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Article

The Effects of Environmental and Social Dimensions of Sustainability in Response to the Economic Crisis of European Cities

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Abstract: The concept of sustainable development, which has emerged over the last few decades, has moved away from the global to the local level. The sustainability measurements at the global level use the triple bottom line, considering environmental, economic and social dimensions; however, the limited data available at the local level has driven what little research there is to use these optics when considering cities sustainability. In this paper, we use a sustainability city index based on the intellectual capital approach, which considers the three dimensions for European cities. Concretely, we use the environmental and social dimensions of this city index to analyze the effect of different levels of development in terms of sustainability over the main economic variables with available information. The results highlight the importance of the social and environmental dimensions of sustainability in cities economic recovery and show that cities with best positions in sustainability have better performance in economic terms.

Keywords: sustainability; indicators; environmental dimension; social dimension; intellectual capital; European cities

1. Introduction

In the last years, the attention of economists has shifted from tangible inputs to intangibles as key elements in economic behavior. Among intangible assets, a critical role is played by knowledge assets. In this sense, intangible assets become important to wealth creation in cities. Hence, cities must find mechanisms to facilitate the development of knowledge within sustainability objectives. A theoretical framework that considers the effect of knowledge base on economic growth is based on endogenous growth theory [1–4]. In terms of the relationships between knowledge base and economic growth or development, researchers developed the following three basic points of view. The first considers as key factors technological infrastructure and innovation [5–8]. The second, and maybe more developed, emphasizes the importance of human capital as a key factor in economic growth [8–11]. Finally, the third considers social and environmental aspects as the most important [11–16].

A key issue in growth theories has been the paradigm shift with regard to the effect that economic growth has on the environment. Growth has gone from being a destructive factor for the environment, with its origins entrenched in Malthusian theory, to a factor that enhances the environment, described as sustainable or "green growth". Such growth has been the subject of analysis by a number of experts since the end of the last century, using a variety of different models and indicators, a review of which can be consulted in [17]. Furthermore, said paradigm was immediately reassigned from its global perspective to a local one. Thus, Camagni [18] considered the local initiatives as key elements in sustainability management. Yigitcanlar *et al.* [19] and Yigitcanlar and Lönnqvist [20] considered that one of the aims of knowledge-based cities must be to achieve sustainability. Campbell [21] provided a new city-planning perspective, based on a holistic development model stemming from a tripartite conflict of economic, social and environmental interests, from which sustainable development can emerge. Haughton and Hunter [22], from the perspective of a city as a system of human organization, consider the concept of a sustainable city as a continual and essential process to achieve sustainable development at a global level and not a goal, objective or an isolated entity.

However, despite the importance of sustainability in economic growth and therefore, in economic recovery, there are few studies that analyze this subject, and many of them are recent. In this sense, we can emphasize the study of [23], which proposes metrics for the environment, health and sustainability of 50 U.S. cities and showed clear interconnections between these and sociodemographic factors. Hu [24] studied the relationships between sustainability and competitiveness in Australian cities showing that urban progress is clearly associated with an environmental cost. Caragliu *et al.* [25] define a European Smart City where social and environmental sustainability is a crucial strategic component; hence, knowledge-based cities are committed to sustainable growth. Shen [26] developed a worldview about the relationship between environmental sustainability and economic development considering developed and developing countries. The main conclusion is that developed countries have a low environmental impact from production stage and developing countries from consumption stage. Moreover, in [24] there was an excellent literature review of papers that includes the environment in urban competitiveness that shows the great importance that this relationship has in the studies developed; however, after reading this paper we do not have a clear conclusion as the majority of studies have been developed for Chinese cities [27–30].

