Methodologies to integrate subjective and objective information to build well-being indicators

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Filomena Maggino[1]

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Abstract

The integration of objective and subjective indicators represents a crucial approach in order to come up with a solid scientific result and understanding of quality of life, also in the social policy perspectives.
Moreover, the need to integrate subjective and objective information comes from different sources (statistical offices and survey) and is causing a growing demand in the study of well-being and happiness of societies.
For this reason the definition of an integrating model is needed. This model requires firstly the definition of a conceptual framework from which it is possible to identify the proper analytical approach (causal analysis, multilevel analysis, life-course analysis, or explorative analyses). Secondly, it requires an organizational context in which the integration can be accomplished by relying on structured and systematic data, observed in long-term longitudinal perspective (e.g. systems of indicators) and in which particular technical issues (i.e. aggregation issues) can be managed.
The paper will discuss these aspects by referring in particular to the feasibility of the different statistical approaches taking into account their specific assumptions. The goal is to describe a procedure able to yield results, not only statistically valid and consistent with reference to the defined conceptual framework, but also easy to read and interpret at policy level.

[1] Contact information:
Università degli Studi di Firenze – Dipartimento di Studi Sociali
Via Laura, 48 I-50121 FIRENZE (Italy)
e-mail: filomena.maggino@unifi.it

1. Societal well-being: conceptual frameworks

"Well-being" is a term largely used and expressing a concept not always clearly defined. Many theoretic models have been developed try to explain and to operationalise different definitions and concepts. The conceptual frameworks could be distinguished through different criteria.

(A) structure of values

The distinction among all the different definitions can be explained by the different structures of life values adopted. According to Diener and Suh (1997) they can be referred mainly to three philosophical approaches:

a) Functioning and capability to select goods and services that one desires (typical measures: economic indices and national accounts)
b) Normative ideals (typical measures: social indicators)
c) Subjective experiences: subjective indicators

The different conceptual frameworks and observation strategies are synthesised in the following table, drawing a simplified and reduced picture of the different and numerous concepts defined in order to define and measure societal well-being.

(B) Different perspective of observation

The different concepts that can be used in order to define the well-being of societies can be distinguished with reference to different perspectives, having reference mainly to **processes**, **conditions**, or **goals**.

Seen in terms of **process**, societal well-being finds the concept of "development" (often referring to qualitative dynamic change of an economic system) and of "growth" (referring to quantitative expansion on the scale of physical dimensions of economic system). Both concepts refer to different but interactive components and characteristics (economic, structural and technologic) that should be considered together (Horn, 1993). A term that can unify those presented above is *progress*, indicating generally "moving forward" (from Latin "*progressus", going forward, advance*). However, as limits or potentialities of the process have been reached, the attention could be turned towards the reverse and opposite process of "de-development" (Horn, 1993).

Seen in terms of **conditions**, societal well-being encounters the concept of

- availability of economic resources (*manpower, equipment, budget*),
- social implications of distribution of income and wealth,
- impacts of economics on national welfare and environment.

This perspective requires testing the improvement by which Individuals identify themselves as a community and acquire collectively the necessary knowledge, power, values and organizational skills to irreversibly share and expand the community's resources for the benefit of all its members without being at the expense of other communities or of the environment (Horn, 1993). In other terms, the conditions should be sustainable.

This perspective moves the attention from the process (development, progress, growth) to the **goal**, which could be represented by sustainability, quality of life, well-being, and so on.

(C) Different viewpoints

Berger-Schmitt and Noll (2000) well systematized the different conceptual frameworks that can be identified by distinguishing mainly between conceptual frameworks centred on respectively individuals and societies. This distinction allowed them to classify the different conceptual frameworks. The following table synthesises the classification:

Societal well-being concepts	Approaches	
Quality of life (conceptualised implicitly or explicitly at individual level)	Resources approach (Scandinavian level of living → objective needs)	
	Capabilities approach	
	Subjective well-being approach (American quality-of-life concept)	
	Basic needs approach	
	Objective living conditions and subjective well-being approach (German quality-of-life)	
Quality of societies	Liveability and quality of nations	
	Societal integration, solidarity and stability	Social cohesion
		Social exclusion
		Social capital
	Sustainability	
	Human development	
	Social quality	

1.1. Towards a comprehensive conceptual framework

Each conceptual framework shows strengths and weaknesses, adopts concepts and/or information which can be partially or completely coinciding or overlapping the ones adopted by the others. Consequently, in order to measure societal well-being it is difficult to adopt just one solution and a multidimensional definition and a comprehensive approach need to be assessed.
A possible conceptual framework could be the following: a good and healthy society is that in which each individual has the possibility to participate to the community life, to develop capabilities and independency, to have adequate possibility to choose and control his/her own life, and to be treated with respect in a healthy and safe environment and by respecting the opportunities of future generations.
This is lined up not only with new methodological perspective in measuring the progress but also with a different policy view that looks at the progress in terms of good life. This is not "just a life in which people feel good, no matter how terrible their real life conditions are, but one in which they feel good with the best of all reasons, because the objectively measurable conditions of their lives merit a positive assessment" (Michalos, 2008).
In other words, a **comprehensive approach** is needed allowing objective living information – with reference to micro-individual level and macro-societal level – and subjective well-being to be integrated.
The conceptual framework of the European System of Social Indicators – EUSI – (Berger-Schmitt and Noll, 2000) represents a good example of a comprehensive approach in measuring societal well-being. It tries to avoid the great part of the overlapping concepts and dimensions by respecting the policy goals defined at European level. The concepts considered by EUSI define three pillars, (i) quality of life, (ii) economic and social cohesion and (iii) sustainability.

(i) "Quality of life" concept (micro level). The adopted approach is that defined by Zapf (1975, 1984), who proposed a model identifying the relationship between two components (objective living conditions and subjective well-being) and two degrees (low and high). The combination produces a category model of individual welfare, as represented in the following table:

Level of → ↓		Subjective well-being	
		high	**low**
Objective living conditions	**high**	*well-being*	*dissonance*
	low	*adaptation*	*deprivation*

In a similar way Michalos (2008) states that the quality of life of a community is a function of actual conditions and what individual (micro level) or the community (macro-level) makes of those conditions. "What individual or the community makes of actual conditions is in turn a function of how the conditions are perceived, what is thought and felt about those conditions, what is done and, finally, what consequences follow from all these inputs." Since an interrelation/interdependency exists between people's perceptions, thoughts, feelings and actions and their own and others' living conditions (Michalos, 2008), four different scenarios can be identified:

Level of → ↓		What people makes of conditions of life	
		Good	**Bad**
Conditions of life	**Good**	*Real Paradise*	*Fool's Hell*
	Bad	*Fool's Paradise*	*Real Hell*

(ii) "Economic and social cohesion" concept. Two goal dimensions has been distinguished:
a) reduction of disparities and inequalities and fighting social exclusion
b) strengthening of connections and social ties including the enhancement of social capital.

(iii) "Sustainability" concept. The sustainable development is referred to the World Bank's four capital approach. In particular, the four goal dimensions are the enhancement and preservation of social, human, produced and natural capital. For each type of capital two aspects have been considered: (i) preservation or enhancement of social capital of present generations and (ii) provision for future generations.

By implementing the EUSI model, we could build the following comprehensive approach:

		Level of observation
QUALITY OF LIFE	subjective well-being	micro
	objective living conditions	micro
SOCIAL COHESION	social exclusion → distribution of welfare (disparities, inequalities of individuals and societies), opportunities	micro
		macro
	social inclusion → social capital (informal networks, associations and organisations and role of societal institutions); integration of individuals and societies	micro
		macro
SUSTAINABILITY PRESERVATION OF	physical capital → behaviour affecting individual health	micro
	social capital → behaviour affecting social relations / networks	micro
		macro
	human capital → processes affecting (in terms of improvement/deterioration) people's skills, education and health	micro
	natural capital → processes affecting (in terms of improvement/deterioration) of natural resources	macro
CONDITIONS (determinant / preconditions)	individual "structure", internal and external (personality traits, …) and individual behaviour	micro
	demographic and socio-economic structures	micro
		macro
	values and interests	micro
	meeting of human needs	micro
	policies	macro

Very recently (September 2009), the *Report* by the Commission on the Measurement of Economic Performance and Social Progress, chaired and coordinated by J.E. Stiglitz J. E., A. Sen & J.-P. Fitoussi, outlined a similar conceptual framework in order to measure progress of societies. In fact, three wide areas have been identified: (i) classical economical issues, (ii) quality of life and (iii) sustainable development and environment.

2. Integration of objective and subjective components: conceptual framework

As we have seen, a comprehensive approach is defined by a multidimensional conceptual framework, requiring both objective and subjective information observed at different levels (micro and macro). In other words, a comprehensive approach needs to integrate objective information – observed at micro (e.g. individual) level and macro (e.g. societal) level – and subjective information – observed at individual level. In policy perspective, the need for subjective indicators arises during (i) the assessment of policy results and (ii) the selection of policy objectives (Veenhoven, 2002).
The possibility to integrate objective and subjective information requires

1. a clear and shared definition of the two perspectives (what is objective and what is subjective)[2]
2. a a clear conceptualization of the relationships between the two components
3. a solid methodological structure for integration .

3.1 Defining objective and subjective components

In order to make the distinction between objective and subjective characteristics more clear from the operating point of view, we can refer to the source – called *unit* – on which the characteristic of interest is measured. The units can be represented by individuals, institutions, social groups, services, administrative areas, geographical areas, nations, and so on. Consequently, we can distinguish between:

- *objective information,* collected by observing reality
- *subjective information*, collected only from individuals.

[2] Maggino F. (forthcoming) *Measuring subjective characteristics and creating subjective data. Theoretical aspects and technical approaches*, Firenze University Press, Archivio E-Prints, Firenze.

Objective components

In synthetic terms, objective components refer to the conditions in which each individual lives (health, working conditions, environmental situations, and so on). They can find different definition according to two major perspectives:

- micro-level, referring and taking into account the individual level
- macro-level, concerning and taking into account economic, demographic, geographical, administrative or social level.

Micro-level

Among the objective characteristics observed at individual level, we can mention:

- *demographic and socio-economic characteristics* (sex, age, civil status, household, educational qualification, professional condition, income, birthplace, residence, domicile, geographical/social mobility, etc.);
- *life style* that can be defined by
  - activities (work, hobby, vacation, volunteering, sport, shopping, etc.),
  - engagements (familiar, working, social, etc.),
  - habits (schedule, using of public transport and of means of communication, diet, etc.);
- *observable knowledge and skills*;
- *observable behaviours*, past and present (maybe related to the future ones).

