Knowledge-city index construction: An intellectual capital perspective

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A B S T R A C T

Knowledge cities are the most capable of producing sustainable economic growth. Cities, where relationships between people are more extensive, provide the most natural environment in which to look for evidence of the knowledge spillovers so emphasized by the endogenous growth theory. The intellectual capital approach considers the ability to transform knowledge and intangible resources into sustainable long-term wealth. The approach does not only contemplate sustainability and social wellbeing, but also intangible factors such as human development, economic structure, trade, image and innovation. This paper proposes a novel methodology to measure intangible capital as the growth capacity of knowledge cities based on intellectual capital using a composite index of seven intangible factors, disaggregated into 19 dimensions with 73 different indicators. Using this methodology, we rank 158 European cities for which information is available. The results show clear differences between northern and southern European cities. The top positions in the ranking are occupied by cities with a favorable balance in human capital; the most important growth factors in the most developed cities being research, development and innovation and image components, whilst these together with the human components are the most important growth factors in the poorest cities.

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1. Introduction

According to Yigitcanlar and Lönnqvist (2013), in the global scenario, knowledge and information are now seen as keys to economic prosperity. The economy of a knowledge city creates value-added products using research, technology, and brainpower. The role of knowledge in wealth creation has become a critical issue for cities. In this sense, urban administrations need to discover new approaches to harness the considerable opportunities of knowledge production for a global order.

These knowledge cities are established with the aims of achieving sustainability and improving quality of life, by providing the required services; of enriching the variety of cultural life and knowledge within the city; and of increasing the skills and knowledge of citizens and workers in the city, as the means of human intellectual development (Yigitcanlar, O'Connor, & Westerman, 2008). In this sense, we highlight the paper published by Lever (2002) for 19 European cities which shows a broad relationship between the quality of the knowledge-based city comprising of tacit knowledge, codified knowledge and knowledge infrastructure and economic change.

From this perspective, if we study the background of the theories of endogenous growth, the main authors point toward innovation or technical progress, human capital and knowledge as key factors for the growth of an economy. Solow (1956) introduces technological progress to explain long-term growth as an exogenous factor, under the assumption of diminishing returns on investment. As such, economies tend towards a steady state in which they no longer grow. For this reason, neoclassical or exogenous growth models by definition defend convergent growth for different economies.

In contrast to neoclassical growth, endogenous growth theories have emerged with the proposals by Romer (1986), Lucas (1988) and Rebelo (1991) figuring prominently. These models explain growth by considering factors such as technological progress as endogenous. Furthermore, these models reject the neoclassical hypothesis of diminishing returns on investment and thus explain that economies are not confined to a stationary state of equilibrium, but are in fact divergent.

In fact, new knowledge-based economy models support knowledge as an endogenous key factor in the growth of economies. In this line of research, the intellectual capital (IC) outlook establishes new measures of the wealth of economies (countries, regions or

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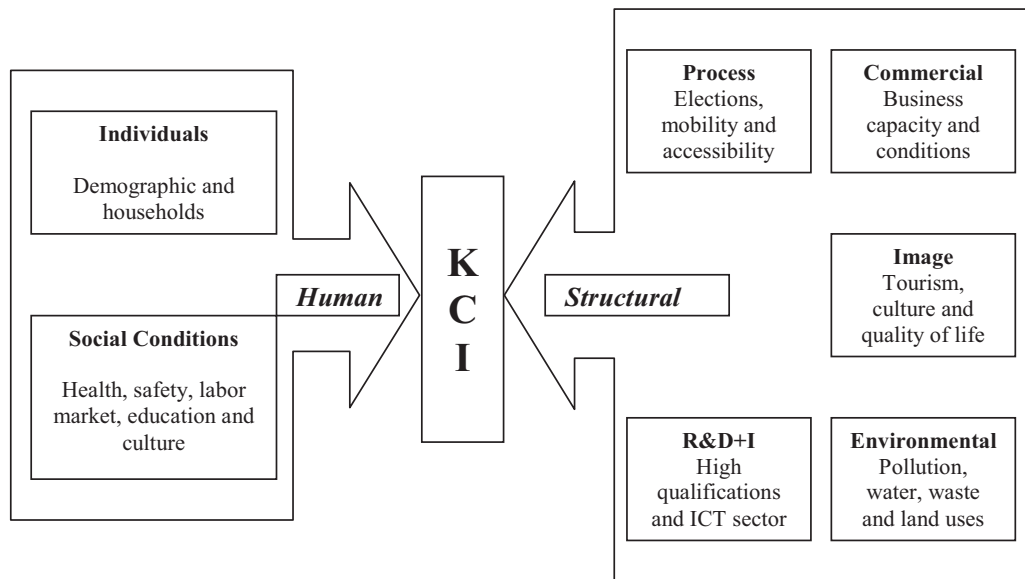
Fig. 1. Conceptual framework of the proposed index (KCI).