Therefore, the literature review has showed a gap because, to the best of our knowledge, there are no papers that consider the effect of sustainability on the response to the economic crisis. To develop such a paper, we consider first that sustainability at the global level uses the triple bottom line, considering environmental, economic and social dimensions. However, this paper focuses on the social and environmental factors to avoid any correlations when it comes to quantifying the effect that such components have on the growth of a city. In order to measure these dimensions, we have considered the model developed by [31], based on intellectual capital to measure the hidden wealth of European cities that considers a number of different intangible assets. The main objective of this paper, taking into account that the analysis will be carried out using data from a period of economic crisis (2009–2010), is to analyze the effect of social and environmental factors on the response to the economic crisis of several European cities. In this sense, the purpose of this paper is to bridge the gap in the literature. Specifically, we analyze the relationships between the economic recovery and this sustainable growth because the response to the economic crisis will be linked to this growth. This analysis allows checking that sustainable or green growth occurring in knowledge-based cities incorporates social and environmental components as key development relationships. Furthermore, it should carry more weight in more developed and better managed cities boasting better tangible assets, implying in turn that efficient growth requires sustainability. Moreover, this paper focuses on European cities, while most of the existing studies consider Chinese cities.

In support of this relationship, the approach used in this paper is as follows: in the second and third sections, we emphasize the method, variables and information available to measure the dimensions of sustainability under consideration, namely social and environmental dimensions, respectively. Then, in the fourth section, we apply statistical techniques to classify the cities into groups, based on the level of their growth in terms of GDP. This classification and analysis of variance allow us to analyze the influence of social and environmental factors, and their components, on economic growth. Moreover, in this section, we analyze the relationship between development and environmental and social components using a regression model for the cities taken together, as well as in their groups. Said analysis will allow us to establish key strategies for development and sustainable growth, and these will be presented in the Conclusions Section.

2. Methods

The social and environmental dimensions of sustainability are estimated by approximation based on intellectual capital, as suggested by [32] in its measurement model of hidden wealth applied to European cities. According to this method, two groups of intangible assets or components are considered: the human component and the structural component. Human capital is comprised of individual capital (in) and social (sc) capital, while structural components comprise process capital (PC); commercial capital (CC); image capital (IC); research, development and innovation capital (RDC); and environmental capital (EC) [31,33,34]. Lastly, by estimating this, we are able to complete the measurement of wealth of cities as a divergent factor, in other words, increasing the differences that exist in terms of GDP.

Furthermore, the different approaches used in the specialist literature to measure the sustainable development of cities are all based on estimating the different composite indices. These indices should take into account the triple bottom line approach of sustainability and therefore include economic, environmental and social dimensions in their assessment. However, given the limited information available locally, few approaches have taken these measurements into account. Mori and Christodoulou [35], for example, show that highly respected indices such as the Green City Index, City Development Index and Ecological Footprint for cities do not take these three factors into account. In fact, the City Prosperity Index is, to the best of our knowledge, the only index developed for cities that takes into consideration this triple bottom line. Traverso [36] developed a methodology based on the integration of Life Cycle Sustainability Assessment (LCSA) and the Dashboard of Sustainability that he integrated into the so-called Life Cycle Sustainability Dashboard (LCSD). LCSD integrates the environmental, economic, and social factors of product sustainability, showing the results by means of a graphical representation (a cartogram).

Taking these two approaches into account and using certain elements defined therein [31], we use some of the dimensions from the intellectual capital model to analyze the effect of different levels of development in terms of sustainability over the main economic variables. Specifically, we use the environmental and social dimensions from the intellectual capital model, but will not consider the economic factor, given that this could lead to correlation issues in the model if we were to include such an important variable for economic recovery, namely GDP. In the intellectual capital model, these dimensions are called environmental capital under structural capital, while under human capital, they are known as social human capital.

The environmental dimension is comprised of four components: pollution, water consumption, waste management and land use (Table 1); as does the social dimension: health, safety, education and culture (Table 1). The variables included for each type of capital were selected after a careful literature review [20,37–45], taking into account the limitations imposed on the research by the amount of information available. The information related with the variables in Table 1 is available in [46].

Table 1. Environmental and social dimensions of sustainability.

