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*Paola Graziano, Dipartimento di Scienze Economiche e Sociali, Università Cattolica del Sacro Cuore, Piacenza e Applied Economics Research Group, Universidad de Cartagena (corresponding author).*

*Paolo Rizzi, Dipartimento di Scienze Economiche e Sociali, Università Cattolica del Sacro Cuore, Piacenza.*

*Mariacristina Piva, Dipartimento di Politica Economica, Università Cattolica del Sacro Cuore, Milano.*

*Laura Barbieri, Dipartimento di Scienze Economiche e Sociali, Università Cattolica del Sacro Cuore, Piacenza.*

✉ laura.barbieri@unicatt.it

✉ paola.graziano@unicatt.it

✉ mariacristina.piva@unicatt.it

✉ paolo.rizzi@unicatt.it

I quaderni possono essere richiesti a:
Dipartimento di Scienze Economiche e Sociali,
Università Cattolica del Sacro Cuore
Via Emilia Parmense 84 - 29122 Piacenza - Tel. 0523 599.342
http://dipartimenti.unicatt.it/dises

✉ dises-pc@unicatt.it

www.vitaepensiero.it


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*Abstract*

The definition of wellbeing and the subsequent search for its determinants are the subject of a great deal of debate and the focus of numerous surveys at national and international level. This has led to a spread of models analyzing collective happiness, life satisfaction and quality of life. We position our paper among the studies on the role of territory on individual and community wellbeing considering the conceptual background of sustainability and, more in detail, the resilience area (OECD, 2014). In our study on the determinants of regional wellbeing, a sustainability-oriented approach- from both a subjective and an objective point of view – is proposed. Our aim is to analyze the effect of adaptation capacity on life satisfaction, studying the role played by resilience in its economic, social and environmental dimensions. The econometric analysis is applied to 238 European regions at NUTS-2 level observed over the last decade. The main empirical result is that resilience is highly significant in explaining life satisfaction: the more resilient the region is, the more satisfied its inhabitants are.

*Keywords*: European regions, wellbeing, resilience
*JEL Classification*: R1, R11, Q01

## *1. Introduction*

The definition of wellbeing highlights a variety of components connected to emotional dimensions, life satisfaction and positive functioning that could be observed from both individual and community points of view. The search for the determinants of wellbeing have extended from philosophy to social science, underlining the characteristics of individuals and communities associated with it. The link among quality of life, collective happiness and life satisfaction are the subject of a wide debate and the focus of numerous surveys at the national and international level (Frey and Stutzer 2000; Layard 2006; Maggino and Nuvolati 2012; Helliwell et al. 2016). Some of these models display the importance of spatial characteristics in different patterns (Rodríguez-Pose and Maslauskaite 2012; Lenzi and Perucca 2016), attempting to define measures of wellbeing focused on the multidimensionality of the phenomenon in the conceptual background of sustainability (Aiginger and Vogel 2015).

In the context of studies on social and economic components of wellbeing, in subjective and objective perspectives, new recent approaches emerge which are related to the concepts of territorial resilience. They originate from the acknowledgment of a central role to the capacity to cope with stressors of various nature as an essential condition for sustainable development of local systems (Dasgupta and Maler 2003). In general, the research approaches to regional resilience find theoretical foundations in the theory of socio-ecological systems (Carpenter et al. 2001; Holling 2001) and they can be summarized into two streams of literature (Foster 2007). The first one identifies resilience as a performance measure, analyzing the response of a specific region responds a stress (Martin 2016; Bailey and Turok 2016). The second one describes resilience as a capacity measure (Cutter and Finch 2007; Foster 2007; Graziano 2014; World Bank 2014), referring to the positioning of a  a specific region according to the resilience capabilities. The capacity approach focuses on the capabilities of territorial system from an holistic point of view.

From these theoretical and methodological aspects, we propose an approach to regional wellbeing that is sustainability-oriented. The objective of our work is to analyze the effect of resilience capacity on regional wellbeing by adopting a quantitative representation that captures the multidimensionality of the phenomenon in the three spheres of sustainability: economic, social and environmental. Our study focuses on 238 European regions at NUTS-2 level observed over the last decade with a focus on the role of material and immaterial factors. Our aim is to understand where levels of wellbeing and resilience follow different trajectories and where there is a marked difference between them. Regional wellbeing is represented by the subjective indicator of Life satisfaction proposed in a survey published by OECD in Region at Glance 2016. In order to describe the factors that improve or reduce the ability to regenerate of territorial systems, some composite indicators (summarizing tangible and intangible territorial assets) are used (Graziano and Rizzi 2016). Section 2 introduces the themes of wellbeing, quality of life and resilience, summarizing works from social science, economics and regional development literature on the topics. Section 3 describes the theoretical framework adopted, highlighting our research questions. Section 4 describes data and methods applied for the construction of composite indicators. Moreover, it introduces the analysis of relations between life satisfaction and economic, social and environmental resilience. Sections 5 and 6 present, respectively, the map of life satisfaction resulting from the spatial distribution of the OECD's indicator and analyze, from an econometric point of view, its determinants. In Section 7 our conclusions are presented and discussed.

## *2. The evolution of theories on wellbeing and resilience*

The development of theories on wellbeing begins with the awareness of scholars and policy makers that the parameters used to evaluate the progress of a society cannot be exclusively economic. Indeed, they must also take into account the fundamental social and environmental dimensions of quality of life, inequality phenomena

and sustainability objectives. The concept of wellbeing has been developed in psychological and social studies starting from the seminal contribution of Easterlin (1974), who exposed the existence of a happiness paradox. According to that study the percentage of people who report being "very happy" has remained constant, if not decreased slightly, over the last decades, despite the significant rise in average income. This fact suggests that largely non-material elements (e.g., family structure and condition, friendship, political and civil rights) might be more important in determining and more effective in delivering happiness than material ones. Much of the economic research has focused on determining the impact of "relational goods" (i.e., the development of friendships, virtues and the engagement in civic life) on the level of individual happiness (Uhlaner 1989).

