Linguistic work quality index

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Abstract: Work quality measures are fundamental to study population welfare. Labour activity occupies most of the workers' day, so quantifying people's welfare by means of work quality is central. Decent work indicators have the aim of establishing the characteristics of an employment relationship to verify that a job is carried out under conditions of freedom, equality, security and human dignity. The purpose of these indicators is to measure the degree to which a certain goal has been achieved in order to develop precise policies to improve people's standard of living. In this paper, a proposal is developed to measure decent work deficit in a linguistic way. A complete decent work index model is formulated using linguistic labels and the linguistic weighted average operator. Finally, some comments are made about the benefits of using linguistic variables when measuring work quality.

Keywords: linguistic models; linguistic weighted average; decent work index; labour conditions; subjectivity; linguistic index; work quality index; welfare.

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1 Introduction

Work is a significant part of life, because of the time people spend working and because it is fundamental to social integration and self-esteem. That is why decent work is an essential element when assessing quality of life (Anker et al., 2003).

Indicators are intended to measure the extent to which a particular objective or result has been achieved. We can use them to assess results and improvement over time in attaining specific objectives. Moreover, they can be useful for cross-country comparisons, and they are also employed to test opposing hypotheses about the relationships between different elements of decent work. Ideally, indicators should measure the target directly (Ghai, 2003, 2005; Aragón et al., 2011; Godfrey, 2003; Lanari, 2005; Schleser et al., 2008; Somavía, 2002; Standing, 2002; Subsecretaria de Programación Técnica y Estudios Laborales, 2004).

General indexes of outcomes in the field of decent work can be developed, for which it is necessary to select quantitative or qualitative indicators depending on the issue studied, the importance that will be assigned to each indicator and how they will be combined into a general index (Ghai, 2003). The existence of qualitative variables or external environmental elements of difficult objective quantification makes it complicated for individuals to represent with an exact numerical value the evaluation of the different aspects related to their welfare (Pedrycz et al., 2011; Bonissone and Decker, 1986; Ragin, 2000; Smithson and Verkuilen, 2006). It is therefore more appropriate to express their conceptions through linguistic values rather than exact values.

This approach to address decision problems is based on fuzzy sets theory and is called linguistic approach; it is applied when the variables involved are qualitative (Zadeh, 1975; Herrera and Herrera-Viedma, 2000; Lazzari, 2010; Eriz and Fernandez, 2015; Merigó et al., 2014; Gil Lafuente and Barcellos de Paula, 2011).

Reliable decent work measurement will enable a clearer understanding of how economic growth is translated into a better quality of life and how the bases of higher quality economic and social development are generated (Anker et al., 2003; Auer, 2007; Bru, 2005; Easterlin, 1995; Frenkel et al., 2011; Grupo de Estudios del trabajo, 2005; Ravallion and Lokshin, 2000; Rifkin, 1996; Somavía, 2000; Van Praag, 2007).

The system of decent work indicators is an attempt to capture in quotidian language an inclusion of social and economic objectives represented in a semantically coherent unit (Correa Montoya, 2008). The decent work index can help to expand the limited perspective of labour issues as they are currently evaluated (Anker et al., 2003).

The employment of fuzzy and linguistic models to evaluate labour conditions within the decent work perspective makes it possible to analyse the individuals' quality of life under the use of approaches that are better adapted to reality. This approach allows capturing different hints when valuing an index that represents the population's welfare and makes it possible to study and process individual and aggregate opinions without losing information or rigor.

This paper provides a proposal to measure the decent work deficit in linguistic form with the dimensions pertaining to the system of decent work indicators. Finally, some comments regarding the advantages of using linguistic variables in the decent work indicator system are included.

In subsequent studies, it would be relevant to perform an affinity grouping according to the absence of decent work in different dimensions (Fernandez, 2012). In addition, the

need to add or modify dimensions, or define new indicators, among other issues, could be evaluated.