Dimension	Components	Variables
Environmental	Pollution conditions	Rainfall (L/m^2)
		(1) 100–Index of Summer Smog: Number of days ozone (O_3) concentrations exceed 120 microgram/m^3
		100–Index: Number of hours per year that nitrogen dioxide NO_2 concentrations exceed 200 microgram/m^3
		100–Index: Number of days particulate matter PM10 concentrations exceed 50 microgram/m^3
		100–Index: Accumulated ozone concentration in excess 70 microgram/m^3
		100–Index: Annual average concentration of NO_2
		100–Index: Annual average concentration of PM10
	Water	100–Index: Total consumption of water
		Price of a m^3 of domestic water (Euro)
	Wastes and recycling	100–Index: Annual amount of solid waste (domestic and commercial)
		Annual amount of solid waste (domestic and commercial) that is recycled
		Recycled/total annual amount of solid waste (domestic and commercial)
	Land uses	Total land area (km^2) according to cadastral register
		Green space area
		Land used for agricultural purposes
		100–Index: Land used for commercial activities (industry, trade, offices)
		100–Index: Land area in housing/residential use

Table 1. *Cont.*

Dimension	Components	Variables
Social	Health	Number of live births per year
		100–Index: Total deaths per year
		Number of hospital beds
	Safety	100–Index: Number of deaths per year due to suicide
		100–Index: Number of murders and violent deaths
		100–Index: Number of car thefts
		100–Index: Number of domestic burglary
		100–Index: Number of deaths in road accidents
	Education	Number of residents (aged 15–64) ISCED [(2)] level 0, 1 or 2 as the highest level of education
		Number of residents (aged 15–64) ISCED level 3 or 4 as the highest level of education
		Number of residents (aged 15–64) ISCED level 5 or 6 as the highest level of education
	Culture	Number of cinema seats (total capacity)
		Number of museums
		Number of theatre seats
		Number of public libraries (all distribution points)

Note: [(1)] Indicators preceded by 100 indicate a transformation of limits, to present lower values coinciding with worst conditions; [(2)] ISCED: International Standard Classification of Education; Source: Own elaboration from [45].

3. Data

After a comprehensive review, we decided to use the Urban Audit database from Eurostat ([46]), which provided us with 17 environmental and 15 social variables (Table 1). These variables were expressed using different units of measurement so to normalize the data, we had to re-scale all the indicators, converting them using a percentage scale ranging from 0 to 100, 100 being the highest and 0 the lowest. Moreover, as appears in the Table 1 footnote, certain indicators have been converted so that they have lower values when conditions are worse; for example, in the number of deaths caused by traffic accidents, the aim would not be to achieve the highest possible value, but the lowest one. With these data, we used a principal component method to determine the weighting of each variable. More specifically, bearing in mind that it is impossible to directly assign weights to each variable, we proceed to transform them into the same number of principal components (P) as variables available

$$P_n = \sum_{n=1}^{k} u_n x_n \quad (1)$$

where u represents the characteristic vectors of each principal component and x the variables used to make the indicators. Using a geometric mean [47] and the percentage of variance retained for each, we have obtained one index for each component of the environmental and social dimensions (Table 1). Following the same procedure, we have calculated one indicator for each dimension through the aggregation of all components of each dimension in one index. The weighting PCA scheme has the main advantage that it is highly objective, however, these weightings are obtained considering only the variables correlation structures and therefore it is not possible to assign highest weight to the variables more important in each dimension. Thus, with the 2009 data, the most recent data available, we are able to ascertain indicators for 158 cities in 24 European countries.

The results, which are presented in the supplementary materials (Table S1), show that German cities achieve the best ranking in terms of the environment while three Spanish cities occupy the lowest positions. For the social dimension, it should be noted that Paris (France) takes first position, even though it was one of the worst performers in the environmental dimension. Therefore, based on the values recorded for each city in the two dimensions under consideration, we can conclude that cities from the north of Europe are primarily concerned with social and environmental factors in sustainable development, whereas cities in the south of Europe do not show any clear strategy in this regard.

4. Experimental Section

After determining the best way to measure the social and environmental dimensions of sustainable development of cities, we attempt to analyze the effect that said dimensions and their components have on this development. It should not be forgotten that economic factors have not been included in order to avoid any potential correlations given that the growth and development of the cities would be measured using GDP. The other major component that comes under the economic heading is the state of the labor market, another variable that we consider when analyzing cities' potential for economic recovery. However, given that it was impossible to acquire more up-to-date data that would have allowed us to examine the economic recovery, we have had to base our study on the period of economic crisis, namely from 2009–2010 and, therefore, we analyze the response to the economic crisis of the city.