The link between quality of life, perceived wellbeing and spatial dimension, highlights the importance of observing the phenomenon from the point of view of territory. The local context of the individual is significant, since intangible aspects such as social cohesion, sense of belonging and identity play a fundamental role (Florida et al. 2013). The spreading of publications and comparative rankings between countries, territorial and urban systems emphasizes the international importance of the theme of wellbeing. Those studies and publications promote an integrated use of subjective and objective indicators, which is now considered a way to measure wellbeing, aimed at capturing the quantitative and qualitative dimensions of the phenomena. The diffusion of perceived wellbeing indicators has encouraged the management of surveys on opinion-leaders and samples of population. In particular, the World Happiness Report analyzes the subjective levels of happiness in more than 60 countries (Helliwell et al. 2016). Thus, the European Commission has carried out subjective surveys on life satisfaction or personal assessments of the main aspects of civic life and European Union policy, through the Eurobarometer Survey since 1973 and The European Social Survey since 2002. The World Value Survey has investigated personal assessments of values, trust, ethical judgments and, in general, immaterial and cultural dimensions of life since

1981. The OECD has produced national and regional indicators in the Better Life Initiative since 2011, in order to measure the development of societies in 11 thematic pillars of wellbeing.

Studies on happiness and subjective wellbeing together with the development of the social indicators movement of the 60s and the 70s in the previous century (International Society for Quality of Life Studies) have suggested the importance of the theme of individual and collective wellbeing also in economic development literature. Hence, in the new theories on local development, concepts such as social capital (Putnam et al. 1993; Rizzi and Pianta 2011), creativity (Florida 2002) and the role of institutions as factors of national and regional growth (Rodrigues-Pose 2013) have been highlighted. These new research lines attempt to intercept the multidimensionality of material and immaterial assets in different economic systems.

The dissatisfaction with strictly economic approaches and the need to catch the real social dynamics of countries and territories, have produced a radical revision of models of analysis and theories about regional development and local policies, with the transition to a new vision of regional competitiveness as the ability of a given territory to ensure its inhabitants a sustainable and long lasting development in economic, social and environmental terms (Dasgupta 2004; Ciciotti and Rizzi 2005). Despite these new policies are still far from concrete implementation (see for example the difficulties and resistances faced by the new place-based adjustment and the reform of Cohesion Policy in Europe), the emphasis on sustainability has led to development models that go beyond the analysis of the purchasing power of citizens or income generated. They also take into account the aspects that contribute to determine the level of wellbeing of individuals, adopting an holistic approach which is closer to the wishes and needs of citizens (Dallara and Rizzi 2012).

Furthermore, in the theoretical background of sustainability, new recent approaches related to the concepts of territorial resilience emerge. The first studies on the topic of resilience are attributable to the research on environmental phenomena. Indeed, starting from the analysis of complex systems and adaptive behaviors, Holling (1973) introduced a definition of resilience in social-ecological systems.

According to this perspective, resilience is the ability to cope with a negative event, tolerating the effect produced by the perturbing action. A resilient system is able to evolve in multiple states different from the previous one, after the perturbing action, guaranteeing the basic functions that characterize it.

The application of resilience modeling to spatial analysis has given rise to two research lines (Foster 2007). The first one identifies resilience as a performance measure, by giving information on how a specific region responds to and recovers from stress (Bailey and Turok 2016; Martin 2012, 2016; Martin and Sunley 2015). It is an hazard-specific approach based on the conceptualization of resilience as a result of a path which involves the identification of the phases of regional economic recession (in particular the shock and the phase of recovery). The second one identifies resilience as a capacity measure (Cutter and Finch 2007; Foster 2007; Graziano 2014; Graziano and Rizzi 2016; Walker et al. 2004; World Bank 2014), by giving information on how a specific region is positioned according to the resources which make it able to respond and recover. The approach of resilience as a capacity measure focuses on the capabilities of territorial system from an holistic point of view, by using descriptors associated with the anthropic and ecological dimensions of territory. Resilience is defined as a complex input, a multidimensional ability which determines the development of territory. At the base of this approach there is the idea that sustainable development is not possible without the improvement of the ability of local systems to cope with negative events and without the containment of actions that could affect these capacities, leading to strong anthropic pressures on territorial systems.

In this sense, there is a strong connection between resilience and sustainability (OECD ; Walker et al. 2004 ). Sustainability captures the aspiration for persistent and equitable wellbeing in the long run, which is summarized in the descriptive elements of resilience as *the ability to persist and to adapt*. Sustainable development aims at creating and maintaining prosperous social, economic and ecological systems from a co-evolutive point of view. Resilience thinking promotes the understanding of the co-evolution of socio-

economic and ecological dimensions of a territorial system from a multidimensional point of view. Both sustainability and resilience recognize the need for precautionary action on resource use and on emerging risks in order to promote the integrity of wellbeing in the future. The inclusion of resilience in any comprehensive measure of sustainability is necessary to take into account risks that significant losses in wellbeing may occur (Dasgupta and Maler 2003). In our work the capacity approach to territorial resilience is followed.

The components feeding resilience are those promoting the availability of resources and facilitating the ability to strategic adaptation, reducing territorial vulnerability. Resilience depends on the ability to adapt, recover and regenerate (Paton 2001; Resilience Alliance 2007; World Bank 2014). The theoretical frameworks proposed in regional sciences (Vale and Campanella 2005; Foster 2007; Pendall et al. 2010; Simmie and Martin 2010; Martin 2012; Graziano 2014; Boschma 2015) offer interesting insights into the analysis of territories capabilities to respond or use the negative event as an opportunity for change and development. The adaptability becomes therefore the basic condition to maintain competitive positioning of the territorial system, depending on system's ability to maintain information that organizes it and to introduce important innovations, in an evolutionary perspective (Boschma 2004; Sotarauta 2005; Martin and Sunley 2007). The applications of these concepts in economic literature (Liou and Ding 2004; Chapple and Lester 2007; Foster 2007; Briguglio et al. 2009; Naude et al. 2009), social sciences (Zimmermann and Arunkumar 1994; Cutter and Finch 2007) and ecological and socio-ecological studies (Carpenter et al. 2001; Walker et al. 2004; Folke 2006) have contributed to enriching the notion of resilience in this systemic interpretation.

## *3. Theoretical framework*

The objective of this section is to define a theoretical framework for the representation of regional wellbeing, hypothesizing some relations that will be verified through the application on the case of European regions. At the present stage, in the literature, there is a lack of contributions on the connection between life satisfaction and resilience capacity. Some evidence could be retrieved in psychological literature (Luthar and Brown 2007; Masten 2011; Ager 2013). Other works highlight the relationship among resilience capacity and the objective measure of wellbeing (Rizzi et al. 2017).