2   Decent work indicators

Decent work is a concept developed by the International Labour Organisation (ILO) to establish the characteristics of an employment relationship in accordance with international standards, so that work is carried out in conditions of freedom, equality, security and human dignity. This concept is based on the recognition that work is a source of personal integrity, family stability, social peace and economic growth, as well as increasing opportunities for productive work and sustainable development of companies.

Work is an important part of life, for the time it occupies in everyday life and because it is a support for social integration. For this reason, when addressing the issue of decent work we refer to an essential aspect of quality of life (Anker et al., 2003).

This new concept emerges from the socio-political context where the labour situation is weak and the category of labour has lost significance and it is a highly valued and explanatory term of reality (Lanari, 2010; Gorz, 1980; Sen, 1995; Stiglitz, 2002).

It is necessary to conduct studies to assess not only the quantity but also the quality of employment that guarantees the raising of the standard of living, the possibility of having a job in which individuals can have the satisfaction of making the best possible use of their skills and knowledge, contributing to the maximum to the common welfare. As a means to achieve this end, with guarantees for all the workers, it is essential to grant opportunities of professional formation and means for the transfer of employees, to adopt in monetary and non-monetary remuneration measures aimed at guaranteeing to all a fair distribution of society's development, recognition of the right to bargain in order to improve the efficiency of production and extend social security measures to guarantee basic incomes and to provide adequate medical care, to protect workers' life and health, childhood and maternity and to guarantee education and professional opportunities (Lanari, 2010).

In the context of the increasing deterioration of labour relations and the rise of poverty and exclusion, it is necessary to review the population's living conditions and give the concept of decent work the sense of being strategic to build a future. If decent work is a human right, a social right that implies its deficit will be to determine how it is performed, how it is measured, which of its dimensions are prioritised to reduce gaps, how goals are set and what policy tools are supported (Lanari, 2010).

It is necessary to determine a system of objective and subjective indicators that allow a measurement of decent work with a certain degree of coherence, accuracy and international comparability.

Data collection and labour statistics have traditionally focused on employment and unemployment, with the second being the most resonant. The volume of employment generated by an economy is not enough to know the characteristics of jobs, or the extent to which they guarantee the quality of life and empower people's skills (Anker et al., 2003).

Many studies have been conducted in order to define a system of indicators that can measure this concept and to compare them interregionally and intertemporally (Lanari

and Giacometti, 2010; Anker et al., 2003; Ghai, 2003, 2005; Lanari, 2010; Song et al., 2014).

A reliable and comprehensive measurement of decent work will provide a clearer understanding of the mechanisms through which economic growth translates into better levels of human welfare and how the foundations for faster economic and social development are laid (Anker et al., 2003). Although people who work or seek work have an idea of what a decent or not decent job means, it is necessary to define an indicator to assess and compare the extent to which the different jobs are decent.

The decent work deficit index is composed of economic and social indicators that define decent work categories. A good measurement of decent work allows us to elucidate new ideas about the different ways of improving the quality of life of the population.

It is possible to analyse the decent work deficit from three dimensions (Lanari and Giacometti, 2010):

- dignity and safety

- welfare and equity

- fundamental rights of work.

3 Linguistic models

During the last years, economic science has made the formalisation of economic concepts where qualitative variables are often inadequate to carry out operations with classic tools. That is why many attempts to measure welfare are rejected by researchers who are focused on objective approaches, and avoid losing rigor in the analysis.

The existence of qualitative variables, inherent to human behaviour, or external environmental elements hard to quantify objectively, makes it difficult for individuals to represent with an exact numerical value the assessment of the different aspects related to their welfare that are intended to be evaluated. Furthermore, it is often necessary to deal with variables describing phenomena of physical or human models by assuming a small finite quantity of descriptors. Sometimes we describe observations about a fact characterising it with naturally translated terms of the variable idea (Pedrycz et al., 2011). Under such circumstances, it is more accurate to express their conceptions through linguistic values rather than exact numerical values.