One of the notions that can help in differentiating generic individual information from subjective information is that the latter can be observed only by/from the subject his/herself, in other words does not admit *proxy* person.

With reference to quality of life, the *objective components at micro level* refer mainly to *individual living conditions*, material resources, standards of living, working conditions and status, state of health, individual status, social relationships, freedom to choose one's lifestyle. Objective indicators allow each aspect of living conditions to be evaluated. Their specificity is in the possibility to define and recognize external objective references. In other words, they are *verifiable*.

Macro-level

It is difficult to make an inventory of all possible objective characteristics definable and observable at macro level because they are different depending on the observed and studied field. Examples can be represented by aspects concerning environmental conditions, observable social, economic and health contexts (economic production, literacy rates, life expectancy, natural and urban environmental indices, political indices, and so on).

Subjective components

Traditionally "subjective characteristics" can be distinguished in three content areas (Nunnally, 1978):

- **abilities**, that concern the capacity in performing different tasks (*performance*, that is evaluated with reference to specified criteria); the abilities can be intellectual (usually thought of as those forms of abilities that are important for scholarly accomplishment and scientific work) or special (usually thought to be important for mechanical skills, artistic pursuits, and physical adroitness); among the abilities we can mention the verbal comprehension and fluency, the numerical facility, the reasoning (deductive and inductive), the ability to seeing relationships, the memory (rote, visual, meaningful, etc.), the special orientation, the perceptual speed;
- **personality traits**, that can be defined as the psychological characteristics that determine the organizational principles and that reflects the way through which an individual reacts to the environment (*locus of control*, ego, introversion, self-esteem, identification, etc.); in this perspective, some overlapping categories can be identified:
  - *social traits*, represented by the characteristic behaviour of individuals with respect to other people; typical social traits are honesty, gregariousness, shyness, dominance, humour, social responsibility, religiosity, charity;
  - *motives*, concerning individual characteristics aimed at reaching a certain goal and satisfying personal nonbiological "needs" and "drives" (affiliation, aggression, achievement, and hostility)[3];
  - *personal conceptions*, concerning the way in which the individual interacts with the social and

[3] Concerning this, we can mention che Abraham H. Maslow in 1954 in his work *Motivation and Personality* defined hierarchy of needs; Maslow postulated that needs are arranged in a hierarchy in terms of their potency. Although all needs are instinctive, some are more powerful than others. The lower the need is in the pyramid, the more powerful it is. The higher the need is in the pyramid, the weaker and more distinctly human it is. The lower, or basic, needs on the pyramid are similar to those possessed by non-human animals, but only humans possess the higher needs.

material environment; i.e., a subject can (a) view other people as basically friendly or hostile, (b) believe that getting ahead in life depends more on luck, (c) believe important to plan personal goals on a long-range; etc.;
- *adjustment*, concerning the relative freedom from emotional distress and/or socially disruptive behaviour; this trait is strongly connected to the others (i.e., a hostile social trait makes the individual less adjustable);
- *personality dynamics*, that consist of organizational principles whereby the above four types of traits are "put together" (i.e., the identification with various role models); these principles help in explaining the articulation of a unique person;

- **sentiments**, generic terms referring to:
  - *interests*, concerning the preferences for particular activities;
  - *values*, concerning preferences for "life goals" and "ways of life"; actually, the term "value" refers to a wide range of contents, from intellectual aspects of life to more abstracts values regarding goals of self-attainment;
  - *attitudes*, concerning feelings about particular objects; traditionally, attitudes are defined as composed by three components:
    - cognitive (beliefs), important component even though not easy to be defined, concerning the way whereby the individual judges the social and material environment (**evaluations**); so, it refers also to the **opinions** that an individual has with reference to particular objects (physical objects, type of people, politics, social institutions, policies, etc.);
    - affective, reflecting the feelings, the evaluations, the emotions, the perceptions and the self-descriptions of an individual with reference to particular objects (i.e., professional role); this component can include also the dimensions of **satisfaction** and **well-being** for the dimensions of individual life (job, study, family, relationships, etc.) and **emotional states** (i.e., happiness);
    - behavioural (actual actions), reflecting the behavioural tendencies of an individual with reference to a certain object, the *intentions* can be included in this component, thought as actions or behaviours that the individual plans and will execute in the future.

Of course, the scheme is not exhaustive and the different identified components for each area can overlap one another.
With reference to well-being, subjective components refer to and concern opinions, evaluations, feelings, perceptions, attitudes, desires, values, and motivations related to each individual life as a whole or in different specific contexts. Contrarily to the objective characteristics, no explicit standard is defined and no external reference can be defined in observing the subjective component.
It can be assessed by individuals' or groups' responses to questions about happiness, life satisfaction, utility, or benefit. Subjective indicators aim at measuring and quantifying individual components involving different elements – as conscience, cognition, emotion, attitude, and opinion – that are related to contingent and mutable situations. Even if it is difficult to assess its measurement, social policies and programmes need more and more data concerning this component in order to complement social, economic, and health factors, such as the degree to which a perceived need is being met and the importance of that 'perceived need' to one's overall quality of life. In their review on quality of life measures, Hughes and Wang (1996) reported a classification of the possible subjective well-being indicators: satisfaction about different aspects of life, sentiments, life perceptions, values and personal aspirations, self-concept, general sense of well-being, happiness and self-esteem. The elements to be considered in planning a survey oriented to measuring subjective quality of life make indispensable an interdisciplinary approach, the only one able to consider and to understand the different levels at which each individual react to the submitted question. The different levels involve personality, values, interests, motivations, intellectual and expressive dispositions, memory, experiences, social attitudes as a member of a limited group or of a community, and so on.

3.2 Modelling the relationship between subjective and objective components

Several conceptual frameworks of integration can be identified. Below, some patterns are introduced.

- Objective and subjective dimensions interpreted in terms of descriptive and evaluative dimensions. As previously stated, objective characteristics can be seen in terms of resources and conditions that individuals can use in order to improve their lives and to pursue their life projects. In this sense, the objective approach makes the social indicators model and Sen's capability model very similar.

Consequently, the terms “objective” and “subjective” should be respectively replaced, according to Erikson (1993), with the terms “descriptive” and “evaluative.”

- Objective living conditions explain subjective well-being. According to “basic needs” approach, subjective appreciation of life depends on the objective living conditions. In other words, objective living conditions is important for the happiness and satisfaction of the individuals. Seen in macro perspective, an improvement in quality of life can occur as a result of social and economic development. It should be taken into account that people’s satisfaction with life in socio-economically disadvantage societies is not necessarily lower than those in advantages communities. In other words, the approach based upon absolute objective standards cannot explain the variances in subjective perceptions. It should be taken account that while objective information can reveal significant discrepancies among places, subjective perceptions and satisfactions differences among individuals can show different variations.
- Subjective well-being explained by comparisons. According to “comparison” approach, subjective well-being is not directly related to objective components or individual living conditions but is based upon the comparison between individual conditions and a series of (actual or ideal) standards (Easterlin, 1974). The comparison can be made at different levels:
  - social level, when comparisons are made between different social entities (social groups, populations, countries, etc.)
  - lifetime level, when comparison are made at individual level and related to individual experiences

		Ambits of comparison				
		Housing	Work	Family	Friends	…
Standards of comparison	previous experiences					
	with other people					
	with aspirations					

The smaller the perceived gap between individuals’ aspirations and their reality, the higher their subjective well-being.

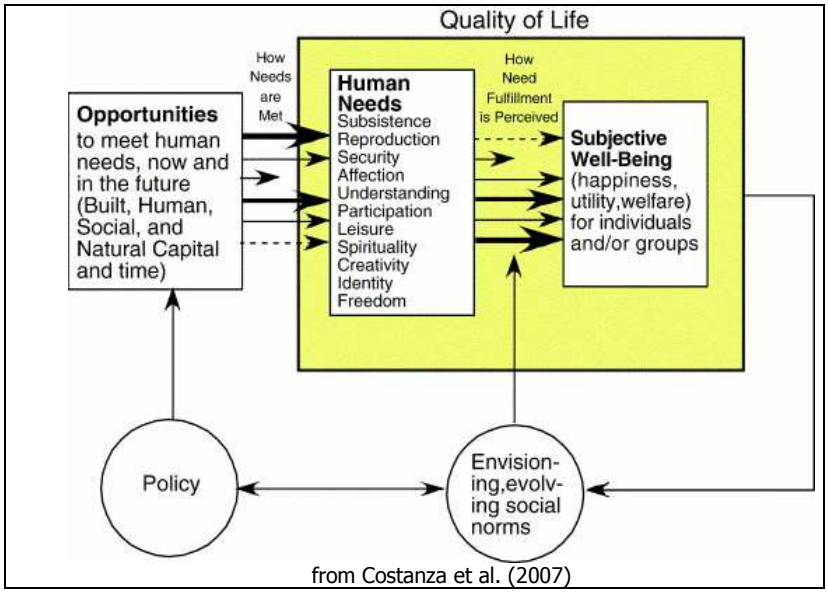
This approach – known as “Michigan model” – can be considered as a fundamental step in defining an approach finalized to the evaluation of subjective well-being based upon perceived differences (Andrews & Withey, 1976; Campbell, Converse & Rodgers, 1976), particularly between aspirations and realizations. This approach registered approval but also criticism, since its definition describes the evaluation of subjective well-being exclusively in cognitive terms and excludes the affective component.

- Multiple discrepancies approach. The previous approach found successive modifications especially thanks to Michalos (1985), who formulates the *Multiple Discrepancies Theory* (MDT). In particular, Michalos introduces the concept of gap (*discrepancy*) between expectations and aspirations (*achievement gap*). According to this theory, subjective well-being represents (is function of) the perceived gap between what one has and wants, and relevant others have, the best one has had in the past, expected to have, expected to deserve, and expected with reference to needs. The gap is observed with reference to different domains (health, finances, family, job, friendships, housing, recreation, religion, transportation, and so on). In this context, happiness is considered a individual trait not dependent on living conditions.
- Disposition approach. According to this approach (Kozma et al., 1990), subjective well-being does not depend on living conditions but depends on stable individual characteristics (personality traits). For this reason, subjective well-being is not produced by the combination of perceptions in different ambits. In other words, the relationships between subjective well-being as a whole and satisfaction in different ambits is definable not in causal terms but in inferential terms (subjective well-being helps in obtaining success in different ambits, c.f. Lyubomirsky et al., 2005). Consequently, the approach pays a special attention on individual traits. Different versions of this approach were defined (*Costa-McCrae* in 1980, *Abbey-Andrews* in 1985). According to the *Kozma-Stones* approach (1990), subjective well-being is composed by two components, one expressed in terms of “reactive state”, - acting in short periods (moods) – and the other expressed in terms of trait (disposition). Living conditions act on the reactive state, while the trait can attenuate the effects of that impact. Happiness is considered an additive combination of the two components (and the error). The importance of this approach is mainly in having encouraged interest in personality components of well-being and for having contributed to explanation of well-being in both conceptual and measurement terms.
- Causal approaches: bottom-up approach, top-down approach, and up-down approach. The causal explanation of well-being is at the core of several studies, which found different solutions. They were synthesized as follow by Diener (1984):
  - ***bottom-up*** approach (inductive – Simple Reactivity Model): subjective well-being is explained as a “reactive state” to the environment. The sum of the reactive measures for the defined ambits allows subjective well-being to be quantified.