The spread of subjective wellbeing indicators is wide-ranging, through surveys based both on opinion leaders and samples of population. The increasing use of subjective and objective measures of wellbeing aims at integrating quantitative and qualitative assessments of quality of life (Diener 2006; Stiglitz et al. 2009; Diener and Tay 2015; Bruni and Porta 2016). Starting from Allardt and Nuvolati theories (1976; 2009), a distinction among level of living and quality of life indicators is proposed. The first ones are related with the satisfaction of economic and social needs; the second ones are connected to the dimension of social relationships and individual wellbeing (see Table 1). Subsequently, another distinction is considered where objective indicators are associated to income, consumption, behaviors, social participation data and subjective indicators are associated to perception and life satisfaction.

This idea reflects the Amartia Sen's capability approach that defines a set of relational resources of an individuals and the ability to efficaciously apply them. Marta Nussbaum (2003) considers as crucial the capabilities that are basis for human rights, and not preferences nor needs. The connections between the quantitative measurements and qualitative ones in terms of capacity and relationship are highlighted. These indicators are often used together searching for empirical evidence of objective observations through subjective and perceptual evaluations.

*Table 1: The subjective and objective approach to wellbeing measure*

| | *Objective approach* | *Subjective approach* |
|---|---|---|
| Level of living | Needs that are satisfied by the possession or handling of material resources | Subjective evaluation of the living condition (cognitive approach) |
| Quality of life | Needs that are satisfied by human relations and social networking | Subjective evaluation of human relations and social networking (emotional approach) |

*Source: Authors' elaboration based on Allardt 1976 and Nuvolati 2009*

In the intersection among those approaches, the last column of Table 1 highlights two distinct dimensions: the *cognitive approach* is related to the subjective evaluation of the living condition, the *emotional approach* is associated to individual perception of human relations.

Moreover, according to OECD (2013), there are three different approaches to defining subjective wellbeing: the first one is referred to life evaluation, such as "a reflective assessment on a person's life or some specific aspect of it"; the second one is referred to affect, which means "a person's feelings or emotional states, typically measured with reference to a particular point in time"; the third one is eudaimonia, as "a sense of meaning and purpose in life, or good psychological functioning" (Durand and Smith 2013).

In this work a method consistent with the first approach defined by the OECD is followed. It is presented in the upper-right panel in Table 1 and it is expressed by indicators that are subjective but connected to the cognitive sphere of life satisfaction and not to the emotional one deriving from particular moments in life.

Regarding the determinants of quality of life perception, it is possible that the country-effect is almost crucial, as well as institutional context and national policies. However, the local context plays the most important role (endowment of public services and intangible aspects such as cohesion, social capital and cultural identity).

Wilkinson and Pickett (2009) stress the role of equality of opportunities in a study on the traditional effect of (increased) standard of living on the level of wellbeing. The authors verify that, in presence of an unequal distribution of resources, the benefits of economic development are reabsorbed – both at the personal and at the community level - by dangerous attitudes which can undermine individual psycho-physical wellbeing leading to a net loss of welfare. Stanca (2009, 2010) suggests that, at an individual level, improved economic conditions are associated with interpersonal relationships of a higher quality. Becchetti et al. (2011) ascertain that the amount of time spent in relationships has a significant and positive impact on wellbeing.

Focusing on territorial resilience helps assessing the sustainability of wellbeing because regional wellbeing is shaped by the interaction among individual characteristics and place-based factors (OECD 2014). As already stated in the previous sections, in our work an holistic approach is adopted in defining territorial resilience which focuses on sustainable development from anthropic and ecological points of view. Resilience is identified as a complex input, a multidimensional ability which determines the development of territory. Resilience is defined as a complex capacity which improves autopoietic mechanisms of territorial systems. The territory is an open system, characterized by interconnected components and feedbacks that cause non-linear processes. When the probability of specific shocks is unknown, an holistic approach is useful to provide an initial informative framework of all systemic features and resources that could determine fragility or could influence the adaptation capacity (Walker et al. 2004). This approach avoids underestimation of unexpected aspects, focusing on factors observed over long periods of time, rather than on resources needed to tackle a specific critical event (Paton 2001). An holistic approach complies with the need for preventive strategies of risk management requiring

to combine the capacity to be prepared for risk with the ability to cope afterwards[1].

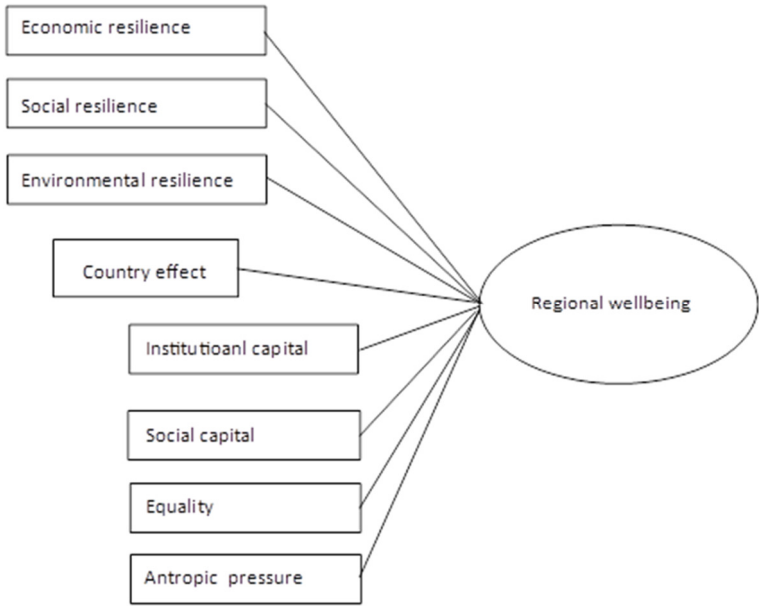
The literature on socio-ecological systems suggests descriptors of territorial resilience capacity that could be summarized as follows: resources availability, heterogeneity and creative approach (Resilience Alliance 2007; Graziano 2014). Resources availability comes from the endowment of natural, human and economic capital and necessary assets for responding to, withstanding and recovering from adverse situations (Foster 2007; World Bank 2014). Heterogeneity is connected to the structure of the systems and it determines the propensity for damage (Adger 2000; OECD 2016). Creative approach refers to adjustments in ecological, social or economic systems in response to present or expected external stimuli, i.e. policies or strategies to moderate vulnerabilities, respond to shocks or transform them in opportunities (Sotarauta 2005; Boschma 2015). As reported, the semantic pillars "resource availability", "heterogeneity" and "creative approach" are used as descriptors of the resilience concepts. In addition, they might be read in the conceptual framework of sustainability, by means of the association with the three dimensions of sustainability (Economy, Society and Environment).

