two duration distributions for equal sized populations whose only difference is the order, must yield the same unemployment measure.

(A3) Replication invariance: $U_\alpha(\boldsymbol{s}') = U_\alpha(\boldsymbol{s})$ whenever $\boldsymbol{s}'$ is obtained from $\boldsymbol{s}$ by a replication of the labor force.

The replication invariance condition (A3) is a standard assumption when we have to compare population of different sizes. These three properties, normalization, symmetry and replication invariance, are satisfied by the unemployment rate, $U_0(\boldsymbol{s})$.

[4] Using the convention that $0^0 = 0$. This is the only member of this family that is not continuous in $\boldsymbol{s}$.

(A4) Monotonicity: $U_\alpha(\boldsymbol{s}') < U_\alpha(\boldsymbol{s})$ whenever $\boldsymbol{s}'$ is obtained from $\boldsymbol{s}$ by a spell reduction, so at least one element in $\boldsymbol{s}'$ is lower than the corresponding element in $\boldsymbol{s}$.

The monotonicity condition implies that the unemployment index should decrease if an unemployed experiences a shorter spell, or if an unemployed individual becomes employed. These four properties, normalization, symmetry, replication invariance and monotonicity, are satisfied by the *per capita duration* index, $U_1(\boldsymbol{s})$.

(A5) Preference for Duration Equality: $U_\alpha(\boldsymbol{s}') < U_\alpha(\boldsymbol{s})$ whenever $\boldsymbol{s}'$ is obtained from $\boldsymbol{s}$ by a spell equalization.[5]

The preference for duration inequality is the analogue of the Pigou-Dalton condition in the inequality literature. For a given total amount of unemployment time, $\Sigma_{i=1}^{n} s_i$, we exhibit a preference for a more egalitarian distribution. This condition is satisfied for the unemployment measures $U_\alpha(\boldsymbol{s})$ for $\alpha > 1$, but not for the unemployment rate or the *per capita duration* index. We may naturally assume that the marginal cost of unemployment is increasing with the length of the spell, so the welfare loss from unemployment increases, at an increasing rate, with unemployment duration.

The parameter α in $U_\alpha(\boldsymbol{s})$ governs the degree of the preference for duration equality, the higher the value the higher the preference for equality. As we shall see in the sequel, for values $\alpha > 2$ the inequality indices behind $U_\alpha(\boldsymbol{s})$ are unduly sensitive to the occurrence of large spell lengths which limits the range of feasible values of α in practice. Most of the applications use a value of $\alpha = 2$ (Shorrocks 2009a; Gradín, Cantó and del Río 2015), which according to Shorrocks (2009a) is not unreasonable, even arbitrary.[6]

[5] For a formal definition of 'spell equalization' see the appendix.

[6] Gorjón, de la Rica and Villar (2018) offer a similar model, derived from microeconomic principles, in which the final unemployment index is very similar to $U_\alpha(\boldsymbol{s})$, but includes a monetary cost unemployment related to income loss, different types of workers –so (A2) symmetry is lost– and our α is split as $1+\nu$ where ν is related to the probability of remaining unemployed. Under this interpretation, 2 is an upper bound to our α parameter, and a value slightly lower than this would be more appropriate. A complication that arises in this setting is that ν depends on the personal characteristics of the unemployed, and also on the particular moment of the business cycle.

In addition to the previous five properties, the family of inequality measures $U_\alpha(\boldsymbol{s})$ satisfies an additional attractive property. It is homogeneous with respect to the unemployment rate, so for a given duration distribution among the unemployed, the value of the index is proportional to the unemployment rate, that is, to the incidence factor.

(A6) Homogeneity with respect to the unemployment rate: $U_\alpha(\boldsymbol{s}') = \mu U_\alpha(\boldsymbol{s})$ whenever $\boldsymbol{s}'$ is obtained from $\boldsymbol{s}$ by a μ-***replication*** of the unemployed.[7]

This makes the family of unemployment measures $U_\alpha(\boldsymbol{s})$ a direct extension of the unemployment rate, so we can think of it as a generalized head-count ratio incorporating more features than just the number of unemployed and we can always separate the incidence from the other two factors, intensity and inequality.[8]

Two characteristics of the family of unemployment measures $U_\alpha(\boldsymbol{s})$ make it attractive from a practical point of view. First, it can be multiplicative decomposed into three terms taking into account the three aspects of unemployment: incidence, intensity and inequality. Hence we can measure de contribution of any of these aspects to the evolution of the unemployment measure.

It can be proved that for $\alpha > 1$ (Shorrocks 2009b)[9]

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[7] For a formal definition of 'spell equalization' see the appendix

[8] Among the single-parameter families of unemployment measures proposed by Shorrocks (2009a, 2009b) $U_\alpha(\boldsymbol{s})$ is not the only attractive one. Using the notion of 'equal equivalent value' of a distribution, introduced by the pioneering work of Atkinson (1970) in the context of inequality measurement, he proposed also the family of unemployment measures given by

$$U_\beta(\boldsymbol{s}) = \left[\frac{\sum_{i=1}^{n} s_i^\beta}{n}\right]^{1/\beta}, \quad \beta > 1 \qquad (2')$$

This family also satisfies (A1)-(A5), but not (A6), unemployment rate homogeneity, and cannot be expressed as a multiple of the unemployment rate. It satisfies, however, other property, duration homogeneity, this is $U_\beta(\lambda \boldsymbol{s}) = \lambda U_\beta(\boldsymbol{s})$ for all $\boldsymbol{s} \in S$ and all $\lambda > 0$, which is not satisfied by $U_\alpha(\boldsymbol{s})$.

$U_\beta(\boldsymbol{s})$ was also proposed by Paul (1992), and it is closely related to the work by Sengupta (2009) who also adopt a welfare approach to the development of unemployment measures through the concept of equally distributed equivalent employment in the economy. $U_\beta(\boldsymbol{s})$ is simply a power mean (Steel 2004; Chapter 8).

[9] See the technical appendix for a derivation of this decomposition.

$$U_\alpha(\boldsymbol{s}) = H.I^\alpha(1+E_\alpha^+) \tag{3}$$

where $I = \mu_q = \frac{\Sigma_{i=1}^q s_i}{q}$ is the *mean unemployment duration* or the mean of the duration distribution among the unemployed, and E_α^+ is an inequality index of the duration distribution for the unemployed closely related to the Generalized Entropy family (Shorrocks 1980). To be concrete

$$E_\alpha^+ = \frac{1}{q}\Sigma_{i=1}^q\left[\left(\frac{s_i}{\mu_q}\right)^\alpha - 1\right]$$

The multiplicative decomposition (3) shows clearly that $U_\alpha(\boldsymbol{s})$ is proportional to the unemployment rate, H, and can be used to decompose the change in the unemployment index into its three components: incidence, intensity and inequality.

For $\alpha = 2$ we get

$$U_2(\boldsymbol{s}) = H.I^2(1+E_2^+) \tag{4}$$

where $E_2^+ = \frac{1}{q}\frac{\Sigma_{i=1}^q(s_i-\mu_q)^2}{\mu_q} = C^2$, the squared of the coefficient of variation of the duration distribution among the unemployed. $U_2(\boldsymbol{s})$ can be written alternatively as $U_2(\boldsymbol{s}) = U_1(\boldsymbol{s}).I.(1+E_2^+)$, so $U_2(\boldsymbol{s})$ incorporates incidence and intensity components, through $U_1(\boldsymbol{s}) = H.I$, and also inequality through the term $I.(1+E_2^+)$. If there is no inequality within the spell durations of the unemployed $E_2^+ = 0$ and $U_2(\boldsymbol{s}) = U_1(\boldsymbol{s}).I$. In this case the difference between $U_2(\boldsymbol{s})$ and $U_1(\boldsymbol{s})$ would only come from inequality between the employed and the unemployed, as reflected in *I*.