This decision problem approach based on the fuzzy sets theory is called linguistic approach. It is applied when the nature of the variables involved is qualitative (Zadeh, 1975; Herrera and Herrera-Viedma, 2000; Lazzari, 2010; Fernandez, 2012; Merigó et al., 2014; Gil Lafuente and Barcellos de Paula, 2011; Kaufmann et al., 1994). Thus, it is possible to model a large number of real situations, more properly, since it allows representing more properly the information of individuals, which is almost always inaccurate.

The difference between linguistic and numerical variables is that the values of the former are not numbers, but words or sentences of natural or artificial language (Zadeh 1975; Carlsson and Fuller, 2010). It is characterised by four elements (Pedrycz et al., 2011):

- name of the variable

- set of names of linguistic values which can take that variable (linguistic labels)

- syntactic rule for generating values of that variable

- semantic rule to associate each value with its meaning.

When a linguistic model is employed, the existence of an appropriate set of terms or labels is assumed, according to the domain of the problem, based on which individuals express their opinions (Zadeh, 1975).

It is necessary to agree on the level of distinction to which uncertainty is expressed, that is, the cardinality of the set, and on the semantics of the labels, i.e., what kind of membership functions use to characterise linguistic values (Zadeh, 1975). The use of the fuzzy linguistic approach allows establishing a semantic for each label or operating with words directly (Xu, 2008).

3.1 Linguistic information aggregation operators computing with words directly

In this paper, the set of linguistic terms used to assess the decent work deficit in each dimension is:

$$S = \{s_{-3} = null(N), s_{-2} = very\ low(VL), s_{-1} = low(L), s_0 = medium(M),$$
$$s_1 = high(H), s_2 = very\ high(VH), s_3 = absolute(A)\}$$

When we define the set of linguistic labels where t is positive integer, we have the following characteristics:

1    $s_\alpha < s_\beta$ if andonly if $\alpha < \beta$

2   there is a negation operator $neg(s_\alpha) = s_{-\alpha}$ and $neg(s_0) = s_0$. s_0 represents a neutral point, and the rest of the linguistic labels are located symmetrically around it.

Xu (2005) extends the discrete set of linguistic labels S to a continuous set $\bar{S} = \{s_\alpha | \alpha \in [-q, q]\}$ to preserve all the information given, where q. $(q > t)$ is an integer big enough. If $s_\alpha \in S$ then s_α is called original linguistic label. On the contrary, s_α is a virtual linguistic label.

Being $s_\alpha, s_\beta \in \bar{S}$, $\lambda \in [0, 1]$, operational laws can be defined as:

1    $s_\alpha \oplus s_\beta = s_{\alpha+\beta}$

2    $\lambda s_\alpha = s_{\lambda\alpha}$.

Representation of $S' = \{s_\alpha \mid \alpha = -t, ..., t\}$ s has its own advantages. Xu (2004, 2005) developed several operators of linguistic information aggregation, which operate with words directly.

One of them is the linguistic weighted average (LWA). Being $LWA : \bar{S}^n \to \bar{S}$. If $LWA(s_{\alpha1}, s_{\alpha2}, ..., s_{\alpha n}) = w_1 s_{\alpha1} \oplus w_2 s_{\alpha2} \oplus ... \oplus w_n s_{\alpha n} = s_{\ddot{\alpha}}$ where

$$\dot{\alpha} = \sum_{j=1}^{n} w_j \alpha_j, \ w = (w_1, w_2, ..., w_n)$$ is the weighting vector of the linguistic label $s_{\alpha i}$ and

$w_i \in [0, 1], \sum_{i=1}^{n} w_i = 1$, then the LWA operator compute aggregated linguistic labels

having into account the importance of the sources of information.

4 Linguistic model to measure global decent work deficit

It is possible to analyse the decent work deficit (employment quality) from three dimensions and their corresponding indicators (Lanari and Giacometti, 2010):

Dimension 1	Dignity and safety	
Indicators	1	stability
	2	social security
	3	right to rest
	4	health and safety at work.
Dimension 2	Welfare and equity	
Indicators	1	incomes
	2	income distribution.
Dimension 3	Fundamental rights of work	
Indicators	1	freedom and social dialogue
	2	child labour.