The descriptive model in our work aims at capturing relations among subjective wellbeing, measured as life satisfaction, and resilience, represented by composite indicators in their economic, social and environmental dimensions at regional level (Figure 1). These resilience variables are the objective elementary explanations of wellbeing used in our model (together with some control variables). They are recognized as crucial factors of subjective wellbeing by a large amount of literature (see the institutional capital in Ott 2011; Rodríguez-Pose and Maslauskaite 2012; Helliwell et al. 2014; the social capital in Leung et al. 2010; Ram 2010; Helliwell et al. 2014; Rodrıguez-Pose and Berlepsch 2014; Rem and Ye 2016; the income equality in Alesina et al. 2004; Rözer and Kraaykamp

[1] Preparation should include a combination of actions such as gaining knowledge, acquiring protection and obtaining insurance (World Bank 2014).

2013; Diener and Tay 2015; and the antropic pressure in Krajhanzl 2010; Borhan et al. 2013).

*Figure 1: The theoretical framework of regional wellbeing*




## *4. Data and Methods*

The theoretical framework is applied to an initial sample of 248 European regions at NUTS2 level, over the 2000-2014 period. EUROSTAT, OECD and Quality of Governance Institute are the sources for the collection of 41 variables, used at their temporal average when possible. These 248 regions belong to 21 European countries and do not include the regions of Bulgaria, Cyprus, Croatia, Lithuania, Latvia, Malta, Norway, Romania and the French Oceanic Islands, because of the lack of data. The construction of the dataset has involved a necessary work of connection between the

Eurostat nomenclature of territorial units (NUTS) and the OECD one (TLs). Some variables are characterized by the presence of some missing values. For some elementary variables a filling procedure has been applied in order to solve the problem of missing data for some specific regions, by using values at NUTS 1 level in place of NUTS 2[2].

In our empirical analysis, we estimate an econometric model where life satisfaction is the dependent variable and it is the result of a survey published by OECD in Region at Glance 2016. It is the average score from 0 to 10 of people that answered to the following question: *"On which step of the ladder would you say you personally feel you stand at this time?"*. Economic, social and environmental resilience are the regressors of the model, while institutional and social capital, single indicators for regional equality and anthropic pressure constitute the group of control variables.

In this work composite resilience indicators developed in previous research are used (Rizzi et al. 2017) where the conceptual framework of regional resilience had been applied to the case of 248 European regions. They started from the idea of resilience as a multidimensional concept, by associating some descriptors to the concept of resilience, according the criteria suggested by literature (Resilience Alliance 2007). 38 indicators were associated to the concept of resilience, and grouped into the three descriptors of resilience. Starting from that dataset they run a first selection of variables, according asymmetry, kurtosis and redundancy information checking. The Pearson correlation coefficient was considered for each pair of variables in order to exclude redundant or too weakly correlated variables. Among the couples of variables which displayed correlation coefficients larger than 0.8 or lower than 0.3 (in absolute values), one of the two variables was eliminated[3].

[2] For example it is the case of Urbanized areas, where NUTS1 values have been used for few regions of France, Italy, Germany, Portugal and Finland, and the case of Life satisfaction and Gini index, where NUTS1 values have been used for some regions of Belgium, Germany, Greece and UK.

[3] This type of approach for the selection of the individual variables and the construction of the aggregated measures was adopted to avoid the duplication of

Hence, the principal component analysis (PCA) was applied to the selected variables and the composite indicators were the first components that explained more than 50 percent of the total variance. Through the loading factors and the eigenvector associated, authors were able to derive the new variables, that are our composite indicators.

To sum up, 13 variables define resilience composite indicators for 248 European regions (Table 2): 4 variables describe the economic sphere, 5 represent the social one and 4 the environmental one.

*Table 2: Economic, social and environmental resilience drivers*

| **ECONOMIC RESILIENCE DRIVERS** | **SOCIAL RESILIENCE DRIVERS** | **ENVIRONMENTAL RESILIENCE DRIVERS** |
|---|---|---|
| Gross Fixed Capital per employee | Long term unemployment | Biodiversity index |
| Employment in S&T sectors | Death rate by cardiovascular disease | Wood Land |
| Weight of graduates on population | Death rate for accidents | Urbanized areas |
| R&D expenditures | NEET rates | Demographic balance |
| | Life-long learning rates | |

Indeed, economic resilience drivers can be attributed to physical and human capital, innovation and entrepreneurship: gross fixed capital per employee, graduates, research and development expenditure, employees in science-technology sectors. Social

information as well as to ensure the possibility of getting composite indicators at the same time (Jolliffe 2002; Dallara 2008).

resilience drivers are related basically to social vulnerability and human capabilities, that means death rate by cardiovascular disease and by accidents, long-term unemployment rate, incidence of young people neither in employment nor in education or training (NEET) and human capabilities (lifelong learning). Environmental resilience drivers are connected to the theme of eco-systemic qualities (biodiversity, wood land) and pressures (artificial infrastructures and population growth rate).

Looking at the other regressors, Institutional Capital is a composite indicator elaborated by Charron et al. (2014) starting from dataset of Quality of Governance Institute. It summarizes aspects of Quality of Governance such as corruption, quality of services, impartiality and rule of law. In the case of Social Capital, this is a composite indicator constructed by Rizzi and Pianta (2011) using data from the European Value Survey. It synthesizes elements of the active dimension of cooperation such as volunteering in social and environmental organizations. Turing to Equality, it is described by an elementary reference to income distribution, which is Gini ratio (2010), whereas anthropic pressure is represented by CO2 emissions per square kilometer. Both use data from OECD source.

We test the role played by resilience proxies and control variables (institutional capital, social capital, Gini index and CO2 emissions) on life satisfaction taking into account the country effect as well. Belonging to a specific country might affect life satisfaction evaluation expressed by interviewed people, therefore we cannot ignore that the national boundary might impact on the cultural perception of wellbeing. We control for the country effect by adopting two alternative strategies: first of all, we include country dummies in our econometric estimates; secondly, we standardize variables with respect to the national average value to focus on the deviation of each regional value from the respective national average (see Section 6).