For cities to achieve sustainable growth, social and environmental factors must be respected, and a relationship must exist between them and growth. Undoubtedly, it should be of greater importance in cities undergoing greater growth, which is why, as a first step, we classify European cities into two groups based on their level of economic growth. To measure this, we use the GDP variation rate for the period 2009–2010, using a non-hierarchical cluster analysis, with the number of groups set at two, classifying the cities according to their level of growth. We are able to use complete information of 119 European cities to analyze these observations. The two groups were composed of 66 and 53 cities, respectively (see Appendix to see which cities are in each group), the latter registering the highest average growth with a figure of 6.960, with the former registering a figure of 2.251.

4.1. Effects of Social and Environmental Dimensions on Economic Growth

Once the groups are established, we check to see, as we supposed in the introduction, if it is the cities with the highest levels of growth that also show the highest levels of social and environmental commitment, in other words, whose indicators registered the highest values. Given the way the groups were defined, the highest values should be those in the second group. Furthermore, the analysis is not based solely on the social (SD) and environmental (ED) dimensions, but rather each one of their components are considered individually to allow us to determine the most important element to economic growth. Lastly, we also include employment growth in the period 2009–2010, as most governments regard the level of employment as the foundation for economic recovery. Employment recovery over the same period should therefore be another indicator of a favorable response to the economic crisis of the city as it heads towards economic recovery.

To carry out the comparison of the values for each of the two cluster groups, we use ANOVA (Analysis of Variance) technique to determine which group has achieved the highest average levels, and to see if the differences between the averages for each group are, from a statistical perspective, significant. However, before we can carry out the ANOVA, we have to determine which is the statistic best suited to carrying out the comparison, so firstly we analyze the homogeneity of variance using the Levene statistic. The results appear in the second and third columns of Table 2.

The results of the Levene test show that the F-statistic should be used to carry out ANOVA in cases where the homogeneity of variance hypothesis is accepted, and use the Welch statistic for the rest. The results of these statistics appear in Table 2.

For social and environmental dimensions, the results (Table 2) show that significant differences exist in the average values registered for each group, although the differences in the environmental dimension are larger. More specifically, the average value for environmental measures in Group 1 is 38.826, while for Group 2 was 42.138. For the social dimension, these values were 48.782 and 50.334, respectively. These results show the importance of both dimensions in cities with the highest rates of growth, and therefore the higher value was recorded in Group 2, comprised of cities with the highest economic growth.

Within each of the dimensions, there are a number of different components that are analyzed separately to determine which component has the highest incidence in economic development and therefore for which there is the greatest difference between the groups. For the environmental dimension, the most significant differences between groups relate to Waste and Recycling and Land Uses, while for the social dimension, it is Education, with all the values in Group 2 being higher. These results show which aspects the group of cities with the highest levels of growth emphasize more, and these are therefore the aspects that must be bolstered to achieve a greater level of economic growth.

Table 2. Levene test and ANOVA.

Variable	Test of Homogeneity of Variance		ANOVA			Average	
	Levene's Statistic	Sig.	Statistic	Statistics Value	Sig.	Average Group 1	Average Group 2
Environmental Dimension	8.346	0.005	Welch	9.387	0.003	38.826	42.138
Social Dimension	4.585	0.034	Welch	4.709	0.032	48.782	50.334
Pollution	7.139	0.009	Welch	1.133	0.290	64.471	65.486
Water	7.091	0.009	Welch	1.245	0.267	42.724	44.652
Wastes and Recycling	7.472	0.007	Welch	6.525	0.012	17.329	24.122
Land Uses	0.027	0.871	F	7.937	0.006	50.263	53.799
Health	0.228	0.634	F	1.415	0.237	48.547	46.373
Safety	2.993	0.086	F	1.132	0.290	63.310	62.312
Education	18.933	0.000	Welch	15.298	0.000	51.203	58.038
Culture	0.367	0.546	F	0.034	0.853	26.360	26.604
Employment 2009–2010	1.937	0.167	F	14.876	0.000	−1.183	0.256

Finally, although numerous studies exist that have already analyzed this relationship, we analyze the effect that economic growth has on employment growth. The results appear in the last row of Table 2 and show the significant differences in the average values registered for each group. Specifically, the rate of employment growth is −1.183 in Group 1, and 0.256 in Group 2. Therefore, although the average levels of employment growth are quite low, these values are higher in the group of countries with greater economic growth showing how the level of development influences employment growth and by extension, economic recovery. This aspect will be considered later in the paper, when we see which dimension has a greater influence on employment growth and therefore, determine the need for social and/or environmental policies to boost said growth.