The model consists in valuing decent work deficit for the individual analysed by means of linguistic labels, assuming that the domain of the variables involved is a set of linguistic terms (Anker et al., 2003). In order to be able to assess the degrees of decent work deficits, a scale should be determined for each indicator, taking into account the characteristics of the available information. Experts should be consulted to determine which category corresponds to each language label (Fernandez, 2014, 2015). To obtain the degree of decent work deficits, in a first step the interviewer will express the valuations of each indicator using a linguistic label of the set S and then, with the model below, decent work deficit is calculated.

4.1 Decent work deficit for each individual

Calculation of decent work deficit will be carried out in four stages:

Stage 1	Importance of each indicator.
Stage 2	Deficit of each dimension.
Stage 3	Importance of each dimension.
Stage 4	Decent work deficit.

4.1.1   Importance of each indicator

The most important indicator for each dimension is selected and assigned a value of 1 (maximum). Then the other indicators are compared with this and a value is assigned to each one r_j, $j = 1$, …, n such that max $\{r_1, \Lambda, r_n\} = 1$ and min $\{r_1, \Lambda, r_n\} > 0$. Each element of the weighting vector is given by the degree of importance (w_j) of the indicator

I_j that is obtained $w_j = r_j / \sum_{j=1}^{n} r_j$, $j = 1, \Lambda, n$; $w_j \in [0, 1]$, $\sum_{j=1}^{n} w_j = 1$.

If all the indicators are equally important, the weights are equal: $w_1 = w_2 = \Lambda = w_2 = 1 / n$.

4.1.2   Deficit of each dimension

If n is the number of proposed indicators of the dimension considered and m the number of dimensions, the degree of deficit (g_i) of dimension d_i is obtained by applying

$g_i = LWA_{d_i}(s_{\alpha_1}, s_{\alpha_2}, ..., s_{\alpha_n}) = s_{\bar{\alpha}_i}$, $i = 1, ..., m$. Where $\bar{\alpha} = \sum_{j=1}^{n} w_j \alpha_j$, w_j is the degree

of importance of the indicator obtained in stage 1 and is the linguistic label that indicates the deficit degree.

4.1.3   Importance of each dimension

Just as in stage 1, the most important dimension of the index is selected and assigned a value of 1 (the maximum). Then the other dimensions are compared with this and a value is assigned to each one $i = 1, \Lambda, m$ such that max $\{u_1, \Lambda, u_m\} = 1$ and min $\{u1, \Lambda, u_m\} > 0$. Each element of the weighting vector is given by the degree of importance (v_i) of the

dimension d_i that is obtained $v_i = u_i / \sum_{i=1}^{m} u_i$, $i = 1, \Lambda, m$; $v_i \in [0, 1]$, $\sum_{i=1}^{m} v_i = 1$. If all the

indicators are equally important, the weights are equal: $v_1 = v_2 = \Lambda = v_m = 1/m$.

4.1.4   Decent work deficit

If m is the number of proposed dimensions and t the number of individuals, the degree of deficit of decent work (T_k) of each individual (r_k) is obtained by applying

$T_k = LWA_{r_k}(s_{\alpha_1}, s_{\alpha_2}, ..., s_{\alpha_m}) = s_{\bar{\alpha}_k}$, $k = 1, ..., t$. Where $\bar{\alpha}_k = \sum_{i=1}^{m} v_i \alpha_i$, $v_i(i = 1, ..., m)$ is the

degree of importance of the dimension obtained in stage 3 and is the linguistic label that indicates the deficit degree. If $s_{\bar{\alpha}_k}$ is the virtual label obtained, the approximation to a label of set S that shows the degree of decent work deficit of individual r_k is made by the usual rounding operation.

5   Application

The quality of employment is an economic issue that has been widely studied by public and private organisations. Formerly, wages were used as an indicator of the quality of

employment, but presently, it is not enough data to determine whether or not the work is decent (Martínez, 2012).

Working conditions are a complex and multidimensional phenomenon that shows several aspects determined by a set of work related factors that result from objective characteristics and rules of universal acceptance that influence the economic, psychological and social welfare of workers (Farné et al., 2011).