- ***top-down*** approach (deductive – Propensity Model): subjective well-being is explained by the presence of individual stable traits, like happiness (individual disposition), which determine satisfaction in single ambits.[4]

Actually, both approaches are not able to explain completely the relationships between the observed variables. This means that causal effects can emerge in both directions. The subsequent debate[5] did not allow us to identify which of the two approaches is the best explanatory description of well-being, and produced the proposal of bi-directional approach (***up-down***). The proposal, which found many supporters, provides for the assessment of causal effects in both directions at the same time. This approach take into account two explanatory components, a long-period component (top-down effect), represented by the personal disposition, and a short-period component (bottom-up effect), represented by satisfaction related to circumstances. The contributions to this approach have been many (Headey et al., 1991; Lance et al., 1995) also from the methodological point of view.[6]

- Needs, opportunities and subjective well-being. A possible model of relationships between objective and subjective components of well-being is that that includes the concepts of (i) human needs, (ii) subjective well-being, and (iii) opportunities, defined in terms of four capital approach (natural capital, produced capital, human capital and social capital) and involving the role of policy, in terms of both input and output. In this perspective, societal well-being is the extent to which objective human needs are fulfilled in relation to personal or group perceptions of subjective well-being. In other words, quality of life can be seen as an interaction of human needs and the subjective perception of their fulfilment, as mediated by the opportunities available to meet the needs. (Costanza et al., 2007)



from Costanza et al. (2007)

The relationships between human needs and perceived satisfaction with each of them can be affected by mental capacity, cultural context, information, education, temperament, and the like. The ability of humans to satisfy their basic needs come from the opportunities and capabilities derived by social, human, built, natural capital (Sen, 1993). For each human need, the corresponding opportunities can be identified, as represented in the following table (from Costanza et al., 2007):

[4] The first reports on the empirical evidences concerning the concept of happiness date back to Beiser in 1974 (Stones et al., 1995).

[5] This issue was debated between Veenhoven and Stones on Social Indicators Research in the nineties.

[6] The study conducted by Mallard, Lance & Michalos (1997) is particularly interested regarding the application of the MDT approach, extended with analysis of causal relationships of subjective well-being.

Human Needs	Possible descriptors	Opportunities (types of inputs needed)				
		SC	HC	BC	NC	T
Subsistance	Food, shelter, vital ecological services (clean air and water, etc.) healthcare, rest.	X	X	X	X	X
Reproduction	Nurturing of children, pregnant women. Transmission of the culture. Homemaking.	X	X		X	X
Security	Enforced predictable rules of conduct. Safety from violence at home and in public. Security of subsistence into the future. Maintain safe distance from crossing critical ecological thresholds. Care for the sick and elderly.	X		X	X	X
Affection	Solidarity, respect, tolerance, generosity, passion, receptiveness.	X			X	X
Understanding	Access to information. Intuition and rationality.	X	X	X	X	X
Participation	To act meaningfully in the world. Contribute to and have some control over political, community, and social life. Being heard. Meaningful employment. Citizenship	X	X		X	X
Leisure	Recreation, relaxation, tranquillity, access to nature, travel.	X	X	X	X	X
Spirituality	Engaging in transcendent experiences. Access to nature. Participation in a community of faith.	X	X		X	X
Creativity / emotional expression	Play, imagination, inventiveness, artistic expression.		X		X	X
Identity	Status, recognition, sense of belonging, differentiation, sense of place	X			X	
Freedom	Being able to live one's own life and nobody else's (having certain guarantees of non-interference with certain choices, such as choices regarding marriage, childbearing, sexual expression, speech and employment", mobility)	X				

SC → social capital **HC → human capital** **BC → built capital** **NC → natural capital** **T → time**

Policy and culture help to allocate the four types of capital as a means for providing the opportunities. According to this approach, overall quality of life is a function of

(a) the degree to which each identified human need is met (*fulfilment*)
(b) the *importance* ("weight") of the need to the respondent or to the group in terms of its relative contribution to their subjective well-being.

The subjective *fulfilment* and *importance* with reference to any need may vary within and across time, space contexts and groups of people. Thus, in designing and assessing quality of life, the goal should be to create a tool that will capture the weighting that is being used by a particular person (or group of persons) at a particular time and place.

The *fulfilment* and *importance* scores can be used to create a single overall metric. For example, the product between *fulfilment* and *importance* gives us a single measurement representing the degree to which needs of varying priorities are being met. This would provide an indication to individuals, groups and policy makers of where resources might be allocated (acknowledging that other factors, such as competing needs, perspectives, and resources, must also be considered in final allocation decisions).

This strategy can also provide an index that could allow us to (Costanza et al., 2007):

- compare QOL levels over time and relative to other communities
- determine whether overall QOL is improving because of changes in how well needs are being met (fulfilment) vs. changes in the weights assigned to each need (reprioritisation, possibly as a result of adaptation).
- compare QOL within and between groups of people—defined by population characteristics such as age, residential community, ethnicity, etc.
- uncover potential relationships between the fulfilment and the importance of needs
- identify possible discrepancies between fulfilment and importance grouped by type of resource required to fulfil each need
- observe variation in weights, i.e. the extent to which different components are considered important, by population characteristics
- observe variation in overall QOL (e.g., one community's needs being met over another's).

- Social epidemiology. A different approach looks at integration between objective and subjective indicators by using the logic and the perspective of *social epidemiology*, which can be defined as the systematic and comprehensive study of health, well-being, social conditions or problems, and their determinants.[7] Traditionally, social epidemiology is defined as the combination of epidemiology (the

[7] In this context, we do not refer to the alternative definition of social epidemiology as "the branch of epidemiology that studies the social distribution and social determinants of states of health" (Epidemiological Bullettin, 2002).

study of the distribution and determinants of disease and injury in human populations) with the social and behavioural sciences in order to investigate social determinants of population distributions of health, disease, and well-being, rather than treating such determinants as mere background to biomedical phenomena (Krieger, 2002).

The principal concern of social epidemiology is the study of how society and different forms of social organization influence individuals' and populations' well-being. Social epidemiology goes beyond the analysis of individual risk factors to include the study of the social context in which the well-being/ill-being phenomenon occurs (in Epidemiological Bullettin, 2002).

Even if social epidemiology is strictly related to the definition and identification of "social problems", (e.g. obesity, infectious diseases, violence, child abuse, drug use, and so on), in our viewpoint this approach turns out to be interesting also in the positive perspective of promoting quality of life (by involving not only the concept of "risk" but also the concept of "resource") since it considers both micro (personal behaviour) and macro trends in the social structure (distribution of wealth, social resources, and so on).

This perspective can help in explaining the path between exposure to social characteristics of the environment (with special attention to inequalities) and its effects on well-being by involving concepts and techniques that require the use of multidisciplinary approaches in order to analyse complex social problems.

In the traditional language of social epidemiology, "risk factors" are behaviours, attributes, individual characteristics, and exposures that may increase the probability of a specific outcome (Krieger, 2002). In order to identify risk factors, a central focus is implementing what we know about a particular condition in order to maintain and improve well-being. Inherent in this definition is the equal emphasis that we can give to objective conditions and subjective conditions as determinants of well-being. For example, the application of this perspective allows the distribution of different levels of living conditions to be analysed in order to understand the relevant factors and their interrelationship between micro and macro trends, and to develop interventions, programs, policies, and institutions that may promote better living conditions and well-being.

The approach of social epidemiology reflects the understanding that social variables or conditions can lie on either side of the equation determining which factors affect well-being. They can be independent variables, which are the characteristics hypothesized to explain the phenomenon. They can also be the social condition or outcome that we are trying to understand, or the dependent variable. For example, depression can be a risk factor for some diseases or social conditions, such as alcohol abuse or child neglect. It can also be the outcome of particular living conditions.

3. Integration of objective and subjective information: practical strategy

In order to manage the complexity of the integration of objective and subjective indicators, a complex applied strategy can be adopted. The strategy constitutes a "composite" **process**, carried out through subsequent/consecutive steps (MULTI-STAGES) and different/alternative analytical approaches (MULTI-TECHNIQUES).

1. REDUCING THE COMPLEXITY OF DATA STRUCTURE. The consistent application of the hierarchical design produces a complex data structure (elementary indicators, cases, variables, areas, etc.). In order to manage the complexity, some dimensions may require a particular treatment, consistently with the conceptual model:

(i) **aggregating elementary indicators** identified for each variable (except those measured by single indicators): the aggregating process aims at re-constructing the conceptual variables consistently with the approach (reflective or formative) adopted at micro level (*construction of synthetic indicators)*

(ii) **aggregating units/cases**: the aggregating process aims at leading information observed at micro-level to the proper and identified macro level of interest (*definition of macro-units*). Identifying the proper aggregation criterion should take into account the nature of measured characteristics (e.g. compositional, contextual, and so on) requiring different analytical approaches.

2. COMBINING INDICATORS. In some occasion, the complexity of the system of indicators may require the indicators allowing for more comprehensive measurement. This need can emerge in order to (Noll, 2009)

- answer the call by 'policy makers' for condensed information
- improve the chance to get into the media (compared to complex indicator systems)
- allow to make multi-dimensional phenomena uni-dimensional

- allow to compare situations across time more easily
- compare cases (e.g. nations) in a transitive way (ranking)
- allows clear cut answers to questions like the following:
    a. are living conditions getting better or worse across time?
    b. do people living in City A enjoy a better quality of life than those living in City B?
    c. is population subgroup X better off than population subgroup Y?

Dashboards (i) or **composite indicators** (ii) can represent useful approaches aimed at summarising indicators.