4.2. Relationships between Social and Environmental Dimensions and Development

The earlier section looked at the effect of environmental and social dimensions on economic growth, although another important aspect that must be taken into account: the relationship with economic development measured in terms of GDP per capita. We apply a regression model to the development achieved by the intelligent cities in 2010 as well as the social and environmental dimensions that make them sustainable. With an in depth look at the relationship itself, we go one step further and analyze development according to the statistically significant components of the aforementioned dimensions. The main results from both specifications appear in Table 3. In purely technical terms, the adjustments are significant and do not show heteroscedasticity or collinearity. The social and environmental dimensions have a direct relationship with development, somewhat stronger in fact for the environmental dimension if we look at the standardized coefficients. If we focus on the components, waste, recycling, health and education (in that order) are the most significant for development (according to the standardized values and the statistical significance *t* test), or in other words, they would be configured as the effective management strategies to achieve sustainable growth. These results would lead us to recommend that cities develop efficient and effective policies that deal with the aforementioned components in order to boost sustainable economic development.

Table 3. Relationships over development (GDP 2010), all 119 cities.

Variable	Coefficient	Standardized Coefficient	*t*-stat	Regression info
ED	301.058	0.2019	2.4626 (**)	R^2 = 0.920
SD	316.845	0.1458	3.1586 (***)	WH-stat = *2.522*
Wastes and Recycling	222.544	0.3636	4.2903 (***)	R^2 = 0.926
Health	361.983	0.4067	6.8608 (***)	WH-stat =*9.9468*
Education	107.763	0.1285	2.1433 (**)	

Notes: (***) (**) 1% and 5% level of significance, respectively. WH: White heteroscedasticity test, non-significant in all cases.

Given the results, a question that we might ask ourselves is whether the relationships are equal for all the cities or whether they change according to the level of economic growth. In this regard, we carry out the same regression model procedure as before but differentiated by the clusters.

The results appear in Tables 4 and 5. The two measurements are important for both groups although for the first one, the social dimension is the key and major factor in its development, whereas the level of both components are more offset in the case of Group 2, *i.e.*, the one that contained the cities with the greatest growth, where an environmental strategy was more useful for their continued growth. In this way, it is the environmental dimension that is incorporated into the development strategy to achieve greater levels of growth in the cities.

Table 4. Relationships over development (GDP 2010), Group 1 (66 cities).

Variable	Coefficient	Standardized Coefficient	*t*-stat	Regression info
ED	181.399	0.1282	1.1114	$R^2 = 0.938$
SD	384.695	0.2403	2.9487 (***)	WH-stat = *1.447*
Health	189.681	0.2560	2.2714 (**)	$R^2 = 0.942$
Safety	176.216	0.1335	2.4599 (**)	WH-stat = *7.905*
Education	107.249	0.1780	1.8165 (*)	

Notes: (***) (**) (*) 1%, 5% and 10% level of significance respectively. WH: White heteroscedasticity test, non-significant in all cases.

When analyzing the key components to development, Health is the common strategy for both groups. If we now take a look at the differences, the development strategy for cities with the greatest growth revolves around recycling for the environmental dimension and culture for the social dimension (Table 5), whereas the development strategy for cities with lower levels of growth revolves around education and safety policy for the social dimension (Table 4). Therefore, for cities with lower levels of economic growth, policies aimed at achieving greater levels of sustainable development focus on improving aspects related to education and safety but do not neglect essential components such as healthcare. Conversely, cities with greater levels of economic growth focus more on healthcare together with recycling and culture as the keys to achieving higher levels of development.

Table 5. Relationships over development (GDP 2010), Group 2 (53 cities).