Indexes are composed by a set of indicators of certain underlying phenomena (Bonnet et al., 2003). A decent work composite index consists of a single aggregated indicator that synthesises and weighs existing information on its different aspects. A composite index takes a system of indicators as input and returns a single value to be able to univocally understand the situation that is intended to show.

Linguistic models are very useful since the indicators that represent the decent work deficit are not merely objective, and it is necessary to consider subjective factors that may have the same or greater relevance than those objectives. It is also relevant to be able to consider the subjective and objective aspects to evaluate the quality of employment.

People can be in a decent work situation due to specific factors or subjective perceptions of certain phenomena. That is why we are not dealing with an absolute concept but rather with a moment of employment situation regarding an ideal. In the case of subjective evaluations, assessments with words rather than exact numbers are more appropriate.

Besides, linguistic models allow combining subjective assessments with objective data, and achieving a combined indicator that provides, on one hand, aggregated information of the situation and, on the other hand, detailed analyses of the different phenomena.

Decent work deficit in each dimension is valued for each individual analysed by means of linguistic labels instead of exact numerical values, assuming that the domain of the variables involved is a set of linguistic terms.

The term s_{-3} (null) of set S will mean that such agent is in the optimum situation (null deficit). By contrast, the term s_3 (absolute) will indicate that the individual is in the worst possible situation in the studied dimension. The rest of the elements of the set will show the gradualness present on their dissatisfaction or satisfaction.

5.1 Dignity and safety

It is intended to identify situations of uncertainty regarding the permanence in the workplace and absence of certain benefits that ensure social protection. There are some limitations regarding the availability of information, so in the first instance it was decided to use simplified indicators in the different aspects analysed.

In order to obtain the degree of lack of dignity and safety, the interviewer will first express the valuations of each indicator using a linguistic label of the set S. And the deficit in this dimension is obtained using the developed model.

A scale was determined for each indicator of this dimension, taking into account the characteristics of the available information. For this purpose, experts were consulted and determined which category corresponds to each linguistic label.

The indicators that will be used to measure the dignity and safety of employment will be those proposed by Lanari and Giacometti (2010) for Argentina:

- stability

- social security

- right to rest

- health and safety at work.

5.1.1 Stability: type of contract

The possibilities of maintaining employment according to the type of hiring are evaluated in Table 1.

Table 1   Type of contract

Contract	Deficit	Associated linguistic label
Full time registered employee	Null	s_{-3}
Self-employed	Medium	s_0
Unregistered casual work	Absolute	s_3

5.1.2 Access to social security and health system

The possibilities of accessing a health and safety system according to the presence or absence of contributions are assessed as shown in Table 2.

Table 2   Access to social security and health system

Access to social security and health system	Deficit	Associated linguistic label
With contributions	Null	s_{-3}
Without contributions	Absolute	s_3

5.1.3 Right to rest

The right to rest associated with the presence or absence of paid vacations is assessed as shown in Table 3.

Table 3   Right to rest

Right to rest	Deficit	Associated linguistic label
With paid vacations	Null	s_{-3}
Without paid vacations	Absolute	s_3

5.1.4 Health and safety

The possibilities of protection against accidents at work are evaluated as shown in Table 4.

Table 4   Health and safety

Health and safety	Deficit	Associated linguistic label
With IWR[1]	Null	s_{-3}
Without IWR	Absolute	s_3

Notes: Insurance of Work Risks. Private companies hired by employers to advise them on prevention measures and to repair damages in cases of work accidents or diseases.

5.1.5 Dignity and safety deficit

Once evaluations of the four indicators have been obtained, the assessment of the lack of dignity and safety at work is obtained through the application of the LWA operator.

It is necessary to establish the weights corresponding to each indicator. In this case, we consider that the four of them have the same weight, therefore $w_1 = w_2 = w_3 = w_4 = 1/4$.