3. MODELLING INDICATORS. This stage is aimed at analysing different aspects involving the integration of objective and subjective indicators by identifying the proper analytical approaches**.**

Goals	Level of analysis	Stages	Aims	by	Analytical issues
1. Reducing data structure:	micro	(i)	**construction of synthetic indicators**	aggregating elementary indicators	From elementary indicators to synthetic indicators - reflective approach - formative approach
		(ii)	**definition of macro-units**	aggregating observed units	From micro units to macro units, by following - homogeneity criterion - functionality criterion
2. Combining indicators:	macro	(i)	**definition of dashboards**	jointly representing indicators	Comparing over time / across units
		(ii)	**construction of composite indicators**	merging indicators	Aggregating information very different from each other (e.g. objective and subjective)
3. Modelling indicators:	macro	(i)	**analysis of indicators**	proper analytical approaches	Different solutions (consistently with conceptual framework)

3.1 Reducing the complexity of data structure

3.1.1 Aggregation of indicators and creation of synthetic indicators

In order to better manage the complexity of the measured data, analytical models are required providing for significant data aggregations at different levels in order to ensure correct and different comparisons, transversal (between groups, regions) and longitudinal at both micro and macro levels.
In other words, the complexity of this structure can be reduced by defining and applying additional models. The purpose of these models is – through the definition and adoption of particular assumptions – to condense and synthesize the dimension by referring to the *multiple measures*.
The construction of synthetic indicators should be consistent with the adopted measurement model. In this context, the traditional distinction between formative and reflective is particular important since aggregation of indicators has to be consistently accomplished. In other words, indicators can be aggregated into complex structure through a consistent methodology according to two different criteria: (i) *reflective criterion* and (ii) *formative criterion*. In both cases, the condensation of elementary indicators, considered multiple measures, produces new synthetic values obtained by applying the appropriate aggregating model. Each synthetic indicator tries to re-establish the unity of the described concept described by the corresponding latent variable.

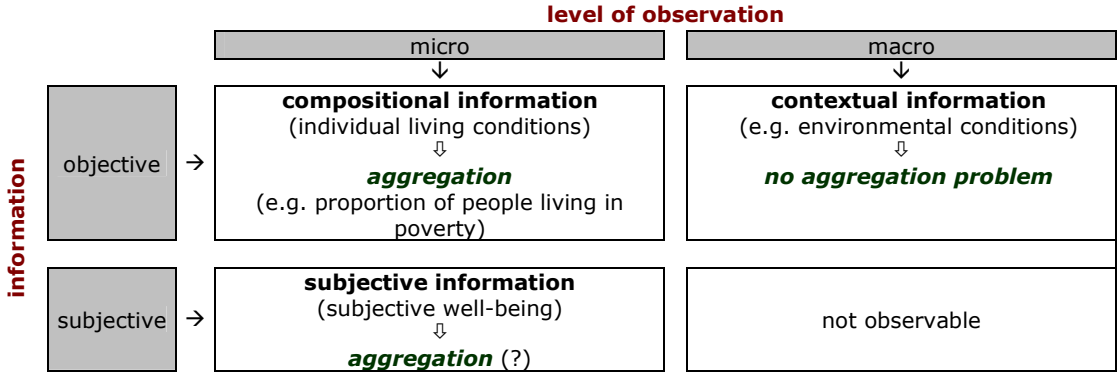
3.1.2 Aggregation of observed units and definition of macro-units

When the conceptual framework leads with is a multidimensional construct emerging from the evaluation of multiple aspects observed at different levels (individual, community, national, and global), the study needs to take into account the different levels at which information is collected and has to be analysed. In fact, some characteristics are observable only at macro level, others can be observed at micro level. For example, Costanza and others (2007) propose a list of (illustrative rather than exhaustive) indicators for measuring human needs:[8]

Need	**Individual level**	**National level**
Subsistence	Self reports on: caloric intake access to clean air, water Access to health care	National data on: caloric deficiencies Aggregated data health care
Reproduction and care	Self reports on: maternity leave/child care Family provision for care Household and child care allocation within the household	National data on: existence and scope of family leave laws Aggregated data on family provision and care Aggregated data on household duties
Security	Self reports on: who provides care in case of acute, chronic illness Who provides care for aged parents etc. Interpersonal violence experiences Environmental practices	National data on: nursing homes, shared housing, multigenerational households Aggregated data on who provides care Crime statistics Aggregated data on environmental practices
Affection	Self reports on: level of attachment to significant others	National data on: aggregated data on levels of attachment, suicide, homicide
Understanding	Self reports on: newspaper, radio, tv, internet usage for news information	Aggregated data on: media usage for news
Participation	Self reports on: volunteering, association memberships	National data on: aggregated data on volunteering, association membership
Leisure	Self reports on: time use, activities pursued, money spent	Aggregated data: time use, activities pursued and money spent
Spirituality	Self reports on: spiritual/transcendent experiences spiritual organization membership Time spent on spiritual activities	National data on: religious/spiritual book production/sales number and diversity of religious/spiritual organizations Aggregated data on self-described spirituality
Creativity / emotional expression	Self reports on: free time use	National data on "elite culture" organizations, events, participation
	Sense of play in work, etc.	Aggregated data on free time use
Identity	Self reports on: major statuses, sense of "place"	Aggregated data on: statuses and sense of "place"
Freedom	Self reports on: personal freedoms in various social contexts (family, work, religion, etc.)	National data on: freedom indicators, expression, press, voting policies etc…

In order to pursue the goal of integration, information should be analysed at the same level. This means that if the interest is to obtain a composite picture (e.g. national), the information collected at micro level needs to be in someway aggregated to the proper scales (spatial or temporal) in order to accomplish a correct analysis integrating objective and subjective data.
Actually, the problem of aggregation concerns the reduction/condensation of values observed at lower levels (usually, individuals) to higher levels (e.g. geographical areas) among which comparisons will be carried out. This problem involves both objective and subjective indicators, with different solutions.

[8] The logic represented in the table is easily applicable to other levels (community, regional, and so on).



The aggregation of objective information (observed at micro or macro level) to the proper scale can be obtained through different **criteria**:
(i) "compositional", when information refers to population (e.g. proportion of people living in poverty),
(ii) "contextual", when information refers to area/territory (irreducible to the individual level), for example, income distribution, population density, or absence of facilities, such as supermarkets, libraries, or health centres.

The aggregation of subjective information requires individuals' values to be aggregated in order to produce new synthetic values to be assigned to new meaningful units identified according to different kind of scales (typologies, geographical areas, administrative territories, etc.). This task is not an easy one and requires different approaches and particular attention and concern.
This aggregation perspective is particularly delicate when the scores to be aggregated refer to characteristics that are non-cumulative (like those related to subjective well-being); consequently, ad-hoc aggregating approaches need to be identified, especially when individual values can not be aggregated by simply summing up individuals' values.
From the technical point of view, the condensing procedure requires to define significant aggregation units and to adopt techniques allowing the aggregation of individual scores (*aggregating criteria*). Two aggregating criteria can be defined.
A. Homogeneity: the values are aggregated if the individual cases are homogeneous according to the characteristics of interest. The aggregated units produced by this criterion are **typologies** which can be then compared with reference to contextual and background (objective) information; identification of typologies requires analytical approaches allowing homogeneous groups among individual cases to be identified (Aldenderfer, 1984; Bailey, 1994; Corter, 1996; Hair, 1998; Lis & Sambin, 1977):

- ***segmentation analysis***, which can be conducted through different approaches (*Hierarchical Cluster Analysis, Q Analysis*);
- ***partitioning analysis***, which can be conducted through other approaches like *K Means Methods*, *Iterative Reclassification Methods*, *"Sift and Shift" Methods*, *Convergent Methods*;***tandem analysis***, which is realized by combining Principal Components Analysis and a clustering algorithm; the latter is applied to the scores obtained by the application of the former.
  The difficulty in applying this approach lies in the identification of synthetic scores that reveal themselves to be useless in identifying a cluster structure among observed units. In this perspective *Cluster Analysis* can also be combined with *MultiDimensional Scaling* (MDS) (Nardo et al., 2005a, 2005b).
- ***Factorial k-means Analysis***, which is realized by combining Principal Components Analysis and one of the *partitioning method* (*K Means method*, that is, *not-hierarchical Cluster Analysis*). A discrete clustering model and a continuous factorial one are simultaneously fitted to two-way data in order to identify the best partition of the objects. The partition is described by the best orthogonal linear combinations of the variables (factors) according to the least-squares criterion. This approach has great potentiality since it simultaneously allows two objectives to be reached: data reduction and synthesis, simultaneously in direction of both objects and variables. The factorial k-means analysis applies a fast alternating least-squares algorithm that extends its application to large data sets (Nardo et al., 2005a, 2005b).

Each analytical approach produces results that vary according to the decisions made in terms of:

- selected indicators;
- measures used in order to evaluate proximities between individual-points;
- method used in order to assign an individual-points to a group;
- criterion used in order to determine the number of groups;
- criterion used in order to check the interpretability of the groups.

Each typology will be considered in the context of the successive higher-level analysis in terms of

- categorical information to which other information can be associated, like the dimension of the group,
- simple descriptive statistics, univariate (mean, median) or multivariate (centroid).

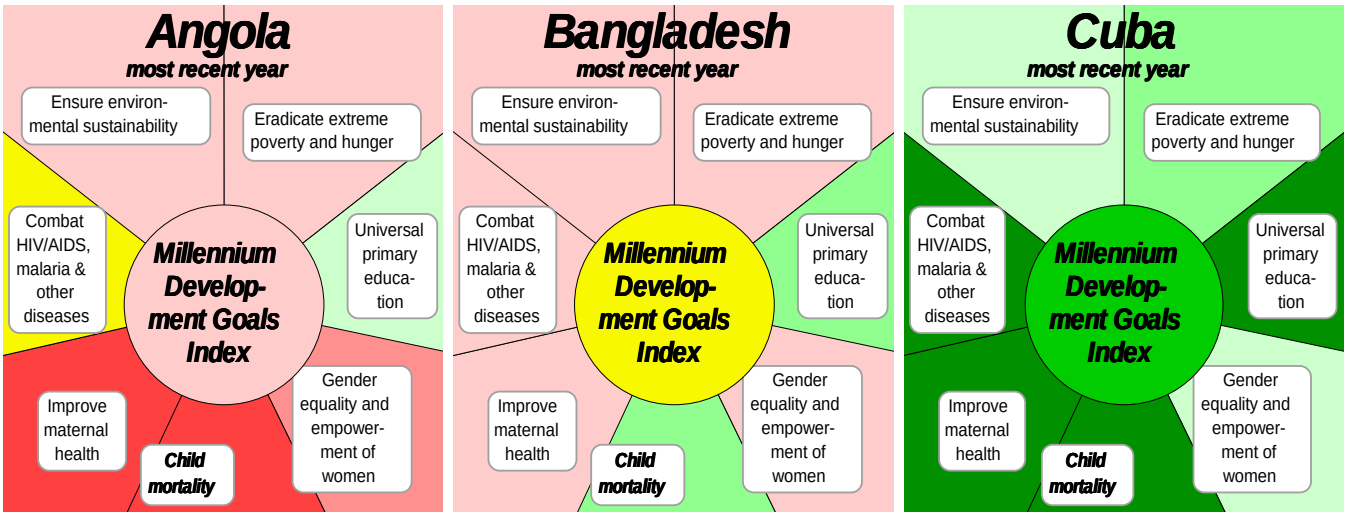
B. Functionality: the values are aggregated if the individuals belong to pre-existent higher-level units defined in terms of **groups** (social, generational, etc.), **areas** (geographical, administrative, etc.), **time periods** (years, decades, etc.).
If the subjective information is collected from a probabilistic sample, it is possible to take into account the weight that each sampled individual has with reference to the correspondent population by assigning a differential weight. The matter is dealt with statistical approaches related to inference methods and sampling techniques.
This kind of aggregation requires particular attention since the application of the traditional statistical averaging techniques does not allow us to highlight the distributional characteristics of each aggregated units, which consequently could not be correctly compared in order to avoid the well-known *ecological fallacy*.[9]
Regarding this issue, attempts aimed at weighting average values by different criteria can be identified (Kalmijn & Veenhoven, 2005; Veenhoven, 2005).