Variable	Coefficient	Standardized Coefficient	*t*-stat	Regression info
ED	313.631	0.1998	1.6931 (*)	$R^2 = 0.909$
SD	338.056	0.1108	2.1601 (**)	WH-stat= *2.122*
Wastes and Recycling	178.613	0.2779	2.3660 (**)	$R^2 = 0.929$
Health	294.953	0.2973	3.5701 (***)	WH-stat = *5.978*
Culture	458.193	0.3335	3.4535 (***)	

Notes: (***) (**) (*) 1%, 5% and 10% level of significance respectively. WH: White heteroscedasticity test, non-significant in all cases.

4.3. Social and Environmental Dimensions and the Economy Recovery

Finally, we directly examine the relationship that both dimensions have with growth in order to determine which strategies can be linked to the so-called "green growth". We divide growth into the two main aggregates available: GDP and employment. In both cases, results are significant and without any issues of collinearity or heteroscedasticity (Tables 6 and 7).

Table 6. Relationships over growth (GDP 2009/2010), all 119 cities.

Variable	Coefficient	Standardized Coefficient	*t*-stat	Regression info
ED	0.1325	0.2580	2.8814 (***)	$R^2 = 0.098$ WH-stat = *3.1647*
SD	0.1033	0.1380	1.5414	
Intercept	−6.1010		−1.7342 (*)	
Wastes and Recycling	0.0319	0.1513	1.7607 (*)	$R^2 = 0.177$ WH-stat = *8.5730*
Education	0.1052	0.3642	4.2390 (***)	
Intercept	−2.0056		−1.4887	

Notes: (***) (*) 1% and 10% level of significance respectively. WH: White heteroscedasticity test, non-significant in all cases.

In the first relationship, with growth in terms of GDP per capita (Table 6), both dimensions are important, particularly the environmental one. In other words, the greatest growth in terms of GDP is primarily linked to the environmental dimension. If we then use the most important components for the relationship, it is primarily Education for the social dimension, and Waste and Recycling for the environmental dimension that stand out as strategies for economic growth. Therefore, these results again emphasize the importance of the environmental dimension, so it we could consider it key in the economic development and growth and, therefore in the response to the economic crisis. Using different components, the results are similar to those obtained when we used the economic development and the main environmental component is again the “Waste and Recycling”. However, in the social dimension, education remains a key factor but the health is not listed as key in economic growth. Therefore, unlike the case of economic development, for the economic growth, the health is not consider as key in order to achieve greater levels of economic growth.

Table 7. Relationships over growth (employment 2009/2010), all 119 cities.

Variable	Coefficient	Standardized Coefficient	*t*-stat	Regression info
ED	0.0517	0.1432	1.5806	$R^2 = 0.075$ WH-stat = *10.7495*
SD	0.1107	0.2104	2.3212 (**)	
Intercept	−8.1011		−3.2366 (***)	
Water	0.0462	0.2084	2.3550 (**)	$R^2 = 0.133$ WH-stat = *13.9973*
Education	0.0503	0.2479	2.7084 (***)	
Culture	0.0549	0.1816	2.0208 (**)	
Intercept	−6.7387		−4.4340 (***)	

Notes: (***) (**) 1% and 5% level of significance respectively. WH: White heteroscedasticity test, non-significant in all cases.

Another factor considered by all of the governments as key in economic recovery is the evolution of the labor market. Thus, we measure the labor market evolution using the employment growth in the period with the information available from 2009–2010. Table 7 shows the results about the relationship between the social and environmental dimension and employment growth. In the case of employment growth for the cities, once again it is the relationship with both dimensions that is of particular note. However, it is undoubtedly the social dimension that stands out in terms of its significance, whereby employment growth is primarily linked, during this period of crisis in Europe, to the social dimension. If we then break down the individual components and focus on the most representative ones, education is the most important component. Moreover, in the social dimension, we must highlight the importance of the culture as a key component in employment growth and "water management" in the environmental dimension. Therefore, if governments want a quick economic recovery using the labor market as a key factor, government policies should be directed towards education, but without forgetting cultural aspects.