The degree of lack of dignity and security at work will be determined by

$$a_{das} = LWA_{das}\left(s_{\alpha_1}, s_{\alpha_2}, s_{\alpha_3}, s_{\alpha_4}\right) = 1/4\, s_{\alpha_1} + 1/4\, s_{\alpha_2} + 1/4\, s_{\alpha_3} + 1/4\, s_{\alpha_4} = s_{\bar{\alpha}_{das}}$$

where

s_{α_1} valuation of the indicator 'stability: type of contract'

s_{α_2} valuation of the indicator 'access to social security and health system'

s_{α_3} valuation of the indicator 'right to rest'

s_{α_4} valuation of the indicator 'health and safety'

$s_{\bar{\alpha}_{das}}$ linguistic label that indicates the degree of dignity and safety deficit.

5.2 Welfare and equity

They express one of the fundamental aspects of security, since they recognise the instrumental character through which benefits are obtained and, on the other hand, the right to fair and equitable treatment in the workplace. In addition, they are basic components as elements of social insertion (Lanari and Giacometti, 2010). The calculation of this dimension is conditioned by the availability of information, in some cases it is needed to use proxy variables.

To obtain the welfare and equity deficit, the interviewer will first express the valuations of each indicator using a linguistic label of the set S. Deficit in this dimension is obtained using the developed model. A scale was determined for each indicator of this dimension, taking into account the characteristics of the available information.

The indicators that will be used to measure welfare and equity will be those proposed by Lanari and Giacometti (2010) for Argentina:

- enough income

- distribution equity.

5.2.1 Enough income

It is possible to measure enough income deficit with a subjective indicator (Lazzari et al., 2013) (Table 5).

Table 5   Conformity with income level

Compliance of income	Deficit	Associated linguistic label
Absolutely satisfied	Null	s_{-3}
Very satisfied	Very low	s_{-2}
Fairly satisfied	Low	s_{-1}
Neither satisfied nor dissatisfied	Medium	s_0
Quite dissatisfied	High	s_1
Very dissatisfied	Very high	s_2
Absolutely dissatisfied	Absolute	s_3

5.2.2 Distribution equity

It is possible to measure the equity deficit with a subjective indicator (Lazzari et al., 2013) (Table 6).

Table 6   Fair income

Amount of extra income you consider fair in accordance with your occupation	Deficit	Associated linguistic label
Less than 10%	Null	s_{-3}
10–39 % more	Very low	s_{-2}
40–59% more	Low	s_{-1}
60–79% more	Medium	s_0
80–99% more	High	s_1
Double	Very high	s_2
More than double	Absolute	s_3

5.2.3 Welfare and equity deficit

Once evaluations of the two indicators are obtained, the assessment of the absence of welfare and equity is obtained through the application of the LWA operator.

It is necessary to establish the weights corresponding to each indicator. In this case, we consider that both have the same weight, therefore $w_1 = w_2 = 1/2$.

Deficit of welfare and equity in employment will be determined by:

$$a_{wae} = LWA_{wae}\left(s_{\alpha_1}, s_{\alpha_2}\right) = 1/2\, s_{\alpha 1} + 1/2\, s_{\alpha_1} = s_{\overline{\alpha}_{wae}}$$

where

s_{α_1} is the valuation of the indicator 'enough income'

s_{α_2} is the valuation of the indicator 'distribution equity'

$s_{\overline{\alpha}_{wae}}$ is the linguistic label that indicates the degree of welfare and equity deficit.

5.3 Respect for fundamental rights of work

According to the ILO, respect for fundamental rights is related to freedom of association, union freedom, the right to collective bargaining, the eradication of child labour and forced labour, and the elimination of discrimination in employment.

Due to the availability of information and the consistency of the estimates, two aspects are considered in this dimension: freedom of social dialogue and child labour.

5.3.1 Freedom and social dialogue

This dimension is related to the worker's possibility to associate to a union or organisation that represents him, with the aim of defending labour rights and acquiring new ones.

It is possible to measure deficit of freedom and social dialogue with two indicators: Possibility of joining a union and presence of union delegate in the company (Tables 7 and 8).