Second, being of additive form $U_\alpha(\boldsymbol{s})$ satisfies a subgroup decomposability property. If the population of interest is partitioned into *G* exhaustive and mutually exclusive groups, so $\boldsymbol{s} = (\boldsymbol{s}^1, \boldsymbol{s}^2, ..., \boldsymbol{s}^G)$, with population sizes n_g, $g = 1, 2, ..., G$, we can write

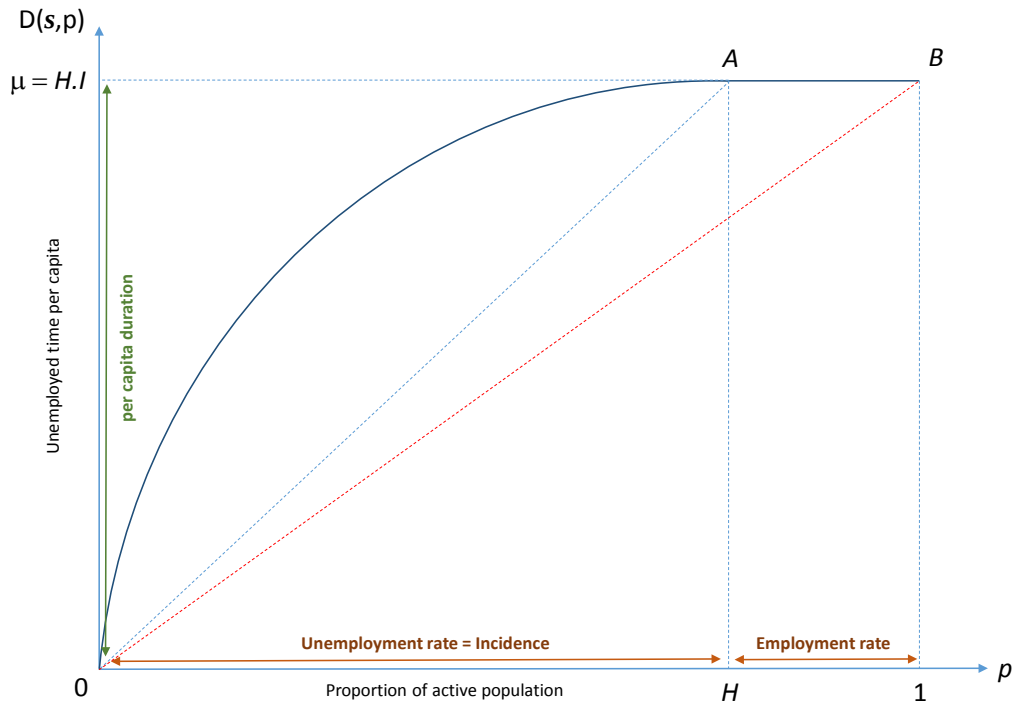
$$U_\alpha(\boldsymbol{s}) = \sum_{g=1}^{G} \frac{n_g}{n} U_\alpha(\boldsymbol{s}^g) \tag{5}$$

Hence the overall unemployment index is the population-share weighted sum of the sub-group unemployment indexes. This property implies that if unemployment grows in a sub-group of the population, while remains constant in the rest, then the aggregate unemployment index must grow. This property is known as sub-group monotonicity, and allows to break down the total unemployment index into several components. This decomposition was first introduced in the context of poverty measurement by Foster, Greer and Thorbecke (1984), and it is quite different from the additive decomposability used in the inequality measures (Shorrocks 1984), where we have between and within groups terms in the decomposition.

2.3. Duration profiles and duration dominance.

In the analysis of inequality a common graphical device is the Lorenz (1905) curve, which plots cumulative income shares again population shares after income have been ordered in a non-decreasing fashion. Ordering distributions by non-intersecting Lorenz curves correspond to unanimous inequality orderings according to a wide class of relative inequality measures that satisfies certain properties –essentially the Pigou-Dalton condition–. A similar result was established by Jenkins and Lambert (1997) for poverty orderings. They named the corresponding curve the "TIP" curve: "Three 'I´s of Poverty", from the incidence, intensity and inequality dimensions of poverty. However, Shorrocks (1993) established the same curves for unemployment indices before the "TIP" curve was developed by Jenkins and Lambert (1997), he named it duration profile.

Figure 1. Duration profile



For any $\boldsymbol{s} \in S$, the duration profile, $D(\boldsymbol{s}, p)$, is computed in a simple way. Just plot cumulative duration shares against population shares, after $\boldsymbol{s}$ has been ordered in a non-increasing order. Figure 1 depicts a typical duration profile. Since for the employed $s_i = 0$, the duration profile becomes horizontal at *per capita duration*, $\mu = H.I$, and at this point we read the unemployment rate on the horizontal axis, H. Mean unemployment duration, I, is given by the slope of the OA segment in figure 1. The concave part of the duration profile measures the inequality in the unemployment duration length distribution. If this curve were in fact a straight line, OA, then unemployment length would be shared equally by the unemployed. If total amount of unemployment time were shared equally among the labour force, the duration profile would be the straight line joining the origin with the last point of $D(\boldsymbol{s}, p)$, OB. In this case everybody is unemployed, so incidence is 100%. At the other extreme, when only one person is unemployed, and the population is large, the duration profile is just a straight line, μB, parallel to the horizontal axis. Unemployment increases as the duration profile shifts upwards. In fact a duration profile is nothing else that a rotated generalized Lorenz curve for unemployment spells (Shorrocks 1983).

A distribution $\boldsymbol{s}' \in S$ duration dominates $\boldsymbol{s} \in S$, in a weak form, whenever the curve of the former lies on or above of the latter. Shorrocks (2009b) established that if $\boldsymbol{s}' \in S$ duration dominates $\boldsymbol{s} \in S$, then $U_\alpha(\boldsymbol{s}') \geq U_\alpha(\boldsymbol{s})$ for $\alpha > 1$.[10] Hence the family of unemployment indices $U_\alpha(\boldsymbol{s})$ for $\alpha > 1$ is fully consistent with partial orderings that comes from dominance criteria of duration profiles, but the direct examination of duration profiles gives us a full picture of the evolution of unemployment in its three dimensions: incidence, intensity and inequality.

3. Unemployment measures in Spain.

3.1. Data description: Spanish Labour Force Survey.

This section applies the previous unemployment indices, and its properties, to the Spanish experience for the period $2001-2017$. The starting year is chosen for comparability reasons, since it was in 2001 when the International Labour Organization (ILO) definition of unemployment was implemented. Data comes from the microdata of the quarterly Spanish Labour Force Survey (LFS, *Encuesta de Población Activa*, *EPA*), covering approximately 65,000 households per quarter. Details on pre-processing of the data can be found in the appendix.

As it is well known –table 1 and figure 2– the unemployment rate in Spain reached its minimum in 2007, after a long period of growth, and experienced a huge rise from that year until 2013. Since then, the unemployment rate has been falling, at almost the same speed that it increased in the previous years. This is the general picture on incidence in the first years of the XXI century. However, out interest here is to go beyond incidence and introduce into the picture the unemployment spell duration distribution: intensity and inequality. The Great Recession has led to important changes in the labour market on the employment side, the growth in temporary and part-time contracts, but also on the unemployment side, with a dramatic increase in long term unemployment.

[10] This is in fact true for a wider class of unemployment indices, that includes not only $U_\alpha(\boldsymbol{s})$ and $U_\beta(\boldsymbol{s})$, but also all unemployment indices satisfying (A2)-(A5).

