A Region's Basic Image as a Measure of its Attractiveness

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Abstract

The growth or decline of a region depends on its power to pull and retain both business and the right blend of people to run them. This pulling power depends on what we call the ***"Image"*** *of the region, a variable which expresses the region's present state of development and future prospects and may be defined as a function of a multitude of factors; economic, social and environmental ones. The Image of a region may prove a very useful tool for planning purposes, since it doesn't only give an early diagnosis of any possible changes, sometimes discontinuous, in the region's pattern of development, but it also indicates the reasons for those changes. Hence, it may be used as the basis for designing appropriate measures to assist a region's development. The objective of this paper is to define a region's image, based on an analysis of the business and the residential location process, to identify, through literature, the factors needed to quantify this image and finally, to suggest ways of measuring these factors.*

Keywords: Region's Image, Region's Attractiveness, Regional Development

JEL Classification: C02, C65, R58

1. Introduction

History has taught us that regional development is a complex process. It results from the balanced presence of tangible and intangible elements mainly originated from the economic and social spheres. Over the past years, a large number of regional growth theories have been developed and a number of models have been built in an effort to describe, explain and eventually predict regional development trends (Pike et al., 2006; Stimson et al., 2006; Capello, 2007; Capello et al., 2008). These models may be classified in various ways on the basis of certain characteristics. A number of such classifications is given below. The first classification is based on the theoretical perspective applied

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to the analysis of regional growth and distinguishes between regional growth and local development models (Stilwell, 1972; Stimson et al., 2006). The regional growth models treat a region as a portion of a national system and its purpose is to explain the aggregate growth rate of income and employment. The local development models treat a region as a set of individual economic factors and its purpose is to identify all the tangible and intangible factors of the growth process. A second classification is made on the basis of the role played by space in the various theories and distinguishes between models where the role of space is passive or active respectively (Capello et al., 2008). The first group of models considers space as a mere physical container of growth. The second group considers space as a resource in itself, being the source of increasing returns in the form of agglomeration economies and territorial externalities, and therefore of local development. Furthermore, a region's location is considered to play a key role in its development. A third classification is based on the way regional disparities are treated and distinguishes between equilibrium and disequilibrium models (Holland, 1976; Pike et al., 2006). The equilibrium models consider that regions will converge regardless of any intervention, due to the causal mechanisms of growth that move regions towards equilibrium. The disequilibrium models consider that regional growth disparities persist and are reproduced over time since they are inherent in the process of a region's development. State intervention is needed in order to reduce disparities and assist the less developed regions. Finally, a fourth classification is based on the assumptions made for the potential trend of regional development and distinguishes between linear and non-linear models (Capello, 2007). The linear models may provide approximate replications of short and medium-run changes, but they fail to interpret long-term developments characterized by structural shifts of an irregular nature. The non-linear models allow for a change in a system's dynamics generated by even small perturbations in structural forms (Pike et al., 2006; Capello et al., 2008).

The present paper introduces a region's Basic Image, a variable which expresses a region's state of development and its future prospects. Furthermore, the factors affecting this variable are defined and ways of measuring them are suggested. Finally, this variable is used as the basis for the building of a model calculating regional growth. Regarding the above mentioned classifications the proposed model

- implicitly assumes that regional disparities persist and are reproduced over time; hence a mechanism is needed to reduce and/or alleviate them
- treats space as a resource and considers that a region's location plays a crucial role in its development
- is a local development model as it aims to identify all the tangible and intangible elements of the growth process
- is a non-linear model

Following this brief introduction, section 2 describes a region as a socio-economic unit, section 3 outlines the process of both business and residential location and section 4 introduces and defines the concept of a region's Image. Section 5 presents the basic properties characterising a region's Basic Image, while section 6 develops a mathematical model for its estimation. Finally, section 7 applies this model to the case of the thirteen

Greek regions, whereas Section 8 summarizes the conclusions and makes suggestions for further research.

2. The region as a socio-economic unit

The growth and decline of a region depends on their ability to attract and retain business and people. The realisation that places compete for investment has expanded in recent years to encompass competition among places for the attention of investors and workers (Malecki, 2004). As people and businesses become more mobile, they will move towards attractive places and evacuate unattractive places. The shrinking of time and distance in the global marketplace means that developments in other parts of the world can impact the fortunes of a place once thought to be competitive. This raises fundamental questions about what places can do, not only to survive but, also, to prosper. Places must routinely reassess whether they are meeting the needs of their citizens and businesses. Each place must be continually involved in a process considering the benefits and attractions to be provided to its inhabitants and the ways in which it can help them find and create new value. A region is successful when it manages to meet the needs of its inhabitants and potential movers and, also, to maximize its efficient social and economic functioning in accordance with whatever goals have been established (Ashworth and Voogd 1988; 1990). The success of a region depends on its capability to attract and keep firms with stable or increasing market shares, whilst maintaining stable or increasing standards of living for those who participate in it (Storper, 1997); in other words, when the region is able to generate high profits for its businesses and high standard conditions for its residents (Bristow, 2010).

On the basis of all the above, one can say that a region should ensure livability, investibility and visitability (Kotler et al., 1999) and, in doing so, it performs a number of functions: economic, social and environmental. These functions, however, are not always compatible; on the contrary, the idea of a potential conflict between them often appears in urban literature. A region is a place for work and social interaction. Thus, working and living must be compatible; however, factories often make the living environment unpleasant or even unbearable. Regions are growing mightily in population, wealth and geographic extent but with potentially adverse social and environmental consequences. A region is an environment in which people live, invest, and share ideas and spaces. They meet people and receive information; they send their children to schools and meet entrepreneurs at parties, seminars, restaurants and sporting grounds. People, including entrepreneurs, are embedded in this environment (Boschma and Lambooy, 1999).

Concluding, it could be said that a region, as a socioeconomic system, has to achieve not only a satisfactory economic performance but also a number of other basic social objectives. If these are not met, then, over the longer term, a conflict would arise and the situation would almost certainly not be sustainable (Llewellyn, 1996; Lovering, 2001; Bristow, 2005). Many examples of that inherent conflict between the economic and social development of a region may be provided. They illustrate the basic fact that much of the region's advantages stem from its infrastructure, which, however, detracts from its

attractions or, in general from, its social and environmental dimensions. The construction of a motorway in a region, for example, may improve its transportation infrastructure but, at the same time, it may cause a deterioration of its environmental conditions. Similarly, excessive use of the land available for business purposes may improve the business development infrastructure of the region but, at the same time, it may restrict the land available for houses, open spaces and recreational grounds. Those were two examples of a rather direct conflict between the factors affecting the economic development potential of a region and those affecting the level of its environmental conditions and social amenities respectively. More generally, however, a kind of indirect conflict between them may also be detected. The improvement of both sets of factors depends largely on the amount of expenditure the region is prepared to place on each one of them. Nevertheless, given that the budget of a region is always limited, a conflict of priorities is bound to develop.