Table 7 Associating to a union

Associating to a union	Deficit	Associated linguistic label
Yes	Null	s_{-3}
No	Absolute	s_3

Table 8 Union representation

Presence of union delegate in the company	Deficit	Associated linguistic label
Yes	Null	s_{-3}
No	Absolute	s_3

5.3.2 Child labour

It is possible to measure the presence of child labour with the age of the worker (Table 9).

Table 9 Child labour

Age of the worker	Deficit	Associated linguistic label
More than 14 years old	Null	s_{-3}
Less than 14 years old	Absolute	s_3

5.3.3 Fundamental labour rights deficit

Once evaluations of both indicators have been obtained, the assessment of the absence of fundamental labour rights is obtained through the application of the LWA operator.

It is necessary to establish the weights corresponding to each indicator. In this case, we consider that both have the same weight, therefore $w_1 = w_2 = 1 / 2$.

Deficit of fundamental labour rights will be determined by

$$a_{flr} = LWA_{flr}\left(s_{\bar{\alpha}_1}, s_{\alpha_2}\right) = 1/2\, s_{\bar{\alpha}_1} + 1/2\, s_{\alpha_2} = s_{\bar{\alpha}_{flr}}$$

where

$s_{\bar{\alpha}_1}$ is the valuation of the indicator 'freedom and social dialogue' that is calculated through the LWA operator, $s_{\bar{\alpha}_1} = LWA_{fasd}\left(s_{\alpha_{uni}}, s_{\alpha_{delrep}}\right) = 1/2\, s_{\alpha_{uni}} + 1/2\, s_{\alpha_{delrep}}$

     where

       $s_{\alpha_{uni}}$ is the valuation of the indicator 'associating to a union' and $s_{\alpha_{delrep}}$ is the valuation of the indicator 'union representation'.

s_{α_2} is the valuation of the indicator 'child labour'

$s_{\bar{\alpha}_{flr}}$ is the linguistic label that indicates the degree of fundamental labour rights deficit.

5.4   Global decent work deficit indicator

Once the three dimensions assessments are obtained, the global decent work deficit valuation is obtained by the application of the LWA operator.

The weights corresponding to each dimension are established. In this case, we consider that the three of them have the same weight, therefore $w_1 = w_2 = w_3 = 1 / 3$.

Decent work deficit will be determined by:

$$a_{DWD} = LWA_{DWD}\left(s_{\bar{\alpha}_{das}}, s_{\bar{\alpha}_{wae}}, s_{\bar{\alpha}_{flr}}\right) = 1/3\, s_{\bar{\alpha}_{das}} + 1/3\, s_{\bar{\alpha}_{wae}} + 1/3\, s_{\bar{\alpha}_{flr}} = s_{\bar{\alpha}_{DWD}}$$

where

$s_{\bar{\alpha}_{das}}$ valuation of the dimension 'dignity and safety'

$s_{\bar{\alpha}_{wae}}$ valuation of the dimension 'welfare and equity'

$s_{\bar{\alpha}_{flr}}$ valuation of the dimension 'fundamental labour rights'

$s_{\bar{\alpha}_{DWD}} \in \bar{S}$ linguistic label that indicates the degree of decent work deficit.

5.4.1   Evaluation of a worker

A survey to a worker is made in which he answers some questions about working conditions and perceptions. Also some characteristics of the worker are taken into account.

This worker presents the following situation:

- He is 50 years old.

- He runs his own business and is the only worker on the company. He pays taxes and makes his own contributions to social security and the health system. He has his own insurance in case of labour accidents.

- When he needs vacations, he closes the company and does not work for that period.

- He is quite dissatisfied with his income, and thinks he deserves a 30% more in accordance with his occupation.

- He is not associated to any union.