All dimensions, incidence, intensity and inequality, will be analysed separately, and an aggregate index of the $U_{\alpha}(s)$ will be constructed. Eventually, a decomposition analysis will be performed.

3.2. The unemployment burden.

Spanish unemployment has always been high relative to our European neighbors. After a long period of growth, which exhibited a decreasing tendency in the unemployment rate since the beginning of the nineties the share of people in the unemployment pool reached its minimum in 2007 with an 8.2% –table 1–, a figure that is not low given the growth rate of the economy at the time. After 2007, when the property bubble burst, jobs were destroyed quicker than they were created and unemployment grew very rapidly. In two years the unemployment rate more than doubled, in the next two years the unemployment rate exceeded 20% and in 2013 it reached its maximum with more than a quarter of the active population jobless, 26.1%. Only in recent years has unemployment began to decrease, and in 2017 the unemployment rate is at the level of 2009, more than double than in 2007.

This general picture is well known, but the main question here is to what extent the duration sensitive unemployment indexes introduced in the previous section shed a different perspective on the behavior of the labor market. What the Great Recession has fundamentally changed is the temporal structure of the unemployed, the spell duration of the unemployment.[11] This is quite clear if we break down the unemployment rate by duration, short *versus* long unemployment rate, where the long term unemployed are those who are more than 12 months seeking actively, but unsuccessfully, for a job –figure 2–.[12]

[11] This is not the only feature that has dramatically changed in the Spanish labor market after 2007. The structure of contracts, permanent *versus* temporary and full *versus* part time, have also been altered in a substantial way, but we focus here only on spell duration.

[12] Short and long run unemployment rates are standard unemployment rates where the numerator includes only short or long run unemployed, and the denominator includes de full active population. Hence, adding both rates yields the standard unemployment rate –table 1–.

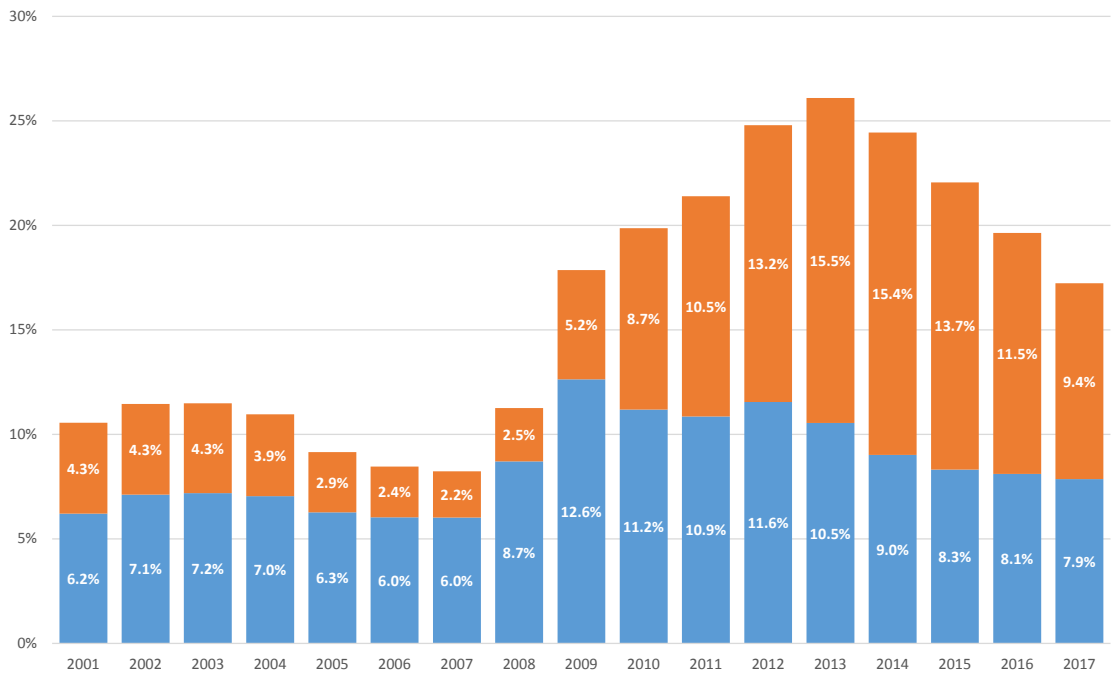
Table 1 - Unemployment statistics

YEAR	Unemployment rate (*H*)	Mean Unemployment Duration (*I*)	Per capita Duration Index ($U_1(\alpha)$)	Inequality Index E_2^+	Unemployment Index ($U_2(\alpha)$)
2001	10.6%	21.5	2.27	2.25	158.2
2002	11.5%	18.9	2.16	2.39	138.0
2003	11.5%	18.2	2.09	2.37	128.7
2004	11.0%	17.5	1.92	2.44	115.5
2005	9.1%	16.2	1.49	3.28	103.3
2006	8.5%	14.4	1.22	3.59	80.6
2007	8.2%	13.6	1.12	3.69	71.7
2008	11.3%	11.5	1.29	4.02	74.1
2009	17.9%	12.6	2.25	2.76	106.5
2010	19.9%	16.1	3.20	1.90	150.1
2011	21.4%	18.8	4.02	1.63	199.1
2012	24.8%	21.5	5.33	1.49	284.7
2013	26.1%	25.2	6.57	1.30	380.9
2014	24.4%	29.1	7.11	1.21	456.1
2015	22.1%	31.9	7.03	1.22	498.4
2016	19.6%	32.1	6.30	1.32	468.4
2017	17.2%	31.1	5.36	1.51	418.8

Source: LFS - INE and own elaboration

In 2007 the long run unemployed represented a quarter of the total, with a rate of only 2.2%, much lower than the short run unemployment rate, 6.0%. Ten years later, the long run unemployment rate was 9.4%, higher than the short run unemployment rate, 7.9%, but it reached 15.5% in 2013. This highlights that one of the actual concerns about the Spanish economy is the unprecedented rise in long-term unemployment during the recent crisis (Jansen, Jiménez-Martín y Gorjón 2016). It´s worth noting that from 2009 the short run unemployment rate exhibits a slightly decreasing tendency, with a small peak in 2012. In this year long run unemployed surpasses short run unemployed, 3.1 million against 2.7 million, which has been higher since then. This fact is more shocking if we focus on the very long term unemployed, persons that have been unemployed for more than two years, as we shall see in the sequel. In short, our unemployment problem is essentially a long term unemployment question, whose strong growth in recent years is a particular reason for concern.