3. The process of business and residential location

Having discussed the nature of a region as a socio-economic unit, it is time now to study the location process of both business units and employees. Mobility within a state is largely a voluntary process. Hence, the growth and decline of a region depends on its ability to attract and retain business activities and the right blend of people to run them (Bristow, 2005). It is, therefore, important to understand how business firms make investment and location decisions. A region should base its business attraction plans on an assessment of its economic conditions and locational characteristics. Furthermore, an accurate and frequent updating of the prevailing economic conditions, cost factors and quality-of-life features provide an understanding of how well this region compares with others. As a rule, business firms rate places as potential sites after considering various factors that constitute the overall local business climate of any given place. Some of those factors can be measured in more-or-less objective terms; these include location accessibility, economic stability, costs, property value, infrastructure, incentives schemes and programs, financial resources, local support services and networks. Others are not easily measured, as they represent more subjective characteristics of a given place; these include business culture, local entrepreneurial culture, personnel, management, professional and workforce competences, availability of specialised suppliers, quality of the local living or social environment, quality of public education, quality of health services etc. These factors, as well as their relative importance, keep changing over time. Factors representing more subjective characteristics have become increasingly more important for location decisions. Furthermore, the content of various factors has changed over time. In the case of accessibility, for example, the emphasis has been shifted from physical accessibility to communication accessibility. Similarly, in the case of labour, the emphasis has shifted from low-cost, unskilled labour, to quality, high-skilled labour. Furthermore, in the case of housing, education and health facilities, the emphasis has shifted from the availability of those facilities to their quality. Finally, environmental considerations, such as clean air and facility compliance with stronger air, water and chemical and waste disposal regulations, have also grown in importance.

A healthy environment has become a powerful stimulus of capital flow and investors are increasingly critical of the environment they choose to establish new projects; in many cases potential investments and the subsequent economic benefits have been lost, simply because the quality of the area was not enough (Kotler et al., 1999).

Therefore, it can be argued that regarding the movement and location of business units, although traditional factors such as location, accessibility to market and natural resources, transportation facilities, land availability, labour, capital and infrastructure remain important, a number of factors representing more subjective characteristics, as well as a number of environmental factors, have also appeared. However, every region must provide some basic standards of services to attract and retain people, business and visitors. Further analysis of the process of locational choice suggests that a distinction must be made between a list of factors or requirements that is seen by the investors of a firm as a minimum for all locations and those additional factors which may tip the balance between one alternative location or another. However, it is only after the basic requirements have been satisfied that the additional factors are considered. In other words, the process of business location appears to be a two-stage process, whereby the final choice is made from a small group of possible locations all of which satisfy a set of basic criteria (Malecki, 2004). Places not only try to attract businesses and investors, but they also attempt to shape a policy towards attracting and keeping residents as part of building a viable community. Places seek to appeal to certain groups, including the wealthy, young families, workers with special or relevant skills, professionals, managers, technicians, senior officials, administrators and connected families. The free movement of goods and people on the internal market and the opening of new markets have led to more intensive competition for talented persons. Local access to intellectual capital represents one of the most important factors in place development (Kotler et al., 1999).

People attraction is likely to become an even more important strategic component in place competition in the years ahead. As a rule, employees rate places as potential sites after considering various factors. Although job availability/quality and job/pay prospects still remain important, a number of other factors have also appeared. These factors include infrastructure, quality of life, housing options and quality, educational services quality, health services quality, access to daycare centres, competitive social security costs and conditions, a positive attitude to newcomers, and relocation services that include efforts to find job opportunities for family partners. This last factor is gaining in importance. Since in most families today both adults are working, an unhappy partner could discourage the move. Furthermore, as in the case of business, the factors affecting the movement of people, their content and their relative importance keep changing over time (Kotler et al., 1999).

Concluding, it could be suggested that regarding the movement and location of households, although job availability and quality, as well as employment earnings, remain among the most important factors – underlining, therefore, the importance of a strong business activities presence in the region – a new set of factors representing more subjective characteristics are becoming increasingly more significant. Employees look not only for reward and job satisfaction, but, also, for intellectual, social and cultural interests.

Although the two-stage process described in the case of business location is not explicit in the case of people, the existence of certain minimum standards is beyond doubt. In many cases, the people who would generally consider moving were not prepared to move to certain particular areas (Bristow, 2010). More importantly, no specific reasons could be given for this attitude; most of the people justified it in terms of "general dislike of the area" or "lack of appeal" for them. In other words, they were not convinced, in their own minds that although the sums were right, the atmosphere was also right for them. Hence, as in the case of business units location, people are also prepared to consider moving only to areas satisfying a set of basic criteria (Burgess, 1982).

On the basis of all the above, there seem to be a set of "attraction" factors, common for both investors and employees. Those factors include economic stability, economic viability, location, accessibility, land availability, infrastructure, financial resources, housing, health and education facilities of high quality. Furthermore, they may be divided into two basic sets. The first set contains factors related to the economic function of the region, such as economic stability, economic viability, location, accessibility, land availability and infrastructure, whereas the second set contains factors related to the social function of the region, such as housing, health and education facilities. Finally, there exist a number of factors related to the environmental function of the region, including clean air and water supply, as well as pollution control. For the purposes of this paper and in order to keep our model as simple as possible, environmental factors will be grouped together with social factors. However, as the environmental dimension becomes increasingly important, those factors should form a distinct third set.

4. The Concept of a Region's Image

As it has already been mentioned in section 2, the growth or decline of a region depends on its power to "pull" and retain both business activities and the right blend of people to run them; this pulling power depends on what we call the Image of the region. The term image is currently used in a variety of contexts. Image is a sum of beliefs, ideas and impressions. It is the total impression an entity makes on the minds of people and exerts a powerful influence on the way people perceive things and react to them (Dowling, 1998; Dichter, 1985). Marketing literature suggests that image is important in this process and identifies different types, including projected and received place images (Kotler et al., 1993). Projected place images can be conceived as the ideas and impressions of a place that are available for people's consideration. This type of images reach the potential mover by an image transmission or diffusion process through various channels of communication, which themselves can alter the character of the message. The received place images are formed from the interaction between these projected messages and the movers' own needs, motivations, prior knowledge, experience, preferences, and other personal characteristics. In this way, potential movers create their own unique representations or mental constructs, resulting in their own personal images of place (Ashworth and Voogd, 1990; Gartner, 1993; Bramwell and Rawding, 1996).

In this paper, image is defined in a slightly different way, as a function of objectively measured factors, which influence the movement of both business units and people. It is clear that a region's image, based on objectively measured factors, may be improved through marketing and promotion activities. Nevertheless, it is believed that the impact of those activities on the region's image is temporary and limited and the only lasting effect is the objective improvement of the various attributes of this image. Competition among places involves the improvement in the attributes that make it possible to attract and keep investment and migrants – that is, to become 'sticky places' (Markunsen, 1996; Malecki, 2004).

Different people hold quite different images of the same place. Because a region may be related to a number of potential movers' groups that have a different type of interaction with it, each of these groups is likely to have a different image of the particular region. Hence, a region does not have an image, but multiple images (Dowling, 1998). Based on the above, it can be argued that, at each point in time, the region "sends out" its Image and, depending on its impact on the people (both employers and employees), the region may be considered attractive or non attractive. One may also argue that since people "receiving" the image of the region belong to various distinct groups (i.e. employers, unskilled workers, skilled workers etc.) and are sensitive to different factors, the impact of the region's Image on the members of each particular group will be different (Kotler et al., 1999).