cities). The World Bank (2006) offers a comprehensive structure with which to measure the wealth of nations; where the composition of wealth of 120 countries is analyzed and disaggregated into a range of assets (produced, natural and intangible), most of a country's wealth being captured by intangible capital. Alfaro, Lopez, and Nevado (2011) measure non-visible wealth of an economy from intangible capitals, and demonstrate that knowledge and knowledge management are divergent and endogenous factors in national economies. Button (1998) and Groot, Nijkamp, and Acs (2001) recognize the existence of increasing returns due to accumulated factors and investment in: physical capital, human capital, research and development (R&D), and external economies (as a consequence of the diffusion of technological knowledge in the production system). This allows us to identify a path of endogenous, self-sustained growth, in the national, regional or local economy. Finally, Vázquez (2007) explains that an endogenous approach to a city is supported in processes of growth and capital accumulation by culture, resources, and an institutions own (tangible and intangible factors), based on which investment decisions are made.

Such literature on economic growth fits nicely with the dynamic view of cities, which views externalities (and particularly externalities associated with knowledge spillovers) as the 'engine of growth' (Romer, 1986; Lucas, 1988). If geographical proximity facilitates the transmission of ideas, then we should expect knowledge spillovers to be particularly important in cities. The models of city growth we consider stress the role of dynamic externalities, and more specifically knowledge spillovers for city growth. According to these models, cities grow because people in cities interact with other people; either on their own or in other sectors, and learn from them. Because they pick up this knowledge without paying for it, these knowledge spillovers are externalities. The frequency of interaction with other people is ensured by their proximity in a city. Because this proximity makes externalities particularly large in a city, all the models predict that cities grow faster than rural areas where externalities are less important because people interact less. This is the approach of a growth model of cities by Glaeser, Kallal, Scheinkman, and Shleifer (1991). In recent years, researchers have developed this approach to help plan the growth of metropolitan areas. Bentlage, Lüthi, and Thierstein (2013) develop an Interlocking Network Model to measure knowledge creation (connectivity) as a factor of local product.

Agreeing with these growth theories, it is necessary to establish measures for all endogenous factors, tangible and intangible, of an economic and social space, such as a city, in order to estimate its wealth growth capacity. For the development of such measures it is necessary to take into account at least: human resources available, quality of life, processes or bureaucratic conditions, trade, entrepreneurship, R&D system, innovation, external image and environmental conditions.

When calculating the value of growth capacity or a knowledge cities index, the IC approach is a very useful and valuable management tool at the business level. The knowledge cities approach was presented as a framework theory in the last century. This approach is centered on human resources and links with the environment of a city, but implementing the model is very difficult with the data available (Knight, 1995). In this paper, we present a knowledge based model of cities, supported by all sources of knowledge defined as growth capacity and summarized in an index that enables the valuation of sustainable wealth as either a multiplier effect of tangible wealth or GDP per inhabitant at a local level. To define all sources of knowledge, we support knowledge management and IC approaches, successfully tested at business and macro (national) level.

Principal component analysis is used to overcome the subjective conditions which occur in other measures of this kind, in order to calculate the weights of different components or dimensions of the index. The estimation of this index will establish a ranking between cities and will test the following hypotheses supported by endogenous growth theories: (i) on a local scale, in a global environment of endogenous growth, the wealthiest cities will generally have greater capacity for growth and better knowledge factors and will be more sustainable; (ii) cities which have a better balance between knowledge factors and sustainable growth will occupy the top positions and display a greater capacity for growth.

2. A review and classification of city indices

Although the analysis of performance of cities is a very novel subject, more and more people are making a concerted effort towards capturing its essence through testing the growth sustainability of metropolitan areas or cities. We detail the main proposals