In summary, the results for each growth model allow us to corroborate the existence of a strong relationship between growth and the environmental and social components of European cities, highlighting the environmental strategy, through revenue, and the social strategy, through employment. Moreover, the primary actions and policies that guarantee the sustainable economic growth of Europe's intelligent cities are the efficient management of waste and water, as well as active policies in culture and education, which, in addition, ensure recovery from the economic crisis.

The limitations of these results can be formed under two groups: (a) methodological ones relate to indicator selection, data availability, weighting assignment, and biased sensitivity analysis; and (b) theoretical ones relate to interrelation between sustainable development and recovery from economic crises. The main methodological limitation is a consequence of the availability of information. Thus, we have used information from 2009–2010 as this is the most current information available and the information availability has determined which cities we have considered in this paper. These limitations open new research lines by incorporating cities from other continents into the study and considering information about other variables as key in economic recovery. Moreover, respect to theoretical limitations, when we have information after the economic crisis we could develop a panel data model in order to establish if the economic situation determines the key factor in the economic and employment growth as well as the final importance between sustainable development and recovery in the European cities.

5. Discussion and Conclusions

In this paper, at a local European level, we have studied the efficient management of intangible assets of a group of cities, together with indicators based on social and environmental dimensions of sustainability, and these have allowed us to corroborate that the best-ranked cities for knowledge are also those that have the highest levels of growth in times of crisis [48,49], ensuring sustainable growth. The analysis carried out has allowed us to establish a measurement of the social and environmental dimensions for sustainability and to then study the relationships of these with other development and growth variables with the available information.

In this sense, we can determine the main strategies of sustainable growth enabled in the cities of Europe in the years towards crisis recovery. Moreover, we have classified the cities into two groups according to the management of these factors and consequently in the development model. One of the most notable aspects of development is that we can confirm that, in Europe, sustainable development has occurred and appears to be divergent, given that by separating the cities into groups according to their levels of growth, the most discernible strategy is the environmental one. This dimension is essential for cities with the highest growth, yet is fundamental for the development of all cities. It is, therefore, a key strategy for sustainable growth and development, particularly the waste management and recycling policy components.

The strategy for the development of European cities is divergent. In a first step, the key is in the social dimension, but the environmental dimension is decisive for the second stage, which correspond to the most developed cities. Therefore, we must emphasize that the main route to development and employment growth is based on the social dimension, major components being education, culture and healthcare.

Lastly, the sustainable growth model of European cities towards economic recovery is based, on the social perspective, in terms of employment and on the environmental perspective in terms of production. Common strategies to both dimensions and key dimensions for both are, especially in the case of the environment, water management and waste and recycling, and in the case of the social, education and culture and labor intensives. The importance of these dimensions is not new because the Industrial Ecology studied these dimension and their influence in sustainability. Concretely, the industrial ecology integrates environmental perspectives into production and consumption strategies with the consideration that environmental efficiencies, allow obtaining economic benefits [50,51]. In the industrial ecology, the dimensions presented in this paper are studied and assessed, using different instruments of analysis and decision support, such as Life Cycle Assessment (LCA), Material Flow Account (MFA), Input-Output Analysis or Exergia [52]. Water, carbon, and ecological footprint are presented in order to compare the level of sustainability and Social Life Cycle Assessment (SLCA) is strongly encouraged in urban systems; studying the level of production of the cities linked with the quality of life [53]. Moreover, the authors of [54,55] considered the concept of urban metabolism as key in the sustainable develop at urban scale. The study of the urban metabolism is part of the State of the Environment (SOE) and provides several indicators of city sustainability. More research that considers urban metabolism is included in the industrial ecology community [56] and use IE tools [57].

Finally, following the analysis of growth in a period of crisis and development for European cities, we can conclude that it is sustainable in keeping with the adequate management of the social and environmental dimensions, in other words, it grows in economic terms, considering growth in the social dimension, while respecting the environment. Therefore, this is the key strategy for sustainable and green growth that will allow European cities to improve the living conditions of its inhabitants and the recovery in economic terms. The more developed cities, however, have implemented this strategy in the first place, so we have two growth rates and therefore two paths to recovery.

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Author Contributions

The authors belong to the Intellectual Capital Research Group (ICR group), which conducts research on this topic. All the authors have cooperated for the design, development and preparation of this work and all have read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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