Whilst this argument is plausible, the evidence presented in section 2 suggests that all groups of potential movers react similarly to a basic set of factors; more precisely, a set of minimum standards, largely common to all groups, must be satisfied if the region is to be considered as a potential choice by any of them. Every community must provide some basic standards of services to attract and retain people, business and visitors. Admittedly, no uniform standards exist. Hence, every region, in order to be/remain attractive, should determine the standards pertaining each time and try to meet them (Kotler et al., 1999).

To reconcile these two views the concept of a region's Image is refined by introducing the following two concepts: the Basic Image and the Specific Image.

The **Basic Image** of a given region measures the degree to which the region satisfies a set of basic criteria, common for all movers. A region satisfying those criteria is considered by all potential movers worthy of a closer examination and a potential final choice.

The **Specific Image** of a given region, as perceived by a particular group of potential movers, measures the degree to which movers who belong to that particular group consider the region as their best final choice. However, although this Specific Image is a function of specific factors appealing mainly to members of that group, it is primarily a function of the Basic Image.

The remainder of this paper will focus on the definition and study of a region's Basic Image. This is a rather abstract concept which expresses the actual state of the region; a physically realisable measure for the Basic image is difficult to find. What may be measured more easily is the net change of a region's population due to migration during each time period. Such a change, however, is of very little importance as a measure of the real state of the region. The perception and reaction times to any change in the state

of a region's Basic Image are different for the various groups of potential movers and are particularly long for certain vulnerable minorities, who lack real choice in place to live and work. Hence, the measurable changes of the region's population due to migration may be generally considered as the delayed and considerably smoothed consequence of changes in the Basic Image.

The study of the mechanisms governing the shaping and the changes of a region's Basic Image is a task of imperative importance. Apart from simplifying the analysis of a region's behaviour, the Basic Image, as an overall measure of its attractiveness and performance, has the following two advantages:

i. It gives an early warning of any potential danger of decline.
ii. It gives the "true" picture of the region and helps decision makes to detect the causes and not only the symptoms of any existing problems.

An early and correct diagnosis of a problem is perhaps the biggest step towards its solution. In the case of regional development, however, the seeds of decay are usually planted during a period of prosperity and no action is taken against them until it is too late. Ironically, the very state of being an attractive place may unleash forces that ultimately unravel the attractiveness of a place. Many places experience a period of growth, followed by a period of decline, and the fluctuations may be repeated several times. Therefore, a monitoring device, which will alert us at the first sight of danger, is a tool of great importance (Kotler et al., 1999).

We have, so far, introduced the Basic Image of a region, as a measure of the degree to which a region satisfies a set of criteria common for all movers. A region satisfying this general set of criteria will be considered as a potential final choice for both people and business activities. Hence, a region's Basic Image will be a function of the factors which influence the movement of both people and business units. Mobility within a state is essentially a voluntary process and state intervention may only be negative in the sense that it can stop or influence movement but it can not direct it. Hence, any attempt to improve or sustain the attractiveness of a region must be directed towards providing the framework within which this voluntary process can flourish. The Basic Image, as defined, may be the basis for such a framework and the factors affecting it will be the prime targets for improvement. The factors affecting the Basic Image, as presented in the previous section, include economic stability, economic viability, location, accessibility, land availability, infrastructure, financial resources, housing, health and education facilities of high quality. Furthermore, they have been divided into two sets according to whether they express the economic or the social function of the region. The factors of the first set (*Accessibility to Centers of Influence, Land Availability, Financial Conditions*) provide a measure of the region's economic development prospects. This measure is referred to as **Economic Indicator.** Similarly, the factors of the second set (*Housing Conditions, Environmental Conditions, Social Conditions*) provide a measure of a region's social profile. This measure is referred to as **Social Indicator.** Hence,

$$\text{Basic Image} = \varphi\left(\text{Economic Indicator, Social Indicator}\right)$$

Ways for the quantification of those Indicators will be presented in section 6.

The expression of the Basic Image as a function of those two Indicators is not accidental; on the contrary, it is consistent with the concept of a region as a socio-economic unit. The main advantage of such an expression is that it may be used to underline and, eventually, describe the potential conflict between the economic and social functions of a region in the course of development (Llewellyn, 1996; Lovering, 2001; Bristow, 2005).

Concluding, it should be mentioned that the growth of a region may be expressed both in absolute or relative terms. In the latter and most interesting case, the development pattern of a given region is compared to that of a hypothetical region, which is referred to as the "typical" region and expresses, as far as possible, an average of the main regions of a similar type to that under study. In this paper, we shall be looking at the relative development patterns of a region. Hence, all the factors affecting its images (Basic and Specific) should be expressed in relative terms, as compared to the corresponding values of the "typical" region.

5. Properties of the Basic Image

Let us now move a step further and concentrate on the problem of the theoretical shape of the graph of the Basic Image. It is reminded that the Basic Image has been defined as a function of two potentially conflicting indicators and, hence, its graph must be a three-dimensional one. In order to get a first feeling of the shape of that graph we start by stating the following simple observations describing the way in which the two indicators operate.

i. The higher the Economic Indicator of a region, the more attractive its Basic Image.
ii. The lower the Social Indicator of a region, the less attractive its Basic Image,
iii. If the Economic Indicator of a region is continuously increasing but, at the same time, its Social Indicator is continuously decreasing, the Basic Image of the region may be either attractive or non attractive and sudden changes in its state may be expected.

Observation (iii) is the most interesting because it implies that the graph we want to draw may be discontinuous.

The general mathematical theory of discontinuous and divergent behaviour from continuous underlying forces is called Catastrophe Theory (Thom, 1975; Zeeman, 1973). The theory is derived from Topology and is based upon some new theorems in the geometry of many dimensions, which classify the ways in which discontinuities may occur, in terms of a few archetypal forms called elementary catastrophes (Poston and Stewart, 1996). Although the underlying mathematics is difficult and the proofs of the theorems involved complicated, the elementary catastrophes themselves are relatively easy to understand and can be used effectively, even by non-experts in the subject (Angelis and Dimopoulou, 1991). Catastrophe theory was developed and popularized in the early 1970's. After a period of criticism, it is now well established and widely applied (Rosser, 2007). Today, the theory is very much alive and numerous nonlinear phenomena that exhibit discontinuous jumps in behaviour have been modeled by using the theory, for instance in chemistry (e.g Wales, 2001), in physics (e.g. Aerts, 2003), in psychology (e.g. Van der Mass et al., 2003)

in clinical studies (e.g. Smerz and Guastello, 2008) and in the social sciences (e.g. Smith et al., 2005; Dou and Ghose, 2006; Huang, 2008).

Table 1 summarizes the elementary catastrophes in the case where a process is expressed through one behaviour variable depending on one up to four control variables.

In the case of a process, for example, where the behaviour depends on two control variables, it is sufficient to know that a theorem exists giving the qualitative shape of a 3-dimensional surface, which shows all possible ways in which a discontinuity in the behaviour may occur. The two control variables are usually referred to as normal and splitting factor respectively.