3.2 Combining indicators

3.2.1 Dashboards

Dashboards represent a tool, useful in the perspective of combining indicators. This tool aims at representing indicators' values
- through an analogical perspective
- by setting them on a standardized scale, allowing comparisons between indicators
- by representing them on colour scale (e.g., a green-to-red colour scale), allowing their interpretation in terms of performance.

In the following example (from Joint Research Centre – European Commission), three countries are compared with reference to several indicators (related to the UN Millennium Development Goals). The colours help in identifying the reached goals (in the perspective of national policy evaluation):



Through the graphical display, dashboards allow comprehensive monitoring and evaluation of programmes, performances or policies, since
- highly complex systems of indicators can be represented by taking into account the hierarchical design,
- an easy communication are possible through a catchy and simple graphical representation,
- indicators can be related to weights interpreted in terms of

[9] Aggregation of scores collected at micro levels is a well-known issue in many scientific fields, like economics and informatics, where particular analytic approaches are applied (like the probabilistic aggregation analysis). In econometric fields, particular empirical methodologies have been developed, allowing the explanation of systematic individual differences (*compositional heterogeneity*) that can have important consequences in interpreting aggregated values (Stoker, 1993).

a. *importance* (reflected by the size of the segments) and
b. *performance result* (reflected by the colour, interpretable in terms of "good vs. bad")

- performances of different cases can be compared.

Several software programmes (free or not) can be used in order to carry out the graphical representation through different images. Whichever representation form is adopted, it allows indicators' values to be displayed through

a. separated values (not aggregated values), allowing weak and strong points to be analysed,
b. colours, allowing the analysis of relative performance (value to be displayed relatively to an expected value or a given level / targets)
c. distributions, allowing assessment indicators' meaningfulness, outliers identification, etc.
d. scatterplot graph, allowing simple correlation analysis between the indicators to be accomplished. This function allows synergies (indicators whose "desirable" values are positively correlated) and potential conflicts (e.g. environment vs. many economic and social variables) to be identified.

Of course, dashboard does not allow complex analysis concerning relationships between indicators and comparisons of performance over time (trends) or across units (inter-cases comparisons).
Dashboards can be useful in view of composite indicators creation.

3.2.2 Composite indicators

A composite indicator synthesizes a number of values expressed by the indicators that compound it (Nardo et al., 2005; Sharpe & Salzman, 2004) and re-establishing the unity of the concept described in the hierarchical design. The aggregating process allows to obtain not a faithful description of the reality, but an "indication" that will be more or less accurate, meaningful, and interpretable depending on the defined hierarchical design and the applied methodology. In other words, the composite indicators are aimed at describing synthetically a reality, which is and remains complex.
The methodology aimed to construct composite indicators requires specific techniques aimed at[10]

1. verifying the dimensionality of selected elementary indicators (*dimensional analysis*)
2. defining the importance of each elementary indicator to be aggregated (*weighting criteria*)
3. identifying the technique for aggregating the elementary indicators values into synthetic indicators (*aggregating-over-indicators techniques*)
4. assessing the robustness of the synthetic indicator in terms of capacity to produce correct and stable measures (*uncertainty analysis, sensitivity analysis*)
5. assessing the discriminant capacity of the synthetic indicator (*ascertainment of selectivity* and *identification of cut-point or cut-off values*)

Composite indicators could represent one of the possible technical approaches to integration of objective and subjective indicators, which would turn out to be aggregated in a unique value referring to each unit of interest (city, country, and so on). This proposal can appear attractive at a first glance but does not reveal to be easy and creates conceptual, interpretative and analytical problems when the aggregation involves measures that are both subjective and objective.
For example, we can consider the standardization issue: in order to create composite indicators, data need to be reduced to a common reference-metric. That is particularly significant when data are measured with reference to different methodologies; for example, individual data do not always meet the requirement of metric measurement (like some objective individual information, for example, family typology); the problem is how to face the issue without adopting sophisticated approaches. In our opinion, this approach could be carefully considered as one of the possible solutions for integration.

3.3 Modelling indicators

Dealing with a comprehensive conceptual framework requires exploring the relationships among the indicators, which conceptually model and hierarchically design the variables.
In this perspective, a proper analytical approach should be identified according to the defined conceptual framework. The feasibility of the different statistical approaches needs to be considered by taking into account their specific assumptions. The goal is to identify a procedure able to yield results, not only

[10] As known, any data analysis process requires a first stage aimed at verifying the completeness (*imputation strategies and techniques* defined for missing data) and transformation of collected data.

statistically valid and consistent with reference to the defined conceptual framework, but also easy to be read and interpreted at policy level.

Structural models approach

With reference to the causal explanatory perspective, we can refer to *Structural Equation Modelling* (SEM), which, as known, represents a statistical technique for testing and estimating causal relationships using a combination of statistical data and qualitative causal assumptions.

SEM is considered a confirmatory rather than exploratory approach. It usually starts with a hypothesis, represented as a model, operationalises the constructs of interest with a measurement instrument, and tests the model.

The causal assumptions embedded in the model often have falsifiable implications, which can be tested through data evidence. SEM can also be used inductively by specifying the model and using data to estimate the values of free parameters. Often the initial hypothesis requires to be adjusted in light of model evidence, but SEM is rarely used purely for exploration.

SEM models allow unreliability of measurement in the model to be explicitly captured and, consequently, structural relations between latent variables to be accurately estimated.

In the ambit of its specific assumptions, this approach can be adopted only in presence of a strong and indubitable conceptual interpretative framework concerning the causal relationships between objective and subjective indicators. In other words, it requires a strong acceptance of the direction of the relation between objective and subjective indicators.

Moreover, as shown above, two possible directions can be defined in casual explanation of well-being, *bottom-up* and *top-down*, which, however, are not separately able to explain completely the relationships between the observed variables. This means that causal effects can emerge in both directions. Diener (1984) suggested using both *bottom-up* and *top-down* approaches in order to examine the causal directions of well-being. Consequently, the application of the model allowing bi-directional effects to be estimated, has to be carried on with extreme caution (Scherpenzeel & Saris, 1996) and requires longitudinal data and analyses. The caution should increase especially in presence of both objective and subjective indicators.

Because of these difficulties, any application of this approach requires a strong conceptualisation of an explanatory model. Otherwise, any result can turn out to be misleading.

Multi-level approach

Multi-level analysis refers to statistical methodologies, first developed in the social sciences, which analyse outcomes simultaneously in relation to determinants measured at different levels (for example, individual, workplace, neighbourhood, nation, or geographical region existing within or across geopolitical boundaries) (Goldstein, 1999; Hox, 1995; Krieger, 2002).

This approach can be applied in the perspective of integrating objective and subjective indicators by assuming that people living in the same territory (e.g. city or region) share the same macro-level living conditions (objective quality of life) that contributes together with the micro-level living conditions (objective quality of live) to the subjective well-being. If the conceptual model is clearly specifiable and acceptable with reference to which variables are to be included in the study and at which level, these analyses can potentially assess whether individuals' well-being is influenced by not only "individual" or "household" characteristics but also "population" or "area" characteristics (Krieger, 2002). In fact, this approach assumes that structural characteristics of territories come before individual living conditions and that both precede subjective well-being. The goal is to describe the relationships between subjective well-being ("outcome" variable), territorial characteristics (macro-level living conditions: socio-economic conditions, demographic trend, and so on) and individual objective characteristics (micro-level living conditions: sex, religion, family composition, level of education, and so on).

The general analytical framework could be multiple regression: the subjective well-being is regressed on territorial and individual characteristics. If the goal is to evaluate the importance of territorial characteristics on subjective well-being, we could aggregate individual data at territorial level, but – as we know – this could result in the well-known *ecological fallacy*. In fact, the correlation between the observations resulting from the multilevel structure (the individuals on the same territory present the same values concerning the territory characteristics) of data make the outcomes of the same territory more homogeneous than those yielded by a random sample of individuals drawn from the whole population. This higher homogeneity is naturally modelled by a positive within-territory correlation among individual level of subjective well-being in the same territory. This problem can be avoided by applying a variance component model.