The dataset we use is cross-sectional by nature: we have regional data obtained as average over certain time spans (see Table A1). Even if we cannot run panel-data estimation, our regressors refer to time periods antecedent to life satisfaction (measured in 2014).

Therefore, we are reasonably confident we are avoiding endogeneity issues and we can safely interpret results with a (moderate) causality relationship.
In equation 1 we report the basic model we test in Section 6:

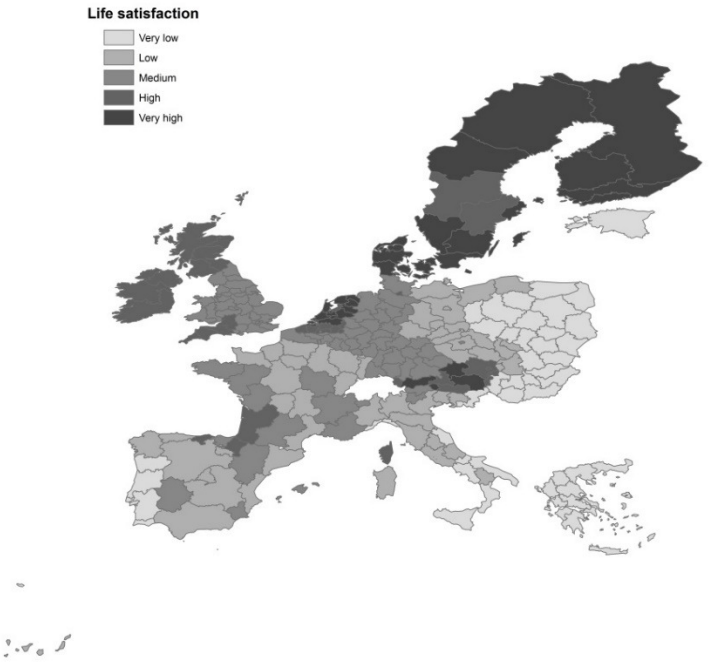
$$life\_satisfaction = \beta_0 + \beta_1 economic\_resilience + \beta_2 social\_resilience + \beta_3 environmental\_resilience + \beta_4 Gini\_index + \beta_5 Institutional\_capital + \beta_6 social\_capital + \beta_7 CO2\_emissions + \varepsilon \quad (1)$$

Data sources and their time period are listed in the appendix (Table A1).

## *5. A map of wellbeing and resilience in the European regions*

A map of wellbeing in European regions, represented by the spatial distribution of life satisfaction indicator, is presented in Figure 2. It rewards some areas on the North Sea, in particular the Dutch regions of Zeeland, Groningen and Friesland, respectively at 1st, 6th and 7th positions. In the group of the "happiest" regions, there are the Danish Hovedstaden (2nd), Nordjylland (3rd) and Midtjylland (4th), the Swedish Småland med öarna (7th) and the Finnish regions. The central Austria region of Tirol (8th) completes the map of the best regions according to life satisfaction variable. At the bottom of the list there are the Hungarian regions of Southern Transdanubia (246th), Southern Great Plain (247th), Northern Hungary (248th), preceded by Greek Ionia Nisia, Central Hungary, Dytiki Makedonia, Northern Great Plain, Sterea Ellada and from the Portuguese Algarve, Região Autónoma da Madeira and Centro.

*Figure 2: The map of Life Satisfaction of European regions*

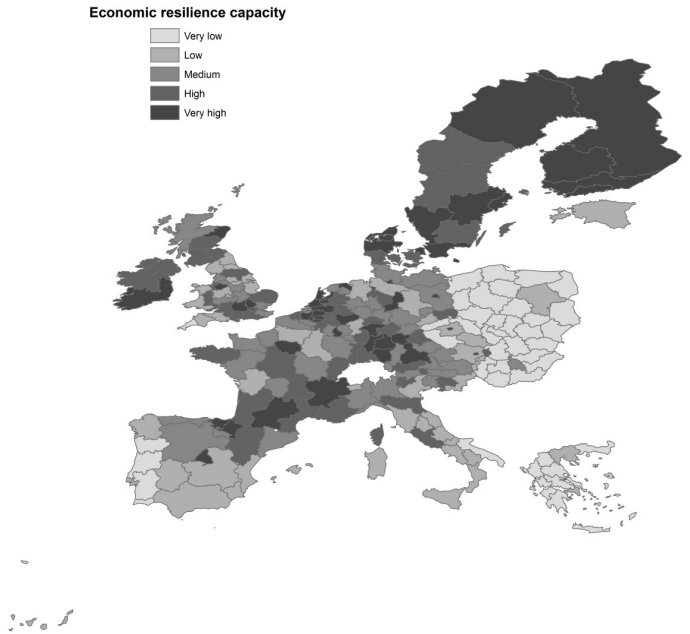



Turning the attention to the economic resilience capacity (Figure 3), it favors the metropolitan regions of the great European capitals and industrialized areas. This is the case of the top 10 capital regions of Hovedstaden (1st), Helsinki-Uusimaa (2nd), Stockholm (3rd), Inner London (4th), Île de France (7th), Région de Bruxelles-Capitale (8th), Luxembourg (10th), followed by and Wien (13th) and Praha (14th), which highlight strong economies of urbanization leading to positive demographic flows and to attraction of investments and high skilled human capital. In the group of the most resilient regions several areas of Germany, Belgium and UK emerge: some with a strong presence of high tech districts (Oberbayern, Berkshire, Buckinghamshire and Oxfordshire respectively at the 6th

and the 18th places), with a remarkable trade vocation (Hamburg and Antwerp, at 9th and 23rd) and with the highest density of scientific, academic and research organizations (Walloon Brabant and Stuttgart, respectively at 5th and 17th places), because of their high propensity to private and public investment in innovation and a widespread quality of human capital.