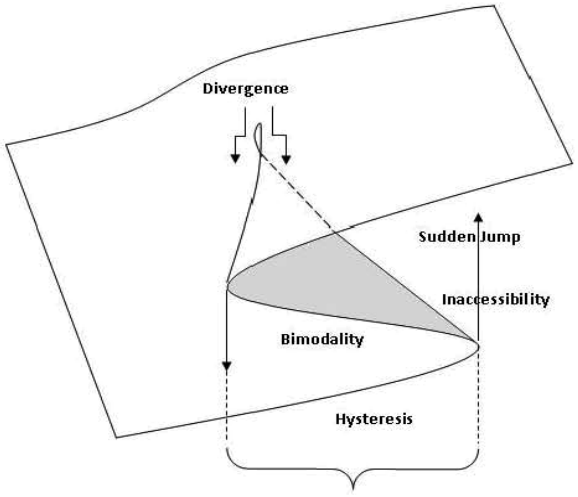
Table 1: Some Elementary Catastrophes

Number of Behaviour Variables	Number of Control Variables	Type of Catastrophe
1	1	Fold
1	2	Cusp
1	3	Swallowtail
1	4	Butterfly

Elementary Catastrophes have characteristic invariant properties and, often, even wave flags (Gilmore, 1993) to gain our attention. Figure 1 illustrates graphically those five properties for the case of cusp catastrophe. Further details about them are given below.

- ***Modality*** arises when, for some combinations of values of the control parameters, there are two or more possible stable values for the state variable.
- ***Sudden Jumps*** take place when a small change in the values of the control parameters may result in a large change in the value of the state variable, as the system jumps from one local minimum to another.
- ***Hysteresis*** occurs whenever a physical process is not strictly reversible. That is, when the jump from one local minimum to another does not occur over the same point in the control parameter space as the reciprocal jump.
- ***Divergence*** arises when small changes in initial values of the control parameters lead to large changes in the final value of the state variable.
- ***Inaccessibility*** means that the physical system has an equilibrium state which is unstable.

Figure 1: The five Characteristic Properties of the Cusp Catastrophe Graph



Returning to the present case, our intention is to show that the process of shaping a region's Basic Image may be modeled in terms of a cusp catastrophe. The first step towards this direction will be to show that at least some of the five invariant properties characterizing phenomena that may be described by the cusp catastrophe (i.e. bimodality, sudden transitions, hysteresis, divergence and inaccessibility) are present in our particular case.

Camagni (2002) notes that regions, unlike nations, more or less can go out of business, becoming so depleted by outmigration that they have, at a long-run, competitive disadvantage. The European continent, with its many competing communities, regions and nations, is now experiencing extreme economic turbulence, where two basic dimensions may be identified. First, every place is subject to internal growth and decline cycles. Second, every place may experience external shocks and forces beyond its control. A large number of European places are experiencing problems, but some more than others (Kotler et al., 1999). The situations fall along a continuum. At the most desperate extreme are places that are dying or are chronically depressed. Many such places have emerged in Europe, as a result of recent decades of economic crises and industrial restructuring. These depressed places lack even the internal resources to launch recovery. There are also acutely depressed places that nonetheless have some potential for revival. While their debts and problems keep worsening, these places possess assets that could support a turnaround should the right leadership and vision emerge. Other places have boom and bust characteristics. These places, as a result of their mix of industries and growth companies, are highly sensitive to business cycle movements. In many cases, in order to survive, those places have shifted their focus from a declining business sector, to a more promising one. On the brighter side

of Europe, we find many places that have undergone healthy transformations. These places have devised effective plans to create new conditions that improve their attractiveness and ensure a turbulence free transition. Finally, some places deserve the title of favoured few, as they enjoy a strong position and continue to attract businesspeople, new residents and visitors (Kotler et al., 1999).

The concept of **modality** and **sudden transitions** in the development of a region is certainly not novel in literature. Many places experience a period of growth followed by a period of decline and the fluctuations may be repeated several times (Camagni, 2002). The growth period inevitably ends because growth lays the seeds of its own destruction. The decline period will also end, but for different reasons. The processes underlying growth and decline dynamics can occur independently of the business cycle stage. However, these processes may be accelerated by sudden changes in the economic climate (Kotler et al., 1999). Boschma and Lambooy (1999) writing about the industrial areas of the 1970's and 1980's, mentioned that had often showed long periods of economic growth, before they declined or even collapsed. Their position became vulnerable due to developments like technological change or the increasing opportunities to shift production to other regions or countries with cheap labour. Within a decade or so, several regions lost many jobs in mature business activities, like textiles, steel making, coal mining and shipbuilding. This was something quite unexpected, because, traditionally, regional economists focus their attention on the positive impacts of agglomeration economies on regional development.

Hysteresis is a characteristic property of the development of a region and is reflected in the delays observed before any sudden changes in the Basic Image of the region take place. For an attractive region, in the process of decline, those delays extend its stay on the attractive side and they are due to the strong attachment to an area displayed by both business units and people. Some business activities are maintained in districts where the original reasons for their development are no longer significant, or even no longer exist. This phenomenon is sometimes referred to as "industrial inertia". While the main reasons for the business units attachment to any area are economic, in the case of people they are essentially psychological. The strength of those psychological factors has been reflected on the poor results of various government schemes aiming to transfer unemployed workers and their families from depressed to more prosperous areas. This finding verifies the existence of strong "residential inertia". Boschma and Lambooy (1999) argue that the poor ability of old agglomerations to learn, innovate and adapt is explained in terms of socio-cultural factors rather than purely economic factors.

Divergence is usually recognisable in the case of two competing regions, especially in a period of rationalisation of their main business activities. Some regions lack the resources to launch a recovery, whereas others have the potential for revival (Kotler et al., 1999). The line between successful and open regions and old industrial, insular, inward-looking industrial districts can be very thin. Some agglomerations, when confronted with catastrophic changes in their regional specialisation, have displayed a strong vitality, like the Boston region and the Birmingham region. On the other hand, similar agglomerations,

like the Ruhr area, the Manchester area, the Liverpool area and the Newcastle upon Tyne area, have followed a quite different trend of no adaptation and, therefore, decline (Boschma and Lambooy, 1999).

The idea of **inaccessibility**, although never expressed in this explicit way, is not novel in literature. The loss of confidence of the community in the future of a region leads to accelerated immigration, rapid shifts in investment and physical neglect. The more sudden the loss of confidence, the more rapid the decline. A region in decline enters a vicious circle as the problems mount and at the same time the region's financial resources and consequently its ability to face those problems decrease. The blight spreads at an accelerating rate and acts as a negative multiplier reinforcing and speeding up the depression. Once a process of regional decline has set in, it becomes self-reinforcing through all kinds of sub indicator and accelerator mechanisms (Boschma and Lambooy, 1999). As a place begins to lose its attractiveness, forces are released that worsen the situation and the image of the place becomes further tarnished. The community raises taxes to maintain or improve the infrastructure and to meet social needs, but the higher taxes only accelerate the out-migration of resources. Unfortunately, the European maps depict numerous places of decaying examples (Kotler et al., 1999). The potential of high acceleration in the loss or gain of a region's attraction power, once it has entered a cycle of deprivation or prosperity, suggests that in such cases a range of values of its Basic Image representing neutrality may be generally considered as unstable and, therefore, practically unattainable.