In statistics, a *variance components model*, also called *random effect/s model***,** is a kind of *hierarchical linear model*. These models (along with generalized linear mixed models, nested models, mixed models, random coefficient, random parameter models, split-plot designs) are part of *multilevel models* (Bryk & Raudenbush, 2002), which are statistical models of parameters that vary at more than one level. These models can be

seen as generalizations of linear models (also extendible to non-linear models)[11] and represent more advanced forms of simple linear regression and multiple linear regression. They are appropriate for use with nested data. In particular, they assume that the data describe a hierarchy of different populations whose differences are constrained by the hierarchy.
In other words, multilevel analysis allows variance in outcome variables to be analysed at multiple hierarchical levels, whereas in simple linear and multiple linear regression all effects are modelled to occur at a single level.
For example, in educational research, where data is often considered as pupils nested within classrooms nested within schools, it may be necessary to assess the performance of schools teaching by one method against schools teaching by a different method. It would be a mistake to analyse this kind of data as though the pupils were simple random samples from the population of pupils taught by a particular method. Pupils are taught in classes, which are in schools. The performance of pupils within the same class will be correlated, as will the performance of pupils within the same school.
Conceptually the model is often viewed as a hierarchical system of regression equations. For example, assume we have data in J groups or contexts and a different number of individuals N_j in each group. On the individual (lowest) level we have the dependent variable Y_{ij} and the explanatory variable X_{ij}, and on the group level, we have the explanatory variable Z_j. Thus, we have a separate regression equation in each group:

$$Y_{ij} = \beta_{0j} + \beta_{1j} X_{ij} + e_{ij} \quad (1)$$

The β_j are modelled by explanatory variables at the group level:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} Z_j + u_{0j} \quad (2)$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} Z_j + u_{1j} \quad (3)$$

Substitution of (2) and (3) in (1) gives:

$$Y_{ij} = \gamma_{00} + \gamma_{10} X_{ij} + \gamma_{01} Z_j + \gamma_{11} Z_j X_{ij} + u_{1j} X_{ij} + u_{0j} + e_{ij} \quad (4)$$

in general there will be more than one explanatory variable at the lowest level and also more than one explanatory variable at the highest level. Assume that we have *P* explanatory variable *X* at the lowest level, indicated by the subscript *p* (*p*=1,…, *P*), and *Q* explanatory variables *Z* at the highest level, indicated by the subscript *q* (*q*=1, …, *Q*). Then, equation (4) becomes the more general equation:

$$Y_{ij} = \gamma_{00} + \gamma_{p0} X_{pij} + \gamma_{0q} Z_{qj} + \gamma_{pq} Z_{qj} X_{pij} + u_{pj} X_{pij} + u_{0j} + e_{ij} \quad (5)$$

Multilevel analysis generally uses Maximum Likelihood (ML) estimators, with standards errors estimated from the inverse of the information matrix. Computing the ML estimates requires an iterative procedure. (Bryk and Raudenbush, 1992; Goldstein, 1999; Hox, 1995)
Even if the multilevel approach presents logic and analytic solutions acceptable from the statistical point of view, this method should be considered carefully in the context of quality of life. For instance, when the territorial characteristics do not affect individuals in the same manner and with the same degree (territorial heterogeneity), some authors (Rampichini & Schifini, 1998) suggest introducing a new level in the hierarchy, represented by individuals within each territory. For example, different clusters of individuals could be identified sharing same living conditions at micro-level. This could lead to results in which similar clusters are in different territories.

Life-course perspective

Life-course perspective refers to a conceptual model that considers well-being status at any given individual state (age, sex, marital status) not only reflecting contemporary conditions but also embodying prior living circumstances. This means that we could try to study people's developmental trajectories (environmental and social) over time, by considering also the historical period in which they live, in reference to their society's social, economic, political, and ecological context. This approach assumes that some components can exist which can determine an effect, at a sensitive or "critical" period of individual life, lasting, or having a lifelong significance. The interest could be oriented to analysing which of these processes are reversible and which could be the role of objective micro or macro level characteristics in this.
This perspective deserves particular attention and consideration. Its limit is mainly represented by the difficulty to obtain detailed and consistent individual longitudinal data and by the complexity of managing, analysing, and modelling this kind of data. According to its characteristics, this approach turns out to be useful in order to study phenomena circumscribable through a clinical logic.

[11] Multilevel analysis has been extended to include multilevel structural equation modelling, multilevel latent class modelling, and other more general models.

Bayesian networks approach

A Bayesian network is a graphical model representing a certain reality described by variables. The goal is to explore the relationships among the variables of interest through probabilities.
When used in conjunction with statistical techniques, the Bayesian network model has several advantages for data analysis because:

1. the model encodes dependencies among all variables and handles situations where some data entries are missing
2. it can be used to learn causal relationships, and hence can be used to gain understanding about a problem and to predict the consequences of intervention
3. it has both a causal and probabilistic semantics, it is an ideal representation for combining prior knowledge (which often comes in causal form) and data[12]
4. Bayesian statistical methods in conjunction with Bayesian networks offer an efficient and principled approach aimed at avoiding data overfitting.

A Bayes net represents a model, reflecting the states of some part of a world that is being modelled and describing how those states are related by probabilities. All the possible states of the model represent all the possible worlds. The direction of the link arrows roughly corresponds to "causality". That is the nodes higher up in the diagram tend to influence those below rather than, or, at least, more so than the other way around.
In a Bayes net, the links may form loops, but they may not form cycles.
This model has several **advantages** for data analysis:

1. the model encodes dependencies among all variables, it readily handles situations where some data entries are missing.
2. it is adaptable since it can be used to learn causal relationships, and hence can be used to gain understanding about a problem domain and to predict the consequences of intervention.
3. it has both a causal and probabilistic semantics, it is an ideal representation for combining prior knowledge (which often comes in causal form) and data.
4. it offers an efficient and principled approach for avoiding the overfitting of data.
5. Since a Bayes net only relates nodes that are probabilistically related by some sort of causal dependency, an enormous saving of computation can result. There is no need to store all possible configurations of states. All that is needed to store and work with is all possible combinations of states between sets of related parent and child nodes (families of nodes).
6. it can be useful in assisting decision making. If some states lead to “positive” results (e.g. pleasure), while others to negative outcome (e.g. pain), it is possible to implement the model in order to maximize the former and minimize the latter. There is a science of decision making that mixes probability with measurements of value. It is called *Decision Theory* or *Utility Theory*. Bayes nets are easily extended to computing utility, given the degree of knowledge we have on a situation, and so they have become very popular in business and civic decision making as much as in scientific and economic modeling.

Some **limitations** can be identified.

1. the remote possibility that a system's user might wish to violate the distribution of probabilities upon which the system is built.
2. the computational difficulty of exploring a previously unknown network.
3. the quality and extent of the prior beliefs used in Bayesian inference processing. A Bayesian network is only as useful as this prior knowledge is reliable. Either an excessively optimistic or pessimistic expectation of the quality of these prior beliefs will distort the entire network and invalidate the results. Related to this concern is the selection of the statistical distribution induced in modelling the data. Selecting the proper distribution model to describe the data has a notable effect on the quality of the resulting network.

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Traditional explorative approaches, such as clustering and mapping approaches, multidimensional analysis, correspondences analysis (Aldenderfer, 1984; Bailey, 1994; Corter, 1996; Hair, 1998; Lis and Sambin, 1977), should be added to the approaches presented above. The approaches are all practicable but in view of their application, their capability to meet assumptions and to fit the needs of the conceptual framework need to be explored.

[12] Classical inferential models do not permit the introduction of prior knowledge into the calculations. This prevents the introduction of extraneous data that might skew the experimental results. However, there are times when the use of prior knowledge would be a useful contribution to the evaluation process.

4. An example

The particular application illustrated here is aimed at illustrating and exemplifying the *multi-technique multi-stage* characterization (goals no. 1 and 3) of the proposed approach by using subjective and objective data provided by the European Social Survey project)[13] and the Joint Research Centre (JRC – European Commission), respectively.

1. REDUCING THE COMPLEXITY OF DATA STRUCTURE

(i) First stage: construction of synthetic indicators at individual level

The goal of this stage is to create synthetic subjective indicators through the aggregation of elementary indicators. The aggregation procedure should be consistent to the adopted model of measurement, that is:

- reflective approach: in this case the aggregation procedure requires an approach aimed to confirm the hypothesis concerning the relationship between latent variables and elementary indicators; in case of subjective indicators, scaling models can generally represent valid approaches. The scaling model has to be chosen consistently with the assumed dimensionality, the nature of observed data (preferences, similarities, and so on), the adopted scaling technique (comparative or non-comparative).
- formative approach: in this case the aggregation procedure requires a different approach like the one aimed at composite indicators construction (Nardo et al., 2005a and 2005b).

From the European Social Survey data, some variables have been identified:

European Social Survey – wave 1 (2002)					
Area	Variable	Items	Item number	Scaling technique	Model of measurement
Politics	Trust in	country's parliament	B7	0 (no trust at all) – 10 (complete trust)	reflective
		the legal system	B8		
		the police	B9		
		politicians	B10		
		the European Parliament	B11		
		the United Nations	B12		
	Self-placement	placement on left-right scale	B28	0 (left) – 10 (right)	
	How satisfied with	present state of economy in country	B30	0 (extremely dissatisfied) – 10 (extremely satisfied)	reflective
		the national government	B31		
		the way democracy works in country	B32		
		state of education in country nowadays	B33		
		state of health services in country nowadays	B34		
Subjective aspects	Happiness	how happy are you	C1	0 (extremely unhappy) – 10 (extremely happy)	
	Life satisfaction	how satisfied with life as a whole	B29	0 (extremely dissatisfied) – 10 (extremely satisfied)	
	Values: important in life	family	E13	0 (extremely unimportant) – 10 (extremely important)	formative
		friends	E14		
		leisure time	E15		
		politics	E16		
		work	E17		
		religion	E18		
		voluntary organizations	E19		
Immigration and asylum issues	Acceptance of immigration: allow	many/few immigrants of same race/ethnic group as majority	D4	1. allow many 2. allow some 3. allow a few 4. allow none to come and live here	reflective
		many/few immigrants of different race/ethnic group from majority	D5		
		many/few immigrants from richer countries in Europe	D6		
		many/few immigrants from poorer countries in Europe	D7		
		many/few immigrants from richer countries outside Europe	D8		
		many/few immigrants from poorer countries outside Europe	D9		

[13] For any further information on European Social Survey project, please refer to http://www.europeansocialsurvey.org/ where data and documentation can be found.

Socio-demographic profile	Income	feeling about household's income nowadays	F31	1. living comfortably 2. coping 3. difficult 4. very difficult on present income	

Items referring to each variable were submitted to analysis in order to verify the dimensionality. Afterwards, in case of:

- *uni-dimensional latent variable*, the items aggregation was performed through a simple additive technique,
- *multi-dimensional latent variable*: the items aggregation was performed through principal component analysis that allowed us to obtain scores showing normal-standardized distributions.