Figure 2 - Short *versus* long unemployment rate

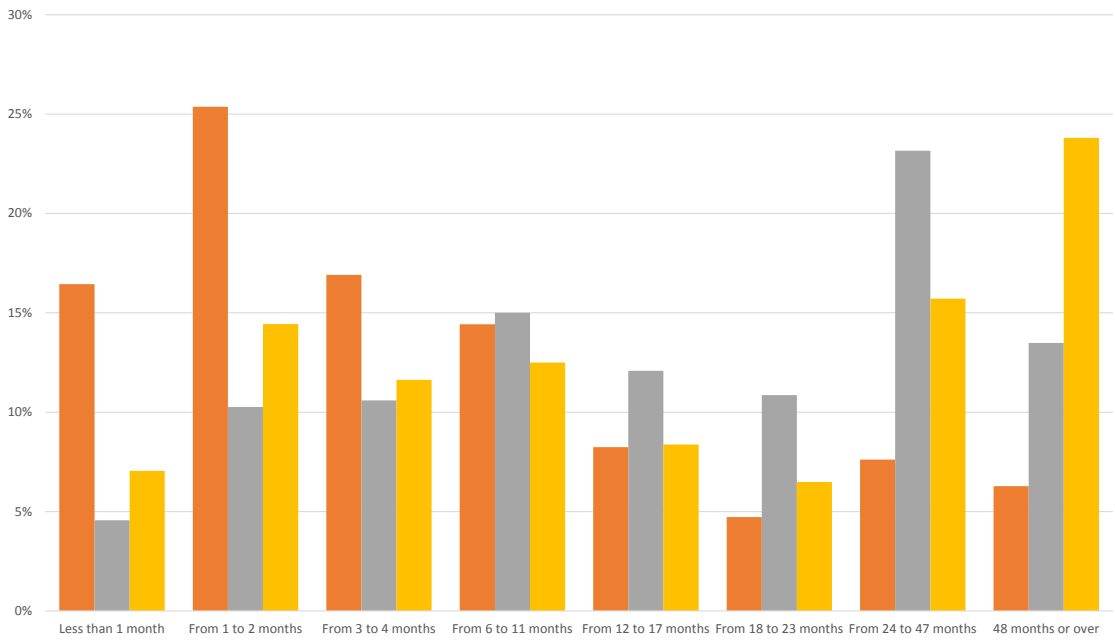


Source: LFS - INE and own elaboration

An alternative way to see this is by looking at the changes in the unemployment spell duration distribution –figure 3–. Previous to the crisis spell duration was rather short for the majority of unemployed, not more than 2 months for about 40% of the unemployed, and only 14% of the unemployment spells lasted for more than 2 years. In 2017 the duration distribution has switched the tails, 40% of the unemployed have spells longer than 2 years, while around 20% are unemployed less than 2 months.

All these changes in the duration distribution mean than introducing spell duration into the unemployment indexes can potentially bring a different picture on the evolution of the unemployment in the economy. In fact, mean unemployment duration, *I*, which was around a year at the beginning of the crisis, has not only increased substantially since then, but has exhibited a permanent increment until 2016, three years later after the maximum value of the unemployment rate, *H*, –table 1–. Similar tendencies can be observed for the per capita duration index, $U_1(s)$, that peaks in 2014, but increases by a factor of almost 5 between 2007 and 2017, signaling the huge effect of the increment in spell duration, and also in the distributionally sensitive unemployment index with $\alpha = 2$, $U_2(s)$, that peaks in 2015, but increases by a factor of almost 6 between 2007 and 2017 –table 1–.

Figure 3 - Unemployment spell duration distribution



Source: LFS - INE and own elaboration

Since to examine duration dominance the best course of action is to examine duration profiles directly (Shorrocks 2009b), we do so for selected years: 2001, 2007, 2013 and 2017 –figure 4–. This gives us a full picture of the unemployment ranking between these years with interesting results. The last years of the pre-recession scenario, 2001 – 2007, show an unambiguous fall in unemployment. The 2001 duration profile clearly dominates the 2007 one, so any unemployment index satisfying (A2)-(A5) will show a decrease in unemployment. The officially labeled crisis years, 2007 – 2013, lead us to the opposite conclusion. The 2013 duration profile clearly dominates the 2007 one by a large extent,[13] so unemployment was definitively higher in 2013 than in 2007 by any unemployment index with sensible properties, despite the reduction in inequality in spell duration among the unemployed. However, the comparison between 2013 and the last available year, 2017, is less clear-cut. The duration profiles between these two years intersect at about the 10th percentile of the population. Clearly, the unemployment rate has fallen by a great extent, from 26.1% to 17.2%, and also per capita duration index, $U_1(\boldsymbol{s})$, but in this case by a much lower amount, from 6.6 to 5.4 months per active person, but with mean unemployment duration, *I*, increasing

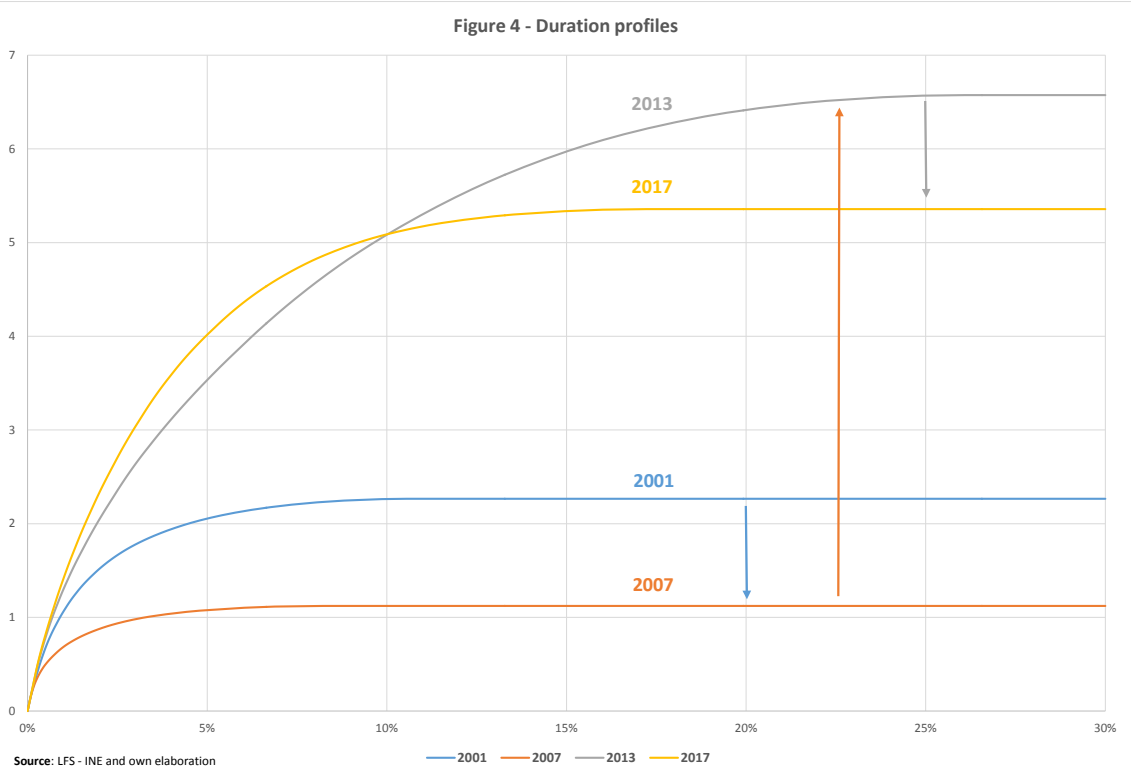
[13] And also dominates the 2001 duration profile, so in 2013 we were clearly worst-off than, not only in 2007, but also than in 2001.

substantially, from 25 to 31 months per unemployed person, and inequality also raising, the unemployment index for $\alpha = 2$, $U_2(\boldsymbol{s})$, indicates that we have in fact higher unemployment in 2017 than in 2013.[14] Hence $U_2(\boldsymbol{s})$, which incorporates spell duration and its distribution into the measure of unemployment, gives us a less optimistic view of the effects of growth on the economy than simply looking at the unemployment rate. What the data shows is that people leaving the unemployment pool are not the unemployed with longer than average spells, on the contrary, unemployed with much shorter spells. So the long, and specially the very long term unemployed are being left behind by the current recovery, at least for the moment.

Given that the 2013 and 2017 duration profiles intersect, there is no unanimous ranking between both unemployment distributions. For $\alpha = 2$, $U_2(\boldsymbol{s})$ indicates that the unemployment is in fact higher in 2017 than in 2013 –contrary to what the unemployment rate indicates–, because we attach enough weight to long spells and the associated inequality. A little of experimentation showed that $U_\alpha(\boldsymbol{s})$ ranks both distributions in the same way that the unemployment rate, *H*, for values not exceeding $\alpha = 1.6$.