6. Modeling a Region's Basic Image

6.1 The general form of the model

We have so far shown that the process of shaping a region's Basic Image has all the properties characterising phenomena which may be modeled in terms of Catastrophe Theory. Hence, we may now use Catastrophe Theory to estimate a region's Basic Image. It is reminded that the Basic Image of a region has been defined as a function of two conflicting indicators. Therefore, the appropriate elementary catastrophe is the cusp. Consequently, the value x, of a region's Basic Image, at each point in time, is given as a solution of the equation:

$$x^3 - bx - a = 0 \tag{1}$$

with,

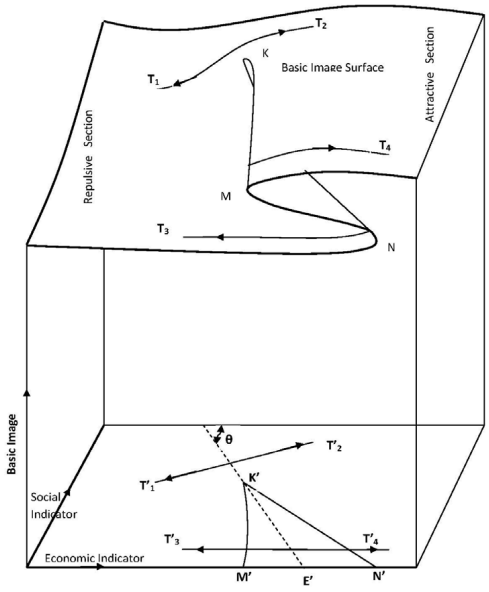
$$\begin{cases} a = m(\alpha - \alpha_0) + (\beta - \beta_0) \\ b = (\alpha - \alpha_0) - m(\beta - \beta_0) \end{cases} \text{ if } m \le 1 \left(i.e.\ \theta \le \frac{\pi}{2} \right) \quad \text{and}$$

$$\begin{cases} a = (\alpha - \alpha_0) + (1/m)(\beta - \beta_0) \\ b = (1/m)(\alpha - \alpha_0) - (\beta - \beta_0) \end{cases} \text{ if } m > 1 \left(i.e.\ \theta > \frac{\pi}{2} \right)$$

Equation (1) is referred to as the **Basic Image Equation** and its graph is qualitatively equivalent to the Cusp Catastrophe Graph (Figure 2).

The variables α, β express the values of the two Indicators, while α_0, β_0, express the values of those two Indicators for the "typical" region. The point (α_0, β_0) corresponds to the vertex of the cusp, while $m = \tan\theta$ represents the slope of the cusp axis and expresses the relative weights attached to each one of the two indicators in defining the Basic Image. For the purposes of this work, the values of all Indicators lie in the interval [0,1], whereas the value of its Basic Image lies in the interval [-1,1]. The value of the "typical" region's Basic Image is 0. Hence, positive Basic Image indicates an attractive region that may be considered as a potential final choice by the various groups of prospective movers.

Figure 2: The Cusp Catastrophe graph in the case of Basic Image



The position of the cusp in Figure 2 is indicative. The trajectory of a region's Basic Image lies on the Basic Image surface. As long as the trajectory remains on the upper section of this surface, the area is attractive, whereas in case the trajectory moves on the lower part, the region becomes repulsive. T_1T_2 and T_3T_4 are typical trajectories of an area's Basic Image and $T_1'T_2'$, $T_3'T_4'$ are their projections on the two dimensional Control Space C. The line KM is the locus of breaking points for areas undergoing sudden loss of attractiveness while the line KN is the locus of turning points for regions going through a phase of sudden increase of attractiveness. $K'M', K'N'$ are the projections of KM, KN on the Control Space and $K'E'$ is the projection on C of the cusp axis.

We have so far defined a region's i Basic Image as a function of a multitude of factors, grouped into two potentially conflicting indicators. A large variety of indicators, either simple or composite, quantifying the economic, social and environmental dimension of a region may be found in the relevant literature (Hammond et al., 1995; Freudenberg, 2003; Slavova, 2008; Eurostat Regional Yearbook, 2008). For the purposes of our model, those indicators are expressed as the geometric mean of several **Sub indicators**, each of which depends on a number of factors among those affecting the region's Basic Image. The use of this geometric mean is justified by the fact that each one of the Sub indicators affecting the respective indicator is considered to be critically important for this indicator's value. Consequently,

$$IND_i^h = \sqrt[m]{\prod_{j=1}^{m} SbI_{ij}^h},\ h = 1,\ 2;\ i = 1,\ 2,\ldots,n$$

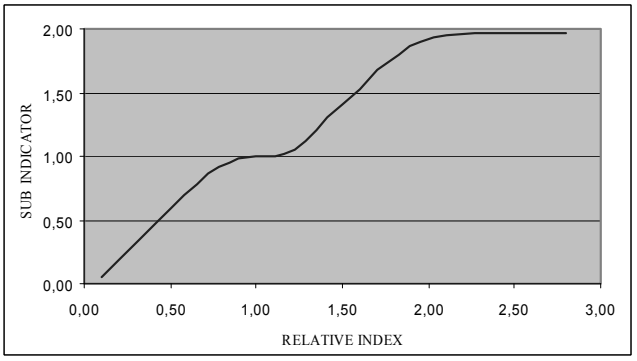
where, IND_i^h denotes the h^{th} Indicator of region i and SbI_{ij}^h denotes the j^{th} Sub indicator of region i, which is related to Indicator h. Each Sub indicator SbI_{ij}^h is defined as a non-linear function of a respective Relative Index RI_{ij}^h. This index is, in turn, a function of all variables, measured or estimated, affecting the Sub indicator and may be defined in the following two ways:

- The values of all variables, expressed in relative terms with respect to the typical region, are used to obtain directly the Relative Index RI_{ij}^h, $h = 1,\ 2$, $i = 1,\ 2,\ldots,n$, $j = 1,\ 2,\ldots,m$.
- The variables are classified into various sets, depending on the specific component of the Sub indicator they affect. The values of all variables which belong to every set, expressed in relative terms with respect to the typical region, are used to obtain directly the respective Relative Sub indices $RSI_{ij_k}^h$, $h = 1,\ 2$, $i = 1,\ 2,\ldots,n$, $j = 1,\ 2,\ldots,m$, $k = 1,\ 2,\ldots,r$. Finally, those Sub Indices are combined so as to give Relative Index:

$$RI_{ij}^h = \frac{\sum_{k=1}^{r} w_k RSI_{ij_k}^h}{\sum_{k=1}^{r} w_k},\ h = 1,\ 2,\ i = 1,\ 2,\ldots,n,\ j = 1,\ 2,\ldots,m,$$

where, w_k, $k = 1,\ 2,\ldots,r$ are weights indicating the relative importance attached to each Sub index in defining the respective Relative Index.