In dignity and safety dimension, he obtains the following valuations:

- Type of contract: self-employed $\rightarrow s_{\alpha_1} = s_0$

- Access to social security and health system:

- With contributions $\rightarrow s_{\alpha_2} = s_{-3}$ right to rest: without paid vacations $\rightarrow s_{\alpha_3} = s_3$

- Health and safety: with IWR $\rightarrow s_{\alpha_4} = s_{-3}$

Then, the LWA operator is applied:

$$a_{das} = LWA_{das}\left(s_{\alpha_1}, s_{\alpha_2}, s_{\alpha_3}, s_{\alpha_4}\right) = 1/4\, s_0 + 1/4\, s_{-3} + 1/4\, s_3 = s_{-0.75}$$

In welfare and equity dimension, he obtains the following valuations:

- Enough income: quite dissatisfied $\rightarrow s_{\alpha_1} = s_1$

- Amount of income in accordance with occupation; 10%–30% more $\rightarrow s_{\alpha_2} = s_{-2}$

Then, the LWA operator is applied:

$$a_{wae} = LWA_{wae}\left(s_{\alpha_1}, s_{\alpha_2}\right) = 1/2\, s_1 + 1/2\, s_{-2} = s_{-0,5}$$

With respect to fundamental labour right dimension, he obtains the following valuations:

- Freedom and social dialogue: $s_{\bar{\alpha}_1}$

- Associating to a union: No $\rightarrow s_{\alpha_{uni}} = s_3$

- Presence of union delegate in the company: No $\rightarrow s_{\alpha_{delrep}} = s_3$

- Child labour: more than 14 years old $\rightarrow s_{\alpha_2} = s_{-3}$

Then, the LWA operator is applied:

$$s_{\bar{\alpha}_1} = LWA_{fasd}\left(s_{\alpha_{uni}}, s_{\alpha_{delrep}}\right) = 1/2\, s_3 + 1/2\, s_3 = s_3$$

$$a_{flr} = LWA_{flr}\left(s_{\bar{\alpha}_1}, s_{\alpha_2}\right) = 1/2\, s_3 + 1/2\, s_{-3} = s_0$$

The decent work deficit for this individual is:

$$a_{DWD} = LWA_{DWD}\left(s_{\bar{\alpha}_{das}}, s_{\bar{\alpha}_{wae}}, s_{\bar{\alpha}_{flr}}\right) = 1/3\, s_{-0.75} + 1/3\, s_{-0.5} + 1/3\, s_0 = s_{-0.42}$$

Then the rounding operation is applied: $s_{-0.42} \cong s_0$. The worker shows a medium decent work deficit.

6   Conclusions

In this paper, a proposal was made to use linguistic models to measure the decent work deficit. The linguistic approach makes it possible to conduct an analysis that is closer to the population real living conditions with the available information. It allows the gradual membership of the group of individuals with a decent work deficit. This proposal will allow showing and aggregating the valuations of individuals linguistically taking into account the intensity of fulfilment or non-fulfilment with the indicators determined. With this approach, the different levels can be captured without losing information and it is possible to operate with inaccuracies without dismissing data or phenomena considered relevant.

Decent work, like many other economic and social concepts, is a complex phenomenon to specify. It is associated with the lack of certain requirements in the labour field that allow satisfactory human progress.

The correct measurement of this phenomenon will provide solutions to a relevant aspect in economic development. Indeed, it will allow knowing where the most affected sectors or individuals are, and why, how many they are, and with that information, designing specific policies that lead to how such individuals can improve their labour welfare.

Fuzzy sets theory and in particular linguistic models are used to model those concepts that are typical of human language and thinking. It makes it possible to operate with the same variables that are used in the traditional measures, incorporating the possibility of gradualness. Fuzzy approach to measure decent work will allow capturing their different levels of deficit without losing information. It admits to display the grays present in population labour situations, degrees that are presented not only by phenomena of subjective nature, but also by current situational phenomena. These models allow developing the usual analyses, as well as other more extensive and deep ones, which, in general, include the classic ones as particular cases.

An extension of the model could be done employing confidence intervals type [a, b].

In subsequent researches, it will be possible to group individuals by deficiency of some dimension or globally, using the affinity theory. It will also be important to conduct studies to evaluate the possibility of adding or reformulating indicators or dimensions and determining the weight structure. In addition, the relevance of combining classical linguistic, statistical, fuzzy and mathematical approaches may be evaluated.

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