Summing up, duration profiles, and the associated $U_\alpha(\boldsymbol{s})$ indexes, provide a quick way to check if two unemployment distributions can be ranked unambiguously with a minimum set of assumptions, essentially monotonicity and preference for duration equality. In our case, ranking is unambiguous when we compare 2001 against 2007 and this year against 2013, but between 2013 and 2017 there is room for disagreement. If we are not concerned about duration inequality then unemployment falls, but with a moderate concern about the distribution of spell duration we are still worst off in 2017 than in 2013 in relation to the unemployment. Given the way in which these curves intersect, the 2013 duration profile intersects from below the 2007 duration profile, this results indicate that the employment creation is leaving behind the long and very long term unemployed (Jansen, Jiménez-Martín y Gorjón 2016).

[14] Even if this index shows a decreasing tendency since 2015 –table 1–.



3.3. A decomposition analysis.

Since labor market outcomes affect differently to various groups in the population it seems of interest to investigate the contribution of these groups to the aggregate unemployment indexes.

This contribution is measured directly by its relative demographic importance –as shown by the first factor in formula (5)–, which is offered in table 2. By sex, contribution is fairly stable along the period, but females exhibits an increasing tendency in its demographic importance. By place of birth, foreigners multiply by 3 its importance in the active population between 2001 and 2010, especially evident in the years before the crisis, since then its share in the active population has fallen slightly. In any case, for this partition of the population the aggregate unemployment index is clearly dominated by Spanish born individuals. By region, contributions are fairly stable and they tend to reflect the demographic importance of the region itself. The leading regions are Andalucía, Cataluña, Madrid and Comunidad Valenciana. By educational attainment, an important relative change in demographic importance is seen between extreme groups. Distinguishing between three groups, up to primary education –including persons with no or little education–, secondary education –part of which is compulsory– and tertiary

education –persons holding a university degree or equivalent–, we see that the lowest educated group shows a decreasing tendency in its demographic importance and the contrary happens with the highest educated group, whose relative importance in the aggregate index increases by 11 percentage points (pp) along the period. This means that the aggregate index is more dependent by the unemployment index of this group at the end of the period than at the beginning. Eventually, by age groups we find a similar evolution than for educational attainment. The young –between 16 and 24 years– show a decreasing tendency in its demographic importance, whereas the old workers –those with 55 and more years– show an increasing tendency. Overall the aggregate index is dominated for the middle age distribution workers –those between 25 and 54 years–.

Even if the relative contribution of the different subgroups of the population is important to track the aggregate unemployment index, we find more interesting to look directly at the evolution of unemployment indexes by subgroups of the population. The crisis has had a very unequal impact across different groups of workers. Table 3 offers some unemployment statistics for the same partitions included in table 2 and confirms some well-known facts, but also unveils some interesting ones when unemployment duration and its distribution is brought into the analysis.[15]

[15] The aggregate evolution shown in table 1 is obtained by the combination of information in tables 2 and 3.

Table 2 - Group contribution to the overall unemployment index by year: Share of active population

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Sex	Male	60.8%	59.9%	59.3%	58.8%	58.5%	57.9%	57.5%	56.9%	56.0%	55.5%	54.9%	54.3%	54.0%	53.8%	53.7%	53.5%	53.5%
	Female	39.2%	40.1%	40.7%	41.2%	41.5%	42.1%	42.5%	43.1%	44.0%	44.5%	45.1%	45.7%	46.0%	46.2%	46.3%	46.5%	46.5%
Nacionality	Spanish	93.8%	91.5%	89.7%	88.3%	86.6%	85.1%	83.6%	82.4%	81.8%	81.8%	81.9%	82.3%	83.1%	83.5%	83.4%	83.2%	83.0%
	Foreigner	6.2%	8.5%	10.3%	11.7%	13.4%	14.9%	16.4%	17.6%	18.2%	18.2%	18.1%	17.7%	16.9%	16.5%	16.6%	16.8%	17.0%
Region of residence	Andalucía	16.4%	16.7%	16.5%	16.5%	16.5%	16.5%	16.6%	16.7%	16.9%	17.0%	17.1%	17.3%	17.4%	17.6%	17.6%	17.5%	17.4%
	Aragón	2.8%	2.8%	2.8%	2.8%	2.9%	2.9%	2.9%	2.9%	2.9%	2.8%	2.8%	2.9%	2.8%	2.8%	2.8%	2.8%	2.8%
	Asturias	2.2%	2.2%	2.2%	2.1%	2.1%	2.2%	2.1%	2.2%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.0%	2.1%	2.0%
	Baleares	2.3%	2.3%	2.4%	2.4%	2.4%	2.4%	2.4%	2.5%	2.5%	2.6%	2.5%	2.6%	2.6%	2.6%	2.7%	2.7%	2.7%
	Canarias	4.4%	4.3%	4.4%	4.4%	4.4%	4.5%	4.4%	4.4%	4.5%	4.5%	4.6%	4.7%	4.7%	4.8%	4.8%	4.8%	4.8%
	Cantabria	1.3%	1.2%	1.3%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
	Castilla-León	5.6%	5.4%	5.4%	5.3%	5.3%	5.2%	5.2%	5.2%	5.1%	5.1%	5.1%	5.1%	5.0%	5.1%	5.0%	5.0%	5.0%
	Castilla-La Mancha	3.9%	3.9%	3.9%	3.9%	4.0%	4.1%	4.2%	4.2%	4.3%	4.3%	4.4%	4.3%	4.4%	4.4%	4.3%	4.3%	4.3%
	Cataluña	17.1%	17.1%	17.3%	17.2%	17.1%	17.1%	17.1%	17.0%	16.9%	16.9%	16.9%	16.7%	16.7%	16.6%	16.5%	16.6%	16.6%
	Comunidad Valenciana	10.5%	10.6%	10.7%	10.8%	10.8%	10.8%	10.9%	10.9%	10.9%	10.7%	10.6%	10.6%	10.6%	10.6%	10.6%	10.7%	10.7%
	Extremadura	2.2%	2.3%	2.2%	2.2%	2.2%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%
	Galicia	6.4%	6.2%	6.2%	6.2%	5.9%	5.8%	5.8%	5.7%	5.7%	5.6%	5.6%	5.6%	5.6%	5.5%	5.5%	5.5%	5.5%
	Madrid	14.2%	14.5%	14.4%	14.5%	14.8%	14.8%	14.9%	14.9%	14.9%	15.0%	14.7%	14.8%	14.6%	14.6%	14.8%	14.7%	14.8%
	Murcia	2.9%	2.9%	3.0%	3.0%	3.0%	3.0%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%
	Navarra	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%	1.4%
	País Vasco	5.4%	5.2%	5.1%	5.1%	4.9%	4.9%	4.8%	4.7%	4.6%	4.6%	4.7%	4.6%	4.5%	4.5%	4.5%	4.5%	4.5%
	La Rioja	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
	Ceuta y Melilla	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Education	Primary	24.1%	22.7%	21.0%	19.7%	17.2%	16.1%	15.7%	15.7%	15.2%	14.5%	13.1%	12.1%	11.2%	9.5%	8.7%	8.1%	7.5%
	Secondary	47.9%	48.4%	49.8%	50.1%	51.1%	52.1%	52.1%	52.2%	52.4%	52.0%	52.5%	52.7%	52.5%	53.3%	53.7%	53.6%	53.5%
	Tertiary	28.0%	28.8%	29.3%	30.3%	31.7%	31.8%	32.2%	32.1%	32.5%	33.5%	34.4%	35.2%	36.3%	37.2%	37.6%	38.3%	39.0%
Age group	16-24	13.5%	13.0%	12.4%	11.9%	11.9%	11.4%	11.0%	10.5%	9.6%	8.9%	8.3%	7.7%	7.4%	7.0%	6.8%	6.5%	6.6%
	25-54	77.9%	78.5%	79.0%	79.3%	78.9%	79.3%	79.7%	79.9%	80.6%	81.2%	81.4%	81.5%	81.5%	81.4%	80.8%	80.3%	79.5%
	55 and more	8.5%	8.5%	8.5%	8.8%	9.2%	9.2%	9.4%	9.6%	9.7%	10.0%	10.4%	10.8%	11.1%	11.6%	12.4%	13.2%	13.9%