Figure 3: An indicative Transformation of a Relative Index into the corresponding Sub indicator



Once the Relative Index has been defined, its values are transformed so as to obtain the corresponding values of Sub indicator SbI_{ij}^{h}. For the purposes of the model, this transformation has been based on available data but, also, on assumptions consistent with generally accepted views expressed in literature. In the case of a given sub indicator SbI_{ij}^{h}, depending on a Relative Index RI_{ij}^{h}, a simple relationship has been used. As long as the value of the Relative Index RI_{ij}^{h} is close to 1, the value of the corresponding sub indicator remains also close to 1, i.e. close to the typical region's value, thus indicating a limited variation of the sub indicator's influence on the region's Image. However, as the value of the Relative Index RI_{ij}^{h} becomes substantially greater or lower than 1, in other words substantially better or worse than the typical region's value, SbI_{ij}^{h} also increases rapidly, indicating its strong influence on the region's development. An indicative transformation is shown in Figure 3. The prospective user of the model, however, may easily modify this transformation if his underlying set of assumptions is different.

Note that each Sub indicator and the respective Relative Index summarize the same aspect of a region's development. The transformation used works as a standardization process and it is needed to ensure that:

- all sub indicators have the same range. For the purposes of the model, all sub indicators have the same range values –usually [0,2]; hence, the range of their product is $[0, 2^n]$ and, consequently, the range of IND_i^h, $h = 1, 2;\ i = 1, 2, \ldots, n$ is also [0,2]. In certain cases, however, the dominance of a particular sub indicator needs to be emphasized. This may be done by increasing its range. In such a case, the range of the remaining sub indicators must be modified, so that the range of their product remains the same i.e. $[0,\ 2^n]$.
- the effect of changes in the values of variables on the values of the respective sub indicators follow the same pattern for all sub indicators.

6.2 Estimation of the model parameters for the case under study

Returning to the present case, it is reminded that the factors affecting a region's Basic Image may be allocated into two sets, according to whether they express the economic or the social aspect of the region. The factors of the first set provide a measure of the region's economic development prospects. This measure is referred to as the **Economic Indicator.** Similarly, the factors of the second set provide a measure of the region's social profile. This measure is referred to as the **Social Indicator.** Furthermore, each of those Indicators is expressed as the geometric mean of several Sub indicators as shown below:

$IND_i^1 = \sqrt[3]{\prod_{j=1}^{3} SbI_{ij}^1},\ i = 1, 2, \ldots, n$		$IND_i^2 = \sqrt[3]{\prod_{j=1}^{3} SbI_{ij}^2},\ i = 1, 2, \ldots, n$	
where			
IND_i^1 :	**The Economic Indicator of region** i	IND_i^2 :	**The Social Indicator of region** i
SbI_{i1}^1 :	The Location Sub indicator of region i	SbI_{i1}^2 :	The Housing Conditions Sub indicator of region i
SbI_{i2}^1 :	The Land Availability Sub indicator of region i	SbI_{i2}^2 :	The Social Conditions Sub indicator of region i
SbI_{i3}^1 :	The Financial Conditions Sub indicator of region i	SbI_{i3}^2 :	The Environmental Conditions Sub indicator of region i

It should be noted that IND_i^1, IND_i^2 coincide with the coefficients a and b of the Basic Image Equation (equation (1)). A clear overview of the variables affecting a region's Basic Image and their conversion through Sub Indices, Relative Sub indices, Relative Indices and Sub-indicators into Indicators and, finally, into the region's Basic Image is given in Table 2. One may argue that some significant variables expressing the region's power to retain/attract movers belonging to various groups are missing from Table 2.

Table 2: Conversion of the variables affecting the Basic Image of region i

INDICATORS, INDICES AND VARIABLES CONCERNING REGION i					
Indicators of region i	**Sub indicators of region i**	**Relative Indices of region i**	**Relative Sub indices of region i**	**Sub indices of region i**	**Variables**
Economic Indicator $\left(IND_i^1\right)$	Location Sub indicator $\left(SbI_{i1}^1\right)$	Relative Location Index $\left(RI_{i1}^1\right)$			Size of Influence Centres
					Distance/Cost from Influence Centres
	Land Availability Sub indicator $\left(SbI_{i2}^1\right)$	Relative Land Availability Index $\left(RI_{i2}^1\right)$	—	—	Area
					Population
	Financial Conditions Sub indicator $\left(SbI_{i3}^1\right)$	Relative Financial Conditions Index $\left(RI_{i3}^1\right)$	—	—	Gross Domestic Product,
					Population
Social Indicator $\left(IND_i^2\right)$	Housing Conditions Sub indicator $\left(SbI_{i1}^2\right)$	Relative Housing Conditions Index $\left(RI_{i1}^2\right)$	Relative Housing Availability Sub index $\left(RSI_{i1_1}^2\right)$	Housing Availability Sub index $\left(SI_{i1_1}^2\right)$	Total Number of Houses
					Population
			Relative Housing Quality Sub index $\left(RSI_{i1_2}^2\right)$	Housing Quality Sub index $\left(SI_{i1_2}^2\right)$	Number of New Houses
					Total number of Houses
	Social Conditions Sub indicator $\left(SbI_{i2}^2\right)$	Relative Social Conditions Index $\left(RI_{i2}^2\right)$	Relative Health Services Sub index $\left(RSI_{i2_1}^2\right)$	Health Services Sub index $\left(SI_{i2_1}^2\right)$	Number of Doctors
					Number of Hospital Beds
					Population
			Relative Educational Services Sub index $\left(RSI_{i2_2}^2\right)$	Educational Services Sub index $\left(SI_{i2_2}^2\right)$	Number of Teachers
					Number of Classrooms
					Population
	Environmental Conditions Sub indicator $\left(SbI_{i3}^2\right)$	Relative Environmental Conditions Index $\left(RI_{i3}^2\right)$	Relative Industrial Pollution Sub index $\left(RSI_{i3_1}^2\right)$	Industrial Pollution Sub index $\left(SI_{i3_1}^2\right)$	Industrial Electricity Consumption
					Total Electricity Consumption
			Relative Car Pollution Sub index $\left(RSI_{i3_2}^2\right)$	Car Pollution Sub index $\left(SI_{i3_2}^2\right)$	Number of Cars
					Population

Such variables include labour availability/quality and financial incentives for investors, as well as job availability/quality, employment earnings and financial incentives for employees. This is a plausible argument but, on the other hand, it must be noted that those factors will be used in a next step, which is, however, beyond the scope of this paper, for the estimation of a region's Specific Images, as perceived by the various groups of potential movers. The Specific Images express the degree to which the members of each group consider the region as their best final choice. A physically realisable measure of those Images is the net change, over a period of time, in the number of the members of each group present in the region. As it has already been mentioned, those changes may be generally considered as the delayed and considerably smoothed consequences of the changes in the Basic Image. Hence, a region's Basic Image, as defined, gives a reliable overall estimate of the region's prospects of development and an early warning for any potential danger. Finally, it must be underlined that the choice of variables used for the estimation of a region's Basic Image depends, among other things, on the availability of data. In any way, however, our intention in this paper is to provide a generic framework for the estimation of a region's Basic Image. Within this framework, every researcher may make the appropriate modifications according to both his research requirements and the data availability.