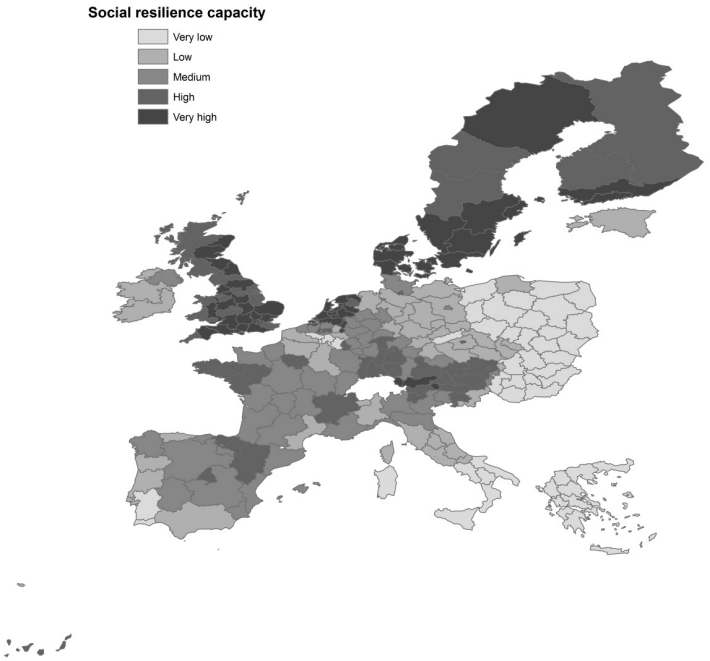
By contrast Swietokrzyskie, Kujawsko-Pomorskie, Lubuskie and Opolskie in Poland, Ionia Nisia and Notio Aigaio in Greece, Východné Slovensko and Západné Slovensko in Slovakia, and Észak-Magyarország in Hungary highlight the lowest levels of economic resilience capacity in Europe.

*Figure 3: The map of Economic Resilience in European regions*



In the case of the social resilience capacity (Figure 4), it is linked to the economic one, with the best results of Scandinavian regions on the North Sea and the Norwegian Sea. In the top 10 group, the high level of social resilience of Midtjylland, Syddanmark in Denmark, Hampshire and Isle of Wight in the English Channel emerge. The map confirms the excellent performance of capital regions of Stockholm (1st), Helsinki (4th), Outer and Inner London (17th and 22nd) and the good result of Madrid (66th), Île de France (69th) and Prague (72nd). It is also possible to observe the excellent positioning of some Dutch areas such as Utrecht (3rd) in Randstad's polycentric urban region due to a low level of social hardship highlighted by the lowest rate of NEET. The performance of some Southern English regions as Surrey, East and West Sussex (10th), Berkshire, Buckinghamshire and Oxfordshire (11th), Gloucestershire, Wiltshire and Bristol (13th) is explained by the high rate of participation in lifelong learning programs reflected in a very low rate of long term unemployment. The performance of Alsace and Rhône-Alpes French regions is noticeable, as well as some peripheral ones such as Bretagne and Pays de la Loire due to the best performance in health dimension represented by low death rate by cardiovascular disease. This is also the case of the Spanish Comunidad Foral de Navarra and País Vasco. On the contrary it is possible to notice the worst performance of other coastal areas such as the Greek regions of Sterea Ellada, Peloponnisos, Anatoliki Makedonia, Ipeiros, Dytiki Makedonia, and Thessalia in the Aegean Sea, but also of Sicily in Italy as marginal area characterized by high level of all components of social hardship and low self-renewal abilities. In the bottom 10 the Slovakian regions of Západné Slovensko, Stredné Slovensko and Východné Slovensko record a very low level of social resilience drivers due to the highest death rate and social hardship.

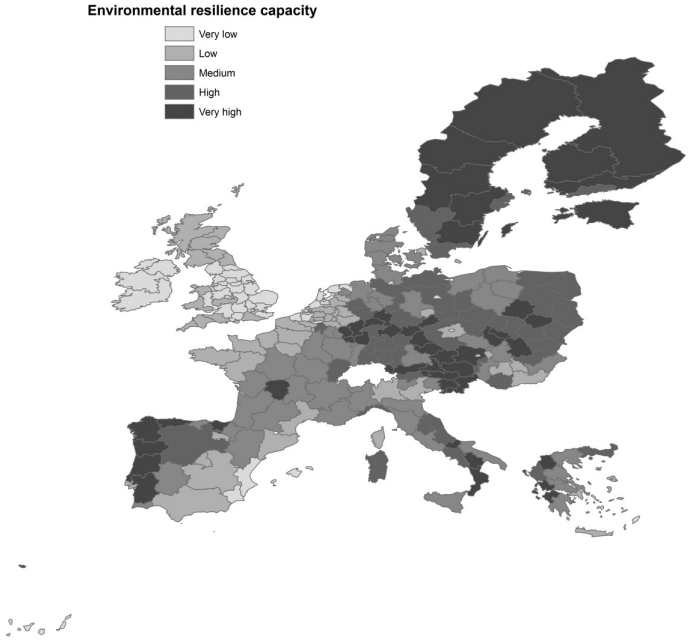
*Figure 4: The map of Social Resilience in European regions*




Finally, Environmental resilience capacity (Figure 5) reverses the picture that emerged in terms of territorial economic and social factors: the richest regions of the United Kingdom and the Netherlands are in fact the most penalized, whereas the Northern European areas of Sweden (Norra Mellansverige, Småland med öarna, Mellersta Norrland and Övre Norrland) and Finland (Pohjois- ja Itä-Suomi, Etelä-Suomi), some Austrian (Steiermark and Kärnten), and German regions (Oberfranken and Gießen) are rewarded thanks to the large extensions of wood land and the low urbanization. However, at the top of the ranking, also some poor regions of Portugal (Alentejo, Centro, Açores), Italy (Calabria, Molise, Basilicata) and Slovenia (Vzhodna and Zahodna Slovenija) show positive ecological balances thanks to lower environmental pressures

because of minor industrial and infrastructural sites. The same evidence is obtained in some East Europe regions such as Stredné Slovensko in Slovakia and Moravskoslezsko in Czech Republic.
On the contrary, low levels of environmental resilience are highlighted by some regions characterized by diseconomies of urbanization: it is the case of regions with very high levels of CO2 emissions per kmq such as Inner London, West Midlands, Outer London, Manchester, West Yorkshire, Merseyside (at the 1st, 5th, 6th, 10th, 11th and 13th places in the corresponding ranking) in the UK and Hamburg and Bremen (at the 7th and 5th place) in Germany. It is also the case of regions with wide urbanized areas, such as Bruxelles and Utrecht (at the 3rd and 24th positions).