Source: LFS - INE and own elaboration

Table 3 - Unemployment statistics by different partitions of the population

		2001			2007			2013			2017		
		Unemployment rate (H)	Mean Unemployment Duration (I)	Unemployment Index ($U_2(\alpha)$)	Unemployment rate (H)	Mean Unemployment Duration (I)	Unemployment Index ($U_2(\alpha)$)	Unemployment rate (H)	Mean Unemployment Duration (I)	Unemployment Index ($U_2(\alpha)$)	Unemployment rate (H)	Mean Unemployment Duration (I)	Unemployment Index ($U_2(\alpha)$)
Sex	**Male**	7.5%	17.8	88.3	6.4%	11.4	37.8	25.6%	23.8	302.9	15.7%	30.0	344.9
	Female	15.2%	24.3	266.7	10.7%	15.5	117.5	26.7%	26.8	472.5	19.0%	32.1	503.9
Nacionality	**Spanish**	10.4%	22.1	162.2	7.6%	15.2	78.0	24.1%	26.1	383.3	16.0%	32.6	418.6
	Foreigner	13.2%	13.5	96.7	11.6%	8.5	39.3	35.7%	22.1	369.5	23.3%	26.2	419.9
Region of residence	**Andalucía**	18.7%	21.1	261.8	12.8%	15.5	136.8	36.2%	27.9	645.0	25.5%	32.2	655.3
	Aragón	5.0%	14.9	40.5	5.3%	11.0	36.6	21.4%	22.3	250.7	11.6%	27.9	248.7
	Asturias	7.7%	28.7	169.1	8.4%	20.2	111.0	24.1%	26.2	396.2	13.7%	34.5	379.4
	Baleares	5.9%	9.7	17.7	7.2%	7.0	14.1	22.3%	19.2	202.0	12.4%	19.0	170.0
	Canarias	10.8%	15.4	83.7	10.5%	14.3	100.4	33.7%	27.5	560.3	23.5%	33.9	681.8
	Cantabria	8.7%	28.8	169.0	6.0%	12.9	40.5	20.4%	23.2	247.5	13.6%	31.3	328.5
	Castilla-León	10.1%	25.7	185.6	7.1%	15.3	77.8	21.7%	23.6	285.6	14.1%	30.5	337.4
	Castilla-La Mancha	9.5%	16.7	83.7	7.7%	12.3	53.2	30.0%	25.5	418.1	20.8%	32.3	514.1
	Cataluña	8.6%	22.2	141.9	6.5%	10.8	32.6	23.1%	22.3	249.7	13.4%	28.6	280.2
	Comunidad Valenciana	9.4%	19.1	121.8	8.7%	9.9	41.0	28.0%	26.1	441.0	18.2%	31.8	459.5
	Extremadura	14.5%	14.6	102.8	13.0%	17.4	162.5	33.9%	25.0	509.3	26.2%	33.0	668.0
	Galicia	11.0%	25.1	194.6	7.6%	17.7	98.7	22.0%	26.0	361.1	15.7%	33.1	414.5
	Madrid	7.6%	22.5	129.0	6.2%	13.4	60.5	19.8%	23.7	247.7	13.3%	29.4	284.4
	Murcia	10.7%	13.9	78.3	7.5%	10.3	43.2	29.0%	24.8	404.5	18.0%	30.3	453.2
	Navarra	4.9%	15.4	49.0	4.7%	12.3	35.3	17.9%	19.4	162.1	10.2%	25.8	200.0
	País Vasco	9.8%	34.1	306.0	6.2%	15.8	69.1	16.6%	24.9	247.8	11.3%	33.7	298.8
	La Rioja	4.5%	21.0	88.8	5.8%	10.6	27.0	20.0%	22.6	262.9	12.0%	29.1	256.8
	Ceuta y Melilla	5.2%	25.4	95.6	19.6%	20.9	214.8	33.7%	29.0	595.1	25.0%	38.4	766.2
Education	**Primary**	11.1%	23.3	196.0	11.0%	16.1	123.7	40.3%	31.2	815.6	31.4%	39.4	1075.2
	Secondary	11.6%	21.2	171.3	9.2%	12.8	73.5	30.0%	25.1	440.6	20.5%	31.4	506.9
	Tertiary	8.3%	20.0	103.1	5.3%	13.4	43.4	16.0%	20.7	160.2	10.0%	25.3	172.2
Age group	**16-24**	21.1%	12.0	80.9	18.1%	7.5	42.8	55.5%	17.3	373.5	38.6%	14.8	252.9
	25-54	9.2%	24.3	168.0	7.2%	14.2	66.6	24.4%	25.4	355.9	15.9%	31.2	381.3
	55 and more	6.0%	35.3	191.3	5.6%	30.2	149.1	18.9%	38.5	570.5	14.6%	51.3	712.8

Source: LFS - INE and own elaboration

Unemployment is higher for females than for males in all dimensions –incidence, intensity and inequality– and periods, but data shows than the recent crisis has been more detrimental for males than for females, and also than the recovery has been slightly more beneficial for males. Unemployment indices, and mean unemployment duration, are much higher, for both sexes, in 2017 than in 2001 or 2007, but the differences between males and females are narrower.

Given the higher values of the unemployment indexes for females her contribution to the unemployment indexes is higher for them than for males. For $U_2(\boldsymbol{s})$ their contribution is between 55% and 70%, despite representing only about 45% of the total active population.

By place of birth, the unemployment rate is always higher for foreigners than for nationals. The differential were only 3 percentage points (pp) in 2001, around 10 pp in 2013, and it is, in 2017, around 7 pp. On the contrary, unemployment spell duration is much lower for foreigners than for nationals. Foreigners have more mobility and willingness to accept lower paid jobs, often requiring poor qualifications. As a consequence, they stay less time in the unemployment pool. The result is that the unemployment index $U_2(\boldsymbol{s})$ is lower for foreigners, so, taking into account duration and inequality in the spell duration distribution, foreigners have lower unemployment than nationals in all years shown in table 3 except 2017, in which the unemployment index $U_2(\boldsymbol{s})$ is similar. To understand these opposite tendencies in the different components of the unemployment index we have to take into account the different situation of migrants, lower familiar network support, more difficulties in accessing unemployment benefits and also the evolution of the active population during the crisis years.

Unemployment heterogeneity across regions is huge, even in the pre-recession years. This is also the rule for mean unemployment duration and for $U_2(\boldsymbol{s})$. Contrary to what happens at the aggregate level, for some regions the unemployment index $U_2(\boldsymbol{s})$ in 2017 is lower than in 2013. They are Aragón, Asturias, Baleares and La Rioja.