All the Sub Indicators presented in Table 2 are defined below.

- **The Location Sub indicator**

Every business activity, in order to operate effectively and efficiently, requires access to sources of raw materials, commerce and service centres, as well as clusters of other industries. In other words, it requires access to what we may generally call "influence centres". An area, the location of which offers "influence centres", has a strong comparative advantage over its competitors in attracting industrial units.

The Location Sub indicator of region i, $\left(SbI_{i3}^{2}\right)$, is a non linear transformation of the Relative Location Index $\left(RI_{i3}^{2}\right)$, which expresses the region's relative position with respect to the various influence centers. Every region is generally surrounded by more than one influence centers. Hence, the Relative Location Index expresses the total influence exerted on region i by all influence centres. In other words, the Relative Location Index is the sum of r Relative Location Sub indices $\left(RSI_{i1_k}^{1}\right)$, $k = 1, 2, \ldots, r$, each one expressing the influence exerted on region i by the respective influence centre k. Hence,

$$RI_{i1}^{1} = \sum_{k=1}^{r} RSI_{i1_k}^{1}.$$

Furthermore, each of the Relative Location Sub indices is a function of:

- The influence centre's size, as defined by its Gross Domestic Product, expressed in relative terms.
- The region's accessibility to the given influence centre, which depends on
  - the cost of transporting a unit quantity between region i and the given influence centre, expressed in relative terms.
  - The degree of a region's spatial discontinuity, as defined by the transport modes available and their transportation capacity, expressed in relative terms.

➢ **The Land Availability Sub indicator**

Measuring land availability is a delicate subject. If the area available for business use is considered fixed, as in the case of an area surrounded by a clearly defined "green belt", then land availability, at any time, may be measured as the fraction of the area which is available for use. Generally, however, the area available for business use is allowed to expand in order to accommodate any further growth. Although expansion is not limitless, the measure presented above is meaningless in this case. A more suitable measure would be the density of population in the surrounding region. High density indicates a high degree of urbanization in the area and makes further expansion difficult. Local regulations on land use must also be taken into account, whenever it is necessary.

The Land Availability Sub indicator of region i, $\left(SbI_{i3}^{2}\right)$, is a non linear transformation of the Relative Land Availability Index $\left(RI_{i3}^{2}\right)$, which is defined as the inverse population density ratio for this region expressed in relative terms.

➢ **The Financial Conditions Sub indicator**

The term refers to the level of general economic conditions prevailing in the region and, somehow, reflects the standard of living of its inhabitants. The Financial Conditions Sub indicator of region i, $\left(SbI_{i3}^{1}\right)$, is a non linear transformation of the Relative Financial Conditions Index $\left(RI_{i3}^{1}\right)$, which is defined as the region's relative gross domestic product per capita expressed in relative terms.

➢ **The Housing Conditions Sub indicator**

The Housing Conditions Sub indicator of region i, $\left(SbI_{i1}^{2}\right)$, is a non linear transformation of the Relative Housing Conditions Index, $\left(RI_{i1}^{2}\right)$, which combines two aspects of the region's housing stock: availability and quality. Housing availability is expressed through the Relative Housing Availability Sub index $\left(RSI_{i1_1}^{2}\right)$, which is the ratio of the total number of houses available over the population, expressed in relative terms. Housing quality is expressed through the Relative Housing Quality Sub index $\left(RSI_{1_2 j}^{2}\right)$, which is the ratio of the number of new houses over the total number of houses, expressed in relative terms. Hence, on the basis of the above we have that:

$$RI_{i1}^{2}=\frac{w_1 RSI_{i1_1}^{2}+w_2 RSI_{i1_2}^{2}}{w_1+w_2}$$, where w_k, $k=1,2$ are the appropriate weights.

➢ **The Social Conditions Sub indicator**

The Social Conditions Sub indicator of region i, $\left(SbI_{i3}^{2}\right)$, is a non linear transformation of the Relative Social Conditions Index, which combines two aspects of the region's social profile, health services and educational services.

The level of health services is expressed through the Relative Health Services Sub index, $\left(RSI_{i2_1}^{2}\right)$, which is the weighted average of two ratios: the ratio of the number of

doctors available in the region over its population, expressed in relative terms and the ratio of the number of hospital beds available in the region over its population, measured in relative terms.

Similarly the level of educational services is expressed through the relative Educational Services Sub index, $\left(RSI_{i3_1}^2\right)$, which is a weighted average of two ratios: the ratio of the number of teachers available in the region over its population and the ratio of the number of school classrooms available in the region over its population, both ratios expressed in relative terms. Hence, on the basis of the above we have that:

$$RI_{i2}^2 = \frac{w_3 RSI_{i2_1}^2 + w_4 RSI_{i2_2}^2}{w_3 + w_4}, \text{ where } w_k,\ k = 3,4 \text{ are the appropriate weights.}$$

- **The Environmental Conditions Sub indicator**

Environment is a unity wherein many elements interact but several of them may be distinguished; air pollution, water pollution, noise, solid waste disposal, and dereliction of land. For the purposes of the present work, two sources of environmental degradation are considered: excessive industrialization and heavy use of cars.

The Environmental Conditions Sub indicator of region i, $\left(SbI_{i3}^2\right)$, is a non linear transformation of the Relative Environmental Conditions Index, $\left(RI_{i3}^2\right)$, which combines two aspects of the region's environmental profile, industrial pollution (excessive industrialization) and car pollution (heavy use of cars).

The level of industrial pollution is expressed through the Relative Industrial Pollution Index, $\left(RSI_{i3_1}^2\right)$, which is the ratio of the total annual electrical consumption in the region over the electrical consumption for industrial uses only, expressed in relative terms.

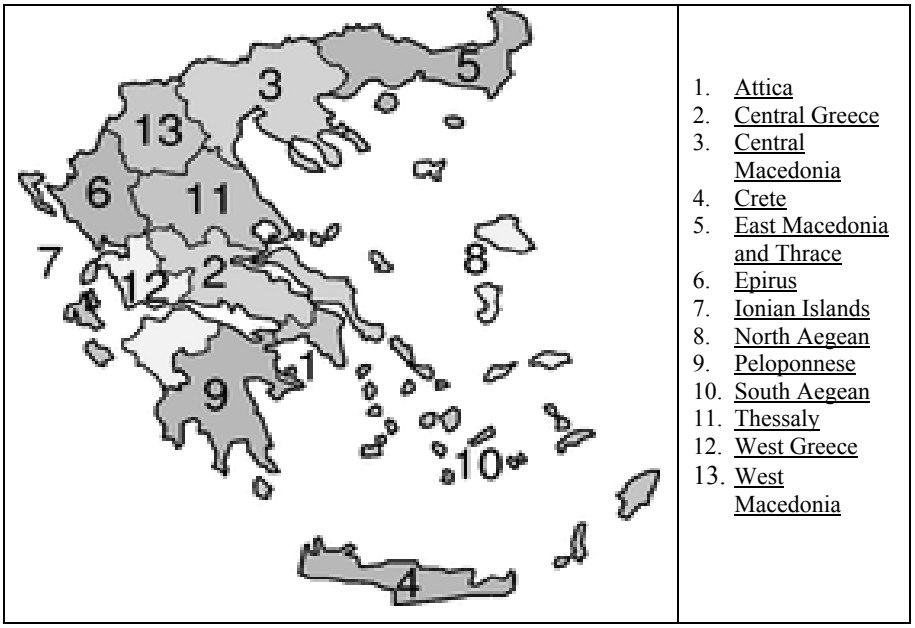
The level of car pollution is expressed through the Relative Cars Pollution Index, $\left(RSI_{i3_2}^2\right)$, which is the ratio of the region's population over the total number of cars available, expressed in relative terms. Hence, on the basis of the above we have that:

$$RI_{i2}^2 = \frac{w_5 RSI_{i2_1}^2 + w_6 RSI_{i2_2}^2}{w_5 + w_6}, \text{ where } w_k,\ k = 5,6 \text{ are the appropriate weights.}$$