*Figure 5: The map of Environmental Resilience in European regions*



## 6. *The determinants of life satisfaction in European regions*

The empirical test of the hypotheses listed above is developed using a final dataset of 238 European regions[4]. Table 3 reports the main descriptive statistics of the variables used in the econometric analysis [5].

*Table 3: Descriptive Statistics*

| *N=238* | | **Mean** | **Std.deviation** | **Min** | **Max** |
|---|---|---|---|---|---|
| Life satisfaction | | 6.578 | 0.680 | 4.5 | 7.8 |
| Economic resilience | | 0.008 | 0.988 | -1.940 | 2.711 |
| Social resilience | | 0.030 | 0.991 | -2.555 | 1.941 |
| Environmental resilience | | -0.006 | 0.994 | -5.305 | 1.572 |
| Gini index | | 0.292 | 0.035 | 0.232 | 0.405 |
| Institutional capital | | 0.533 | 0.164 | 0 | 1 |
| Social capital | | 0.267 | 0.132 | 0 | 1 |
| CO2 emissions | | 7.095 | 1.321 | 3.119 | 11.070 |

[4] Even if the composite indicators are obtained for the whole sample of 248 regions, for the sake of robustness of the econometric analysis, the final sample used in the empirical analysis has been cleaned of countries with a number of regions less than 5 (Estonia, Ireland, Luxembourg, Slovenia, Slovakia). We adopted this cleaning strategy in order to have adequate variability among regions within a single country.

[5] Per capita GDP, generally included as regressors in similar studies, has not been included in the analysis due to potential multicollinearity problems. Indeed, per capita GDP is highly correlated with Economic resilience (0.801) making the joint inclusion of these two regressors not advisable.

Table 4 reports the correlation coefficients among the variables. As can be seen, our dependent variable (life satisfaction) is positively correlated with all the independent variables, exception made for environmental resilience and Gini index. Only the following econometric analysis can properly test the roles of the multi-varied relationships affecting life satisfaction.

*Table 4: Correlation matrix*

| | Life satisfaction | Economic resilience | Social resilience | Environmental resilience | Gini index | Institutional capital | Social capital |
|---|---|---|---|---|---|---|---|
| Economic resilience | 0.754* | | | | | | |
| Social resilience | 0.804* | 0.753* | | | | | |
| Environmental resilience | -0.222* | -0.278* | -0.385* | | | | |
| Gini index | -0.279* | -0.206* | -0.061* | -0.336* | | | |
| Institutional capital | 0.804* | 0.683* | 0.766* | -0.166* | -0.277* | | |
| Social capital | 0.008 | 0.002 | 0.198* | -0.425* | 0.304* | 0.007 | |
| CO2 emissions | 0.212* | 0.410* | 0.288* | -0.578* | 0.135* | 0.171* | 0.104 |

*Note: * Significant at 5%.*

As a first estimate, we run an OLS model including country dummies controlling for unobservable country's characteristics.

Taking into account the fact that economic resilience and social resilience depict different resilience dimensions which, however, turn out to be highly correlated (0.753), we adopt two different specifications for our econometric model: in the first one we consider the economic resilience as independent variable while, in the second one, we replace this independent variable with social resilience.
As reported in the Table 5, heteroscedasticity robust standard errors have been used and the R-squared always resulted satisfactory.

*Table 5: Econometric results - OLS*
*Dependent variable: Life satisfaction*

| | | **(1)** | **(2)** |
|---|---|---|---|
| Economic resilience | | 0.113*** | |
| | | (0.025) | |
| Social resilience | | | 0.157*** |
| | | | (0.048) |
| Environmental resilience | | -0.035 | -0.035 |
| | | (0.030) | (0.029) |
| Gini index | | 0.331 | 0.674 |
| | | (0.847) | (0.883) |
| Institutional capital | | 1.240*** | 1.164*** |
| | | (0.182) | (0.223) |
| Social capital | | 0.012 | -0.123 |
| | | (0.236) | (0.277) |
| CO2 emissions | | -0.064*** | -0.058*** |
| | | (0.018) | (0.018) |
| Country-dummies | | yes | yes |
| | | | |

| | | | |
|---|---|---|---|
| Constant | | 6.837*** | 6.729*** |
| | | (0.293) | (0.303) |
| Wald test country-dummies (*p*-value) | | 57.23*** (0.000) | 41.09*** (0.000) |
| $R^2$ | | 0.915 | 0.912 |
| *No. of observations* | | *238* | |

*Notes:*
*- Robust standard errors in parentheses;*
*- * significance at 10%, ** 5%, *** 1%;*
*- VIF tests prove the absence of multicollinearity problems.*

As model (1) shows, economic resilience is highly significant in explaining life satisfaction: the more economic resilient the region is, the more satisfied their inhabitants are. Also institutional capital positively impacts on life satisfaction, while CO2 emissions have a significant negative effect.
In model (2), economic resilience is replaced by social resilience, which has a higher positive impact than the former. The other independent variables show the same impact as in the previous specification. In both the specifications, the country dummies turn out to be jointly significant, suggesting that the regional dimension has to be analyzed also taking into account the national boundary.
Considering that the feeling and response to a questionnaire in terms of life satisfaction could be influenced by country culture, we also consider the standardized variable based on the respective country values. The standardization procedure allows us neutralizing the country effect. Subsequently, we implement our model using standardized variables[6]. In this model we do not include country

[6] We opted for a standardized procedure for two reasons. First of all, our dependent variable, life satisfaction, is a subjective measure which might be affected by a common cultural country-specific perception. Therefore, we wanted to emphasize

dummies (to avoid a double counting effect caused the country "effect"). Results are presented in Table 6.
Also in this case, economic and social resilience have a positive impact on life satisfaction as institutional capital does. While CO2 emissions always impact negatively: the more polluted the region is with respect to the country, the more unsatisfied the inhabitants are.