Taking into account educational attainment, and distinguishing between three groups, up to primary education –including persons with no or little education–,

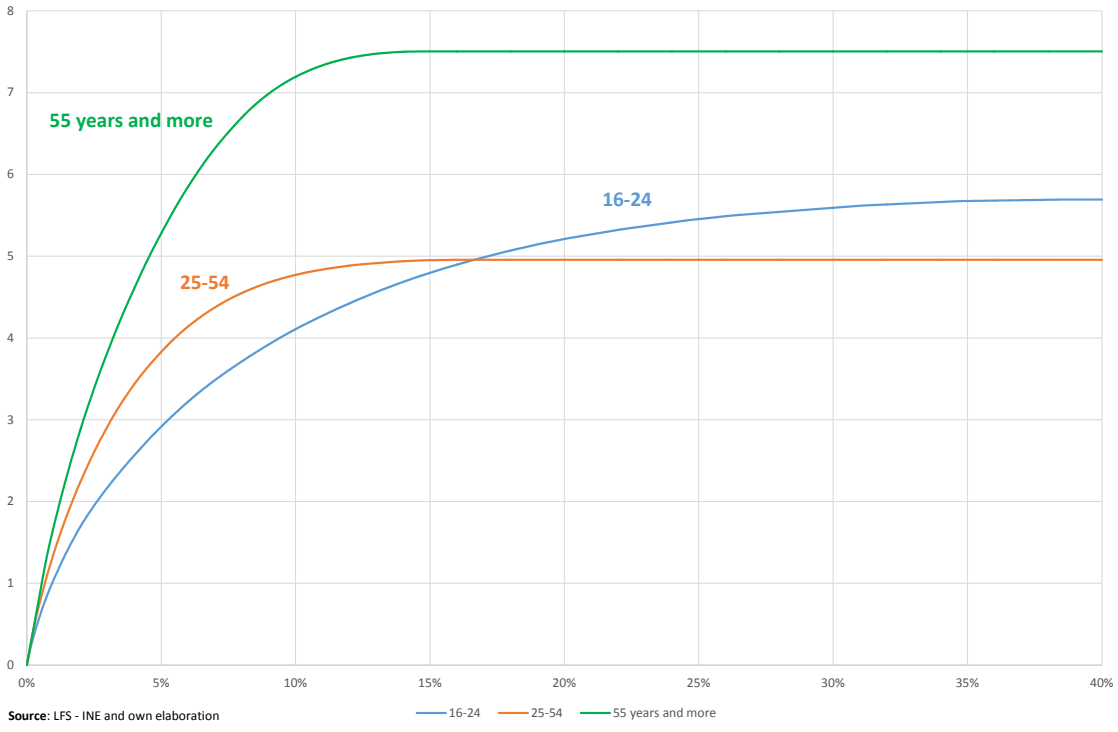
secondary education –part of which is compulsory– and tertiary education –persons holding a university degree or equivalent– we get the standard pattern. Low educated workers are the main victims of the crisis. In 2013 their unemployment rate was 40.3%, more than doubling the unemployment rate for workers with tertiary education, 16.0%. In addition, they stay longer in the unemployment pool, in 2017 mean unemployment duration for workers with up to primary education is almost 40 months. On the other side of the distribution, workers with a university, or equivalent, degree enjoy lower unemployment rates and stay less time unemployed. Duration profiles show that, for a given year, unemployment is unambiguously higher the lower the educational level. In fact, decomposing $U_2(\boldsymbol{s})$ by groups using (5) we get the persons with low education accounts, in 2017, for about 20% of the unemployment index, even if they only represents about 8% of the active population. The opposite happens with the group of persons with tertiary education, which in this year accounts for only 16% of the unemployment index, but they account for about 39% of the active population.

Breaking down the unemployment by age groups, the young –between 16 and 24 years–, the middle age distribution –between 25 and 54 years– and the old workers –those with 55 and more years–, yields interesting results. Judging the differences only by the unemployment rate reveals, as is well known, that the most vulnerable group is the young, with an unemployment rate significantly higher than the other two groups, and that reached 55.5% in 2013 and 38.6% in 2017, still 20 pp higher than in 2007, and clearly unsustainably high. The lowest unemployment rate is exhibited by the oldest group. However, looking at unemployment duration turns the tables completely. Young persons exhibited lower mean unemployment duration and unemployment index $U_2(\boldsymbol{s})$, but older workers show a substantially high mean unemployment duration and unemployment index $U_2(\boldsymbol{s})$. In fact if we choose any index in the family $U_\alpha(\boldsymbol{s})$ for $\alpha \geq 1$ we get a completely different result, the most vulnerable group is the oldest person. The reason should be clear, if you are 55 or above and employed, then you have less chance to become unemployed, but if you are fired, then you will probably never get out of the unemployment pool in the rest of your remaining working life. Note that mean unemployment duration for this group of people is in excess of 50 months in 2017.

Hence if spell duration is important, it is quite likely that the most vulnerable group is not the youngest, but the oldest.

Examining the duration profiles for 2017 for these age groups –figure 5– shed some light of the situation. The duration profile for the oldest group clearly dominates, not only the middle age persons, whose unemployment rate is a slightly higher, but also, and by a large extent, the youngest, despite having an unemployment rate more than 20 pp higher. In this situation, for any index in the family $U_\alpha(\mathbf{s})$ for $\alpha \geq 1$ our unemployment measures indicates that the oldest are in a worst-off situation than the young regarding to unemployment. For other years we get similar results.

Figure 5 - Duration profiles by age group - 2017



Source: LFS - INE and own elaboration

4. Final comments.

This paper has presented concisely one of the families of duration sensitive unemployment indexes developed by Shorrocks (2009b). An application with the Spanish Labor Force Survey for the period $2001-2017$ is offered. In addition to incorporating in a single index the 3 dimensions of unemployment: incidence, intensity and inequality, this family of indexes, and its components, are able to shed some light into the consequences of the crisis and the recent recovery.

In particular, at the aggregate level, the huge increment in the long and very long term unemployed persons after the Great Recession indicates that spell duration, and also the inequality in the distribution, should be taken into account when measuring unemployment in a comprehensive manner. When we do so, the fall in the unemployment rate from 2013 offers a less optimistic view of the recent recovery. In fact, for sensible values of the inequality aversion parameter, α exceeding 1.6, we get that unemployment is still higher in 2017 than in 2013, even with a decreasing tendency. The reason is that the persons that are exiting from the unemployment pool are short term unemployed, and the long term unemployed are being left behind by the recent economic growth. The 2013 unemployment duration profile does not dominate the 2017 profile, so we cannot say unambiguously that unemployment in 2017 is lower than in 2013.

Looking at different partitions of the active population we get some of the well known facts about the behavior of the labor market in Spain, but also new ones. The most surprising is, probably, that introducing spell duration and its distribution into unemployment measures may bring in other groups into the set of most vulnerable workers. The clear example is the workers in the last years of their working life, they enjoy the lower unemployment rate, but also the highest unemployment index when unemployment duration and a preference for equality are introduced into unemployment measures. The duration profiles are easy to build, intuitive and highly informative.

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Data Appendix

All data used in the paper come from microdata of the Spanish Labour Force Survey (LFS, *Encuesta de Población Activa*, *EPA*). These are available at the webpage of the Spanish National Statistical Institute (INE, http://www.ine.es/). The LFS is a quarterly survey covering approximately 65,000 households each quarter, around 180,000 individuals. From the original data we extracted only the information for the active population individuals, which gave us in excess of 5 million records for the complete period, 2001 – 2017.

The LFS survey reports imperfect information on unemployment duration from two questions: (*i*) '*How long have you been looking for a job?*' (DTBUS/ITBU), and (*ii*) '*How long has it been since your last job?*' (DTANT).