7. Application of the Proposed Model

The methodology presented in the previous section is now used for the estimation of the Basic Image of the 13 regions of Greece (Figure 4). The required data have been drawn from the official site of the Hellenic Statistical Authority. The results are shown in Table 3, which gives the values of Economic Indicator, Social Indicator and Basic Image for all 13 regions of Greece for the year 2005. The values of Economic and Social Indicator for the typical region have also been calculated and found to be 0.45 and 0.52 respectively.

Figure 4: The 13 Greek Regions



Source: http://upload.wikimedia.org/wikipedia/commons/9/9d/GreeceNumberedPerepheries.png

Table 3: Basic Image values for the 13 Greek Regions

$m = 1,\ \alpha_0 = 0.45,\ \beta_0 = 0.52$

REGION	Economic Indicator	Social Indicator	BASIC IMAGE
1. ATTICA	0.6969	0.4748	0.7493
2. EAST MACEDONIA & THRAKI	0.4355	0.4436	-0.4954
3. CENTRAL MACEDONIA	0.5234	0.5083	0.4663
4. WEST MACEDONIA	0.4989	0.5655	0.4579
5. EPEIROS	0.4840	0.6169	0.4666
6. THESSALY	0.5283	0.4930	0.4646
7. IONIAN ISLANDS	0.3676	0.5732	-0.1755
8. WEST GREECE	0.5023	0.4841	0.3649
9. STEREA ELLADA	0.5673	0.4445	0.5222
10. PELOPONNISOS	0.5107	0.5158	0.4398
11. NORTH AEGEAN	0.2238	0.5485	-0.4405
12. SOUTH AEGEAN	0.2605	0.5754	-0.3588
13. CRETE	0.2801	0.5494	-0.3952

By looking at the results the following conclusions may be drawn:

- All mainland regions have positive Basic Image with the exception of East Macedonia and Thrace, whereas all island regions have negative Basic Image.
- East Macedonia and Thrace, the only mainland region with a negative Basic Image value, is a remote border region with poor accessibility, something which is reflected in the relatively low value of its Economic Indicator. Hence, any effort to improve its Basic Image should start from the improvement of its accessibility i.e. transportation infrastructure and means.
- The negative Basic Image value of all island regions is a natural consequence of their high spatial discontinuity which makes it extremely difficult for them to attract economic activities involving transportation of materials and goods. All efforts aiming to reduce their geographic discontinuity, through the improvement of transportation infrastructure and means, have limited results. Hence, a realistic alternative way to overcome the problem will be to bypass geographic discontinuity through one of the following measures or a combination of them:
  - Development of local business activities, not requiring extensive transportation of physical entities. The effectiveness of this measure, however, is questionable, as the potential markets for the local products are usually very limited.
  - Development of business activities for which unfavourable location is not necessarily a handicap. Tourism is such an activity, where geographical discontinuity may not be a problem but, on the contrary, in certain cases, a strong comparative advantage. The exclusive dependence of the region's development, however, on a single activity, such as tourism, is vulnerable to external factors and therefore risky.
  - Establishment of a communication network, where no discontinuity occurs. In this way, the regions will be able to attract or develop economic activities involving the production of intangible goods (financial services, computer software) locally, which, then, may be communicated to customers located elsewhere. The rapid development of Information and Communication Technologies (ICT) over the last years has made the third solution possible.

  The choice of the proper measure or combination of measures depends on the specific characteristics of the region given.

The estimation of a region's Basic Image for a given year gives a "snapshot" view of a region's development. A more interesting exercise however, would be to estimate the region's Basic Image for a number of years, to identify its respective trend and to study its changes. It must be noted that the way in which the Basic Image has been structured, allows the researcher to determine not only the changes in the region's Basic Image value, but also the causes of those changes. Going backwards from the Basic Image, through indicators, sub indicators, indices and sub indices to the variables, one can identify the real causes of the Basic Image changes. Hence, the Basic Image may prove a very useful managerial tool for both local authorities and business firms. The local authorities may use the Basic

Image in order to monitor the development of the various regions, get an early warning of any potential problems they may face and take the necessary measures to prevent them. The business firms on the other hand, may use the Basic Image in order to follow the development of various regions, assess their potential for future growth and take the proper location and investment decisions.

8. Conclusions and Suggestions for Further Research

A region's development depends on its ability to retain existing business activities and attract new ones. This ability depends on what we call the Image of a region and it is a measure expressing the region's current state of development and its future prospects. The paper introduced the concept of a region's Basic Image, developed a mathematical model for its estimation, applied the model to the case of the thirteen regions of Greece and presented the results. The Basic Image gives a "true" picture of a region's development, an early warning of any future problems. Furthermore, its structure allows a researcher to identify not only the changes in the Basic Image values, but also the causes of those changes and, hence, take the necessary measures. Consequently, the Basic Image may prove to be a very useful managerial tool, which can help the authorities to improve the region's attractiveness and future prospects of development. The application results seem logical and expected. They show that the proposed model expresses a region's attractiveness in a realistic way, in the sense that it quantifies the region's appeal to the full range of its existing and potential business units and employees.

A special note, however, should be made for the island regions. As it has been mentioned in the previous section, all islands have negative Basic Image values expressing their difficulty in attracting economic activities involving heavy transportation of raw materials and finished goods. However, a number of alternative measures for overcoming this problem have been proposed, opening up new prospects for those regions' growth. Hence, the Basic Image should be redefined so as to take into account these prospects and the effects of measures taken in this direction. This redefinition of a region's basic image is one of the main areas for further research.

The Basic Image, as defined so far, has left out a number of important variables, endogenous or exogenous. Hence, another area of further research would be to redefine a region's Basic Image, so as to include some of those variables. A first set of such variables may be those related to the region's environmental conditions and could define a third indicator, which may be referred to as Environmental Indicator. A second set of variables may be those related to the prevailing socio-economic environment in which the region operates and could define a fourth indicator, which may be referred to as General Economic Climate Indicator. As it has been seen in section 5, in the case of three or four indicator the most appropriate elementary catastrophes are the Swallowtail and the Butterfly catastrophes respectively. Hence, our task will be to examine how those elementary catastrophes may be used to model the enriched Basic Image.

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