*Table 6. Econometric results – OLS – standardized (Std) variables*
*Dependent variable: standardized Life satisfaction*

| | | **(1)** | **(2)** |
|---|---|---|---|
| Std Economic resilience | | 0.318*** | |
| | | (0.065) | |
| Std Social resilience | | | 0.265*** |
| | | | (0.068) |
| Std Environmental resilience | | -0.106 | -0.114 |
| | | (0.067) | (0.068) |
| Std Gini index | | -0.002 | 0.028 |
| | | (0.063) | (0.064) |
| Std Institutional capital | | 0.230*** | 0.215*** |
| | | (0.060) | (0.064) |
| Std Social capital | | 0.082 | 0.059 |
| | | (0.057) | (0.059) |
| Std CO2 emissions | | -0.317*** | -0.292*** |

the differences among regions within a single country, once the common country effect has been taken into account. For coherence, the same transformation has been applied to all the regressors. Secondly, the advantages of standardized variables in regression analysis have been illustrated by Kim and Feree (1981) and Duncan (2014).

| | | | |
|---|---|---|---|
| | | (0.073) | (0.074) |
| $R^2$ | | 0.244 | 0.218 |
| *No. of observations* | | *238* | |

*Notes:*
*- Robust standard errors in parentheses;*
*- * significance at 10%, ** 5%, *** 1%;*
*- VIF tests prove the absence of multicollinearity problems.*

## *7. Conclusions*

The paper analyzes the relationship between wellbeing, represented by a subjective indicator of Life satisfaction, and a complex concept of regional resilience, adopting an holistic approach. It distinguishes the three dimensions of sustainability (economy, society and environment) and investigates the multi-varied relationships affecting subjective wellbeing.

The model is applied to the case of European regions, to obtain a geographical map of wellbeing and regional resilience in its different dimensions. The descriptive and econometric results show some expected results and some new evidence.

The geography of life satisfaction rewards some areas on the North Sea, in particular the Dutch regions of Zeeland, Groningen and Friesland, the Danish Hovedstaden, Nordjylland, Midtjylland and the Finnish Länsi-Suomi, Helsinki-Uusimaa. An expected piece of evidence is the map of European economic and social resilience capacity. It transpires to be more intensive in the metropolitan regions of the capitals and in industrialized areas. Conversely the Mediterranean regions of Spain, Italy and Greece, Portugal and Eastern Europe are penalized. However, the costs of good economic and social performances are found in poor environmental resilience capacity in the richest regions, with the exception of the Scandinavian area capable of positive ecological balance.

The main empirical result of the paper, based on 238 European regions, is that resilience is highly significant in explaining life satisfaction: the more resilient the region is, the more satisfied its inhabitants are.

This means that the constitutive dimensions of territorial resilience, i.e. the availability of resources and the ability to adapt and innovate at the regional level, reinforce the perceived wellbeing of the inhabitants, providing more confidence in their own means, as if the local context became an ally to their personal fulfillment. Hence, also the capacity of territorial systems as a whole to react to crises and shocks can influence satisfaction and sentiment towards people's lives. In the same way, trust in institutions and their quality are confirmed as significant drivers of wellbeing, as affirmed by many studies, but attested in the paper also at the regional level. In other words, the territory offers positive externalities which are associated with the most strictly personal, psychological and emotive factors of happiness and life satisfaction. In our test the role of social capital does not emerge, while in literature there always seems to be a factor positively linked to satisfaction. However, in our case, the picture might be less linear than expected. Likewise, the negative link between income inequality and perceived wellbeing does not appear in the regressions, as deduced from the discordant results of literature.

Finally, CO2 emissions have a significant negative effect, for the high positive correlation between economic resilience and anthropic pressure on the environment. The environmental resilience seems not to significantly affect life satisfaction, except for CO2 emissions. Indeed, this variable refers to the relationship between humans and environment more than other indicators used in the analysis in order to describe the ecological sphere.

Starting from this analysis clear trade-offs emerge among the economic and ecological dimensions. The new steps of research should explore these cross-links, in order to better clarify the complex relationships between regional wellbeing and resilience in the perspective of more targeted and balanced policies.

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*Annex*

*Table A1 – The dependent and independent variables of life satisfaction model*

| Variable | Description | Units of measurement | Source | Time |
|---|---|---|---|---|
| *Dependent variable* | | | | |
| Life satisfaction | Average score from 0 to 10 of people that replied to the following question: On which step of the ladder would you say you personally feel you stand at this time? | Index | OECD | 2014 |
| *Variables summarized in the composite indicators as regressors* | | | | |
| *Economic Resilience* | | | | |
| Gross Fixed Capital per employee | Gross Fixed Capital per employee | Euro | Eurostat | 2000-10 (mean) |
| Employment in S&T sectors | Share of active population employed in science and technology | % | Eurostat | 2008-13 (mean) |
| Weight of graduates on population | Weight of graduates on population | % | Eurostat | 2000-12 (mean) |
| R&D expenditures | Total intramural R&D expenditure | Euro per inhabitant | Eurostat | 2000-12 (mean) |
| *Social resilience* | | | | |
| Long term | Share of | % | Eurostat | 2000-12 |

| | | | | |
|---|---|---|---|---|
| unemployment | unemployment which is long-term (12 years and over) | | | (mean) |
| Death rate for cardiovascular disease | Share of deaths for cardiovascular disease | % | Eurostat | YEAR? |
| Death rate for accidents | Share of deaths for transport Accident | % | Eurostat | 2000-10 (mean) |
| NEET rates | People from 18 to 24 neither in employment nor in education and training | % | Eurostat | 2000-12 (mean) |
| Life-long learning rates | Share of population from 25 to 64 in education and training (last 4 weeks) | % | Eurostat | 2000-12 (mean) |
| *Environmental resilience* | | | | |
| Biodiversity index | Landscape diversity expressed as Shannon Evenness Index | Index | OECD | 2009 |
| Wood Land | Woodland as share of land cover | % | Eurostat | 2009 |
| Urbanized areas | Residential, economic and infrastructure related areas as share of land use | % | Eurostat | 2009 |
| Demographic balance | Total population change | % | Eurostat | 2000-2012 |
| *Control variables* | | | | |

| | | | | |
|---|---|---|---|---|
| Gini index | Regional income distribution from 0 to 10 | Index | OECD | 2010 |
| Institutional Capital | Measures of corruption, quality of services, impartiality and rule of law. | Composite indicator | QoG Institute - Charron et al. (2014) | 2013 |
| Social Capital | Representation of active dimension of cooperation such as volunteering in social and environmental organizations | Composite indicator | European Value Survey - Rizzi and Pianta (2011) | 2011 |
| CO2 emissions | CO2 emissions per square kilometre of regional area | Ton per km2 | OECD | 2008 |

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