The information on spell duration provided by the LFS is imperfect for at least two reasons. First of all, it relates to the so called ´interrupted spell´ length of a given stock of unemployed (Salant 1977, Akerlof and Maine 1981). This is a consequence of the statistical source of the information used, a rotating panel. It is well known that an interrupted spell is not a good measure of the real spell duration actually experienced by an individual, and the difference between the interrupted spell, recorded at the time of the interview, and the complete spell can be huge. At the end of the day what matters for an unemployed is the total time he has been unemployed before finding a new job (or exiting the labour force), not the time he has been unemployed at the time of the survey. But this is how the statistical information is generated. As mentioned in the text, we make no attempt to correct this. In fact, we are interested in adding the spell duration dimension to the unemployment rate usually reported to monitor the labour market within the same statistical framework. So these measures can be routinely computed along the standard unemployment rate.

Second, the answer to the previous question does not guarantee that the person has been unemployed all the time since he began looking for a new job, or since he lost his previous employment. In the first case, he could be employed for several short periods of time, but still looking for a new job during these periods. In other words, data does not take into account multiple spells experienced by a given person. In the second

case, he could be inactive part of the time, but again active and unemployed at the moment of the interview. Again, this is a consequence of how the information is gathered, since the LFS does not record the history of individuals, but only the situation at a particular moment in time. We take these imperfections as given.

The INE derives duration information for the unemployed from the first one: '*How long have you been looking for a job?*' (DTBUS/ITBU), but both have been used in the analysis of unemployment duration in Spain (Bover and Gómez 1999; Bover, Arellano and Bentolila 2002). The information about '*looking for a job*' is recorded in months for the period 2001 – 2004 (DTBUS), but from 2005 onwards this information is recorded as a categorical variable (ITBU) in 8 intervals:

- Less than 1 month
- From 1 to 2 months
- From 3 to 5 months
- From 6 to 11 months
- From 12 to 17 months
- From 18 to 23 months
- From 24 to 47 months
- 48 months or over

This information is not restricted to unemployed people, since some employed persons also declare being looking for a different job.

The information about '*since the last job*' is also recorded in months, but is available for the complete period, 2001 – 2017 (DTANT). Within the active population, this information is available only for the unemployed who were previously employed.

Inspection of both variables for the period in which level record information is available, 2001 – 2004, revealed that they are quite different from a quantitative point of view. The correlation coefficient among them is only 0.55. DTANT not only shows a higher mean than DTBUS, 26 against 20 months, but also greater volatility. DTBUS is truncated at 180 months, whereas DTANT doesn´t, and shows a few implausible very high values, in excess of 600 months.

Since we are interested in getting individual information, and also be consistent with published official data we decided to use the information from: '*How long have you been looking for a job?*' (DTBUS/ITBU). This is also the option of other researches using

the European LFS (Gradín, Cantó y del Río 2015). For the period 2001 – 2004, this implies using DTBUS, but for the period 2005 – 2016 we have to impute a value at record level consistent with the information in ITBU. The imputation method is as follows. If the value of DTANT is consistent with interval in ITBU, we take this as the number of months that the unemployed has been looking for a job. Unfortunately, this only happens in about 50% of the cases. For the rest of the records, we impute randomly a month consistent with the interval of ITBU, using weights derived from the empirical distribution of the values of DTANT consistent with interval in ITBU we are imputing. The empirical distribution is not far from the uniform distribution, with the exception of the last, open ended interval. For this interval, the imputed values are truncated at 180 months.

Once we have a value for the time the individual has been looking for a new job we generate the spell variable as this value plus 0.5, since the information in the survey always refers to completed months.

This procedure respects aggregate information for the intervals defined in ITBU, and generates variability at individual level. The alternative, assuming a uniform distribution of spell duration within the interval, bias downward the inequality component in unemployment measures that take into account distributional factors. In addition, a uniform distribution cannot be implemented for the last open ended interval. In this case the standard procedure seems to fix the duration at the lower limit (Shorrocks 2009a, Gradín, Cantó y del Río 2015), 48 months in our case. This is the simplest method without having to rely on a particular probability distribution at the right tail, but it is also the most conservative approach. In fact it is too conservative. Data analisis for the period 2001 – 2004, when we have the exact number of months the unemployed have been looking for a job, shows clearly that this rule bias downward the duration by a significant extend, even in periods of much lower unemployment than during the Great Recession. For this reason, we think that our imputation rule provides a more realistic picture of the unemployment duration.

Technical Appendix

The following **properties** appear in the text:

- The distribution $\boldsymbol{s}' \in S$ is a ***permutation*** of $\boldsymbol{s} \in S$ if both have the same size and $\boldsymbol{s}' = \Pi \boldsymbol{s}$ for some permutation matrix, Π, of the appropriate dimension.

  A decreasingly ordered distribution is just a permutation of an unordered distribution, where Π reorders the elements of the original distribution in the appropriate way.

- The distribution $\boldsymbol{s}' \in S$ is obtained from $\boldsymbol{s} \in S$ by a ***replication*** if the size of $\boldsymbol{s}'$, n', is a positive integer multiple, μ, of the size of $\boldsymbol{s}$, so $n' = \mu n$, and if $\boldsymbol{s}'$ can be partitioned in the form $\boldsymbol{s}' = (\underbrace{\boldsymbol{s}, \boldsymbol{s}, ..., \boldsymbol{s}}_{\mu})$.

- The distribution $\boldsymbol{s}' \in S$ is obtained from $\boldsymbol{s} \in S$ by a ***spell reduction*** if both have the same size and $\boldsymbol{s}' = T(\boldsymbol{s})$ for some transformation $T : S \to S$ satisfying

$$0 \leq s_i' < s_i \quad \text{for some } i; \quad s_j' = s_j \quad \text{for } j \neq i$$

- The distribution $\boldsymbol{s}' \in S$ is obtained from $\boldsymbol{s} \in S$ by a ***spell equalization*** if both have the same size and there exists i and j such that

$$s_i > s_i' > s_j; \quad s_i' + s_j' = s_i + s_j; \quad s_k' = s_k \ \forall k \neq i, j$$

  Note that if $s_i > s_i'$ it should be the case that $s_j' > s_j$ to preserve the totals.

- The distribution $\boldsymbol{s}' \in S$ is obtained from $\boldsymbol{s} \in S$ by a **μ-*replication*** of the unemployed if both have the same size, but the unemployed sub-group is replicated μ-times, so $\boldsymbol{s}'$ can be partitioned in the form $\boldsymbol{s}' = (\underbrace{\boldsymbol{s}^+, \boldsymbol{s}^+, ..., \boldsymbol{s}^+}_{\mu}, 0, ..., 0)$.

Proof of the multiplicative decomposition of $U_\alpha(\boldsymbol{s})$ in (3). The proof is trivial, and parallels the one given in Aristondo, Lasso de la Vega and Urrutia (2010) for the Foster-Greer-Thorbecke poverty indices.

Start from the definition of E_α^+,

$$E_\alpha^+ = \frac{1}{q}\Sigma_{i=1}^{q}\left[\left(\frac{s_i}{\mu_q}\right)^\alpha - 1\right] = \frac{1}{q}\Sigma_{i=1}^{q}\left(\frac{s_i}{\mu_q}\right)^\alpha - 1$$

Hence,

$$1 + E_\alpha^+ = \frac{1}{q}\Sigma_{i=1}^{q}\left(\frac{s_i}{\mu_q}\right)^\alpha = \frac{1}{q\mu_q^\alpha}\Sigma_{i=1}^{q} s_i^\alpha$$

Since $\mu_q = I = \frac{\Sigma_{i=1}^{q} s_i}{q}$, and multiplying to both sides by I^α and $H = \frac{q}{n}$,

$$H.I^\alpha.(1 + E_\alpha^+) = \frac{\Sigma_{i=1}^{q} s_i^\alpha}{n} = U_\alpha(\boldsymbol{s})$$

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