Reflective approach: aggregation accomplished by testing multi-dimensional hypothesis

Variable	Items	Item number	Item loading	Factor/dimension	Variance explained (%)	Aggregated score
Trust in	the legal system	B8	0.5	national security	31	TRUST_NS
	the police	B9	1.0			
	the European Parliament	B11	0.8	international institutions	33	TRUST_II
	the United Nations	B12	0.5			
	country's parliament	B7	0.7	national politics	36	TRUST_NP
	politicians	B10	0.7			
How satisfied with	present state of economy in country	B30	0.5	satisfaction for national foundations	41	SAT_NF
	the national government	B31	0.7			
	the way democracy works in country	B32	0.5			
	state of education in country nowadays	B33	0.5	satisfaction for national social services	31	SAT_NSS
	state of health services in country nowadays	B34	0.5			

Reflective approach: aggregation accomplished by testing unidimensional hypothesis

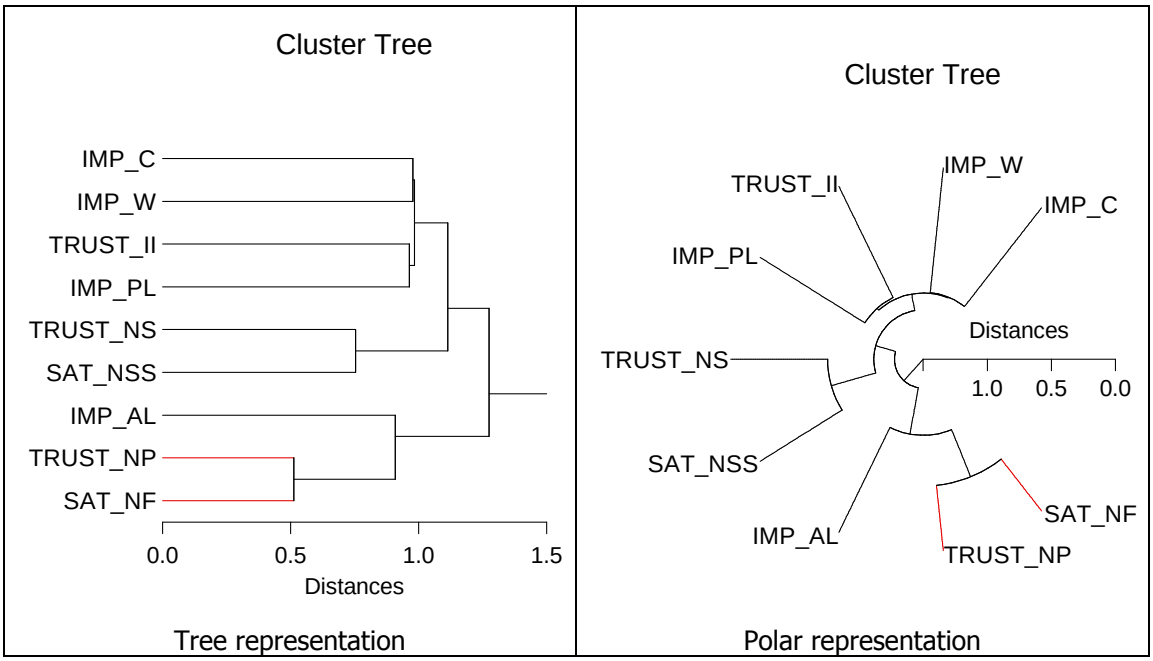
Variable	Items	Item number	Unidimensional model	Aggregated score
Acceptance of immigration: allow	many/few immigrants of same race/ethnic group as majority	D4	aggregation though additive technique	IMMIGR
	many/few immigrants of different race/ethnic group from majority	D5		
	many/few immigrants from richer countries in Europe	D6		
	many/few immigrants from poorer countries in Europe	D7		
	many/few immigrants from richer countries outside Europe	D8		
	many/few immigrants from poorer countries outside Europe	D9		

Formative approach: aggregation accomplished through Principal Component Analysis

Variable	Items	Item number	Item loading	Component	Variance explained (%)	Aggregated score
Values: important in life	family	E13	0.6	Private life dimension	23	IMP_PL
	friends	E14	0.8			
	leisure time	E15	0.7			
	politics	E16	0.8	Active life dimension	18	IMP_AL
	voluntary organizations	E19	0.6			
	family	E13	0.5	Caring dimension	18	IMP_C
	religion	E18	0.9			
	voluntary organizations	E19	0.5			
	work	E17	1.0	Work dimension	15	IMP_W

Ten synthetic indicators were computed and then submitted to a successive level of aggregation, according to the formative approach, in order to obtain a small group of meaningful and interpretable composite indicators. This aggregation was obtained through Principal Component Analysis and Hierarchical Cluster Analysis (linkage method: Ward; distance technique: Pearson). The outcomes obtained by the two methods turned out to be identical and show the same four dimensions, each one composed by indicators referring to trust, importance and satisfaction characteristics. A particular result has to be noticed: "importance for private life" indicator obtained significant loadings in two components in Principal Component Analysis.

Synthetic indicators		Item loading	Obtained component	Variance explained (%)	Aggregated score
National politics	TRUST_NP	0.8	Public & political life	18	COMPOSITE1
Active life dimension	IMP_AL	0.6			
Satisfaction for national foundations	SAT_NF	0.8			
national security	TRUST_NS	0.8	Welfare dimension	15	COMPOSITE2
Private life dimension	IMP_PL	0.4			
Satisfaction for national social services	SAT_NSS	0.7			
Caring dimension	IMP_C	0.4	Personal life principles	12	COMPOSITE3
International institutions	TRUST_II	0.6			
Private life dimension	IMP_PL	0.4			
Work dimension	IMP_W	0.6			



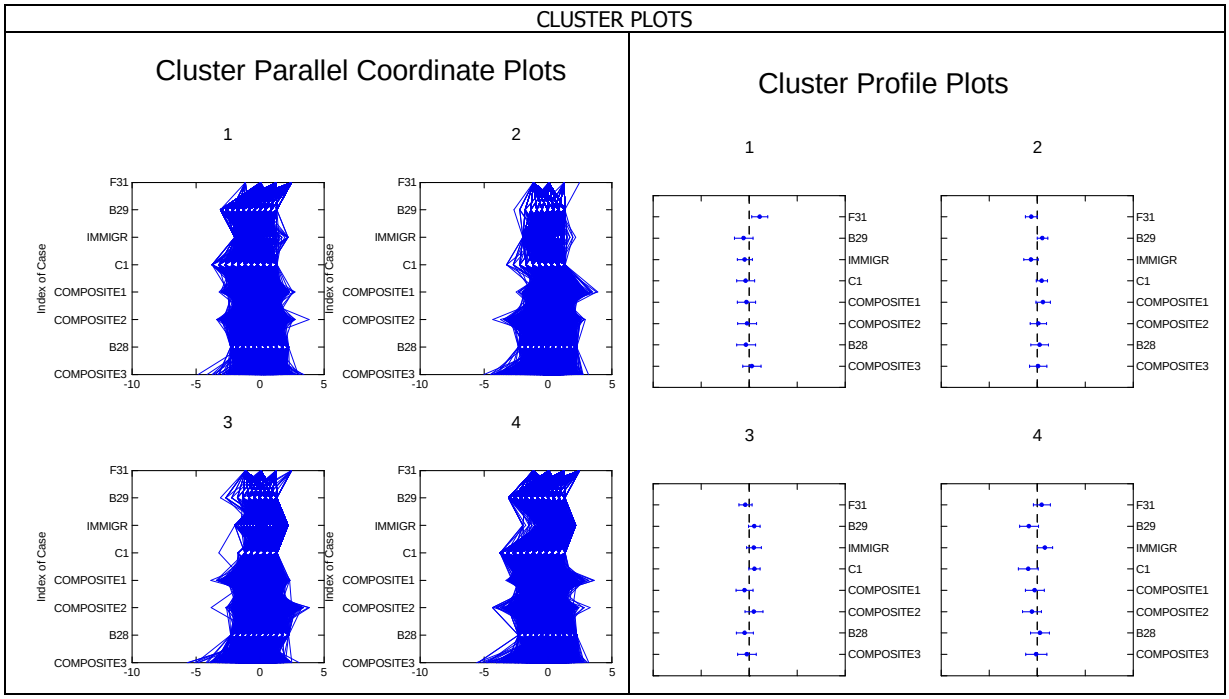
Composite scores were calculated by means of Principal Component Analysis according to the observed results.
At this stage the aggregation process has concerned also objective indicators (construction of composite indicators through formative criterion).

(ii) Second stage: definition of macro-units

At this stage, a partitioning analysis were conducted (*K means method*) in order to explore the existence of homogenous groups of individuals. In the following table and figures, the results are presented.

		INDICATOR	min.	mean	max.	SD
CLUSTER 1 (n=7369)	B29	life satisfaction	-3.10	-0.58	1.31	0.97
	C1	happiness	-3.74	-0.37	1.34	0.93
	F31	Feeling about household's income nowadays	-1.14	1.10	2.46	0.85
	B28	self-placement on left-right scale	-2.30	-0.34	2.24	0.98
	IMMIGR	Non-acceptance of immigration	-1.96	-0.47	2.17	0.79
	COMPOSITE1	Public & political life	-3.19	-0.29	3.13	0.95
	COMPOSITE2	Welfare dimension	-3.88	-0.22	3.83	0.98
	COMPOSITE3	Personal life principles	-4.86	0.27	3.44	0.97
CLUSTER 2 (n=14855)	B29	life satisfaction	-3.10	0.54	1.31	0.54
	C1	happiness	-3.74	0.48	1.34	0.59
	F31	Feeling about household's income nowadays	-1.14	-0.61	2.46	0.63
	B28	self-placement on left-right scale	-2.30	0.26	2.24	0.92
	IMMIGR	Non-acceptance of immigration	-1.96	-0.64	2.17	0.76
	COMPOSITE1	Public & political life	-2.50	0.60	4.08	0.76
	COMPOSITE2	Welfare dimension	-4.32	0.12	2.90	0.86
	COMPOSITE3	Personal life principles	-5.03	0.10	3.15	0.91

CLUSTER 3 (n=9703)	B29	life satisfaction	-3.10	0.53	1.31	0.60
	C1	happiness	-3.23	0.54	1.34	0.58
	F31	Feeling about household's income nowadays	-1.14	-0.40	2.46	0.68
	B28	self-placement on left-right scale	-2.30	-0.46	2.24	0.90
	IMMIGR	Non-acceptance of immigration	-1.96	0.48	2.17	0.78
	COMPOSITE1	Public & political life	-3.85	-0.49	2.36	0.90
	COMPOSITE2	Welfare dimension	-3.83	0.48	3.85	0.94
	COMPOSITE3	Personal life principles	-5.71	-0.24	3.07	0.97
CLUSTER 4 (n=10418)	B29	life satisfaction	-3.10	-0.86	1.31	1.00
	C1	happiness	-3.74	-0.93	1.34	1.04
	F31	Feeling about household's income nowadays	-1.14	0.47	2.46	0.89
	B28	self-placement on left-right scale	-2.30	0.30	2.24	0.99
	IMMIGR	Non-acceptance of immigration	-1.96	0.81	2.17	0.79
	COMPOSITE1	Public & political life	-3.47	-0.26	3.61	0.99
	COMPOSITE2	Welfare dimension	-4.34	-0.54	3.29	0.99
	COMPOSITE3	Personal life principles	-5.59	-0.11	3.22	1.11

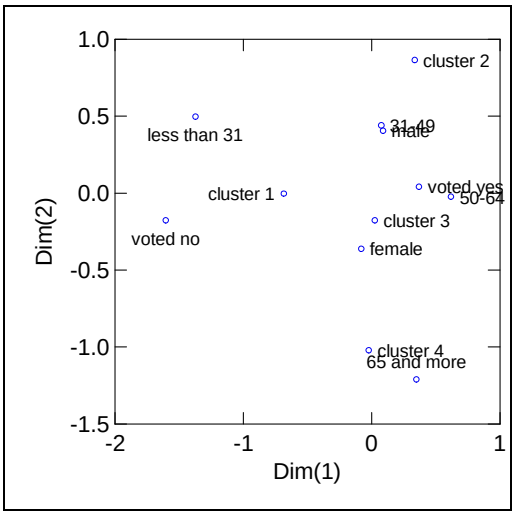


The obtained clusters have shown quite differentiated profiles. In the following table a possible synthetic description of each cluster is described. Cluster 1 and cluster 4 seem to be the group with problematical profiles. Cluster 1 and cluster 4 seem to be the groups with problematical profiles. In particular, cluster 4 seems to be composed by individual with low level of well-being and trust and importance in society dimensions, high level of non-acceptance of immigration and low, and a clear self-placement on left-right political scale.

		CLUSTER 1	CLUSTER 2	CLUSTER 3	CLUSTER 4
B29	life satisfaction	Medium-low	Medium-high	Medium-high	low
C1	happiness	Medium-low	Medium-high	High	low
F31	Feeling about household's income nowadays	many difficulties	Very comfortable	comfortable	Some difficulties
B28	self-placement on left-right scale	Centre-left	Centre-right	Left	Right
IMMIGR	Non-acceptance of immigration	Medium-low	Low	Medium-high	High
COMPOSITE1	Public & political life	Medium-low	High	Low	Medium-low
COMPOSITE2	Welfare dimension	Medium-low	Medium-high	High	Low
COMPOSITE3	Personal life principles	High	Medium-high	Low	Medium-low

The conceptual framework should point out the individual objective characteristics to be integrated with the subjective ones (synthesized in clusters definition) at micro level. This level of integration is aimed at exploring and understanding subjective responses in terms of individual characteristics.
In this application we have chosen gender, age, and individual position with reference to vote in last political election. These indicators were submitted to correspondence analysis together with the cluster indicator. The analysis, performed on more than 38 thousands respondents with almost 30% of total inertia explained, produced a configuration (see following figure) in which the more frequent profiles can be identified. For

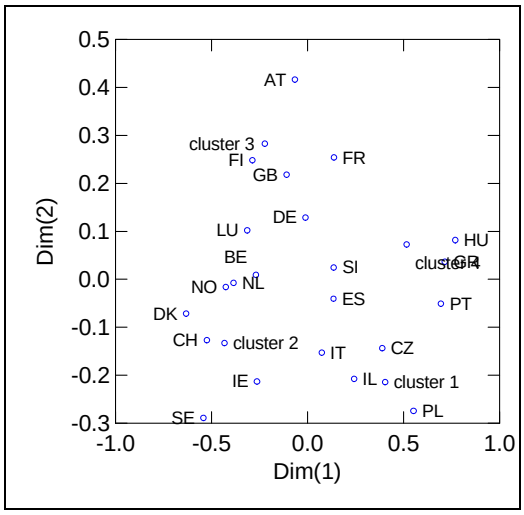
example, cluster 1 is more frequent among young individuals who did not vote, while cluster 4 is more frequent among elderly persons.



The clusters obtained through the previous stage were considered aggregations of subjective information (homogeneity criterion). In the following table the incidence of each cluster for each country can be observed.

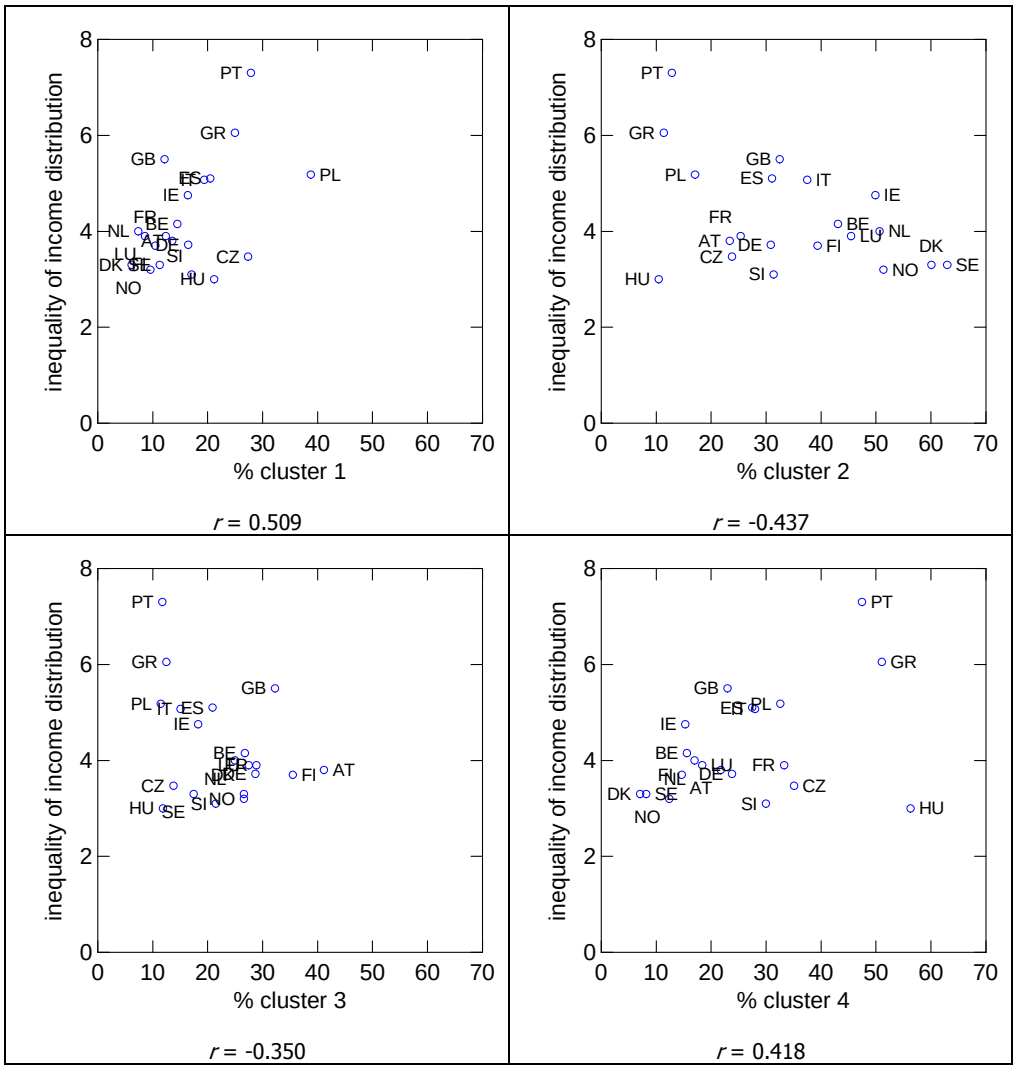
		cluster				Total	N
		1	2	3	4		
AT	Austria	13.6	23.4	41.2	21.8	100.0	2257
BE	Belgium	14.5	43.1	26.8	15.6	100.0	1897
CH	Switzerland	10.9	57.5	22.9	8.8	100.0	2040
CZ	Czech Rep.	27.4	23.8	13.8	35.1	100.0	1360
DE	Germany	16.5	30.9	28.7	23.8	100.0	2919
DK	Denmark	6.2	60.1	26.6	7.1	100.0	1500
ES	Spain	20.5	31.1	20.9	27.5	100.0	1728
FI	Finland	10.5	39.4	35.5	14.7	100.0	2000
FR	France	12.4	25.4	28.9	33.3	100.0	1503
GB	United Kingdom	12.2	32.5	32.3	23.0	100.0	2051
GR	Greece	25.0	11.4	12.5	51.1	100.0	2566
HU	Hungary	21.2	10.5	11.9	56.3	100.0	1685
IE	Ireland	16.4	49.9	18.3	15.3	100.0	2046
IL	Israel	32.6	26.1	19.0	22.3	100.0	2497
IT	Italy	19.4	37.5	15.1	28.0	100.0	1206
LU	Luxembourg	8.6	45.5	27.5	18.4	100.0	1552
NL	Netherlands	7.4	50.7	25.0	17.0	100.0	2364
NO	Norway	9.6	51.4	26.6	12.4	100.0	2036
PL	Poland	38.8	17.1	11.5	32.6	100.0	2109
PT	Portugal	27.9	12.9	11.8	47.5	100.0	1511
SE	Sweden	11.3	63.0	17.5	8.2	100.0	1999
SI	Slovenia	17.1	31.4	21.5	30.0	100.0	1519
Total		17.4	35.1	22.9	24.6	100.0	
N		7369	14855	9703	10418		42345

After that, correspondence analysis was performed by considering different indicators and applying a particular causal model (cluster=country). In the following figure the four clusters turn out to be more frequent with reference to different country. For example, cluster 1 is more frequent in Poland, Israel, and Czech samples.



3. MODELLING INDICATORS

At this stage the information of the incidence of each cluster for each country was used and related to objective indicators measured at macro level. In the following figures (in which *x* scales show the same range in order to preserve comparability between scatterplots) the national incidences are related to *inequality of income distribution* of each country.



The results show a clear relationship between clusters incidences and the objective indicator measured at country level especially with reference to cluster 1, which represents the more

problematic among the four observed clusters.

5. Final remarks

The main goal of this work is to illustrate the composite approach through which integration between objective and subjective information is made possible. The approach is carried out through subsequent stages. In each stage different analytical solutions can be found. The soundness of the approach and of its results relies on the defined and adopted conceptual framework assuming the correct perspective to be identified according to different objectives, (i) the aggregation of indicators and units, (ii) the integration of objective and subjective information, and (iii) the levels at which the previous objectives have to be pursued.
The illustrated application, which was made possible by the contribution of the Econometrics and Applied Statistics Unit (EAS) at the Joint Research Centre of the European Commission, has the restricted goal to illustrate and exemplify the *multi-technique multi-stage* characterization of the proposed approach. Since the process of integration of subjective and objective information can have different goals (monitoring, reporting, accounting, and so on), the outcomes can provide useful solutions for the different objectives.
The paper presents only the first step of our study. Together with EAS – JRC, the methodology will be explored in order to provide further results, especially in longitudinal perspective.

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