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A historical overview and critical analysis of town centre delimitation methodologies

Ioannis A. Pissourios[CDMR]

Neapolis University Pafos, School of Architecture, Land and Environmental Sciences, 2 Danais Avenue, 8042 Pafos, Cyprus; phone: +35 796 507 694; e-mail: pissourios@gmail.com

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Abstract. The article aims at exploring the literature on town centre delimitation methods over the last sixty years. Specifically, the first section explores the content of the term town centre, while the second one proposes an organisation of town centre delimitation research in three main periods. The third section comprises the main corpus of the article, as several town centre delimitation methodologies of the last sixty years are presented and discussed. For their presentation, a three tiered analysis is introduced. In the first stage the decisions of researchers regarding centrality estimators are discussed, in the second stage the study focuses on the choices of the spatial units, in which the chosen variables will be studied, and in the third stage the study discusses the methods that are used to characterise each of the studied spatial units as central versus non-central. Based on the analysis, the article concludes that town centre delimitation is an issue which transcends various scientific disciplines and that each of these disciplines comprehends the centre of a town in a unique way. Thus, future methods of town centre delimitation should take into account the choices made in each of the three stages presented above, and should also link the above choices to the objectives and the theoretical context of the study.

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Contents:

1. Introduction 156
2. Centrality, town centre, central business district and similar terms 156
3. The main periods of town centre delimitation research 157
4. Critical presentation of main town centre delimitation methodologies 158
   4.1. Centrality estimators 159
   4.2. Spatial reference units in delimitation methods 161
   4.3. Central versus non-central areas 162

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5. Conclusions 163
References 164

1. Introduction

The conceptual context of 'town centre' is hard to define, even if it is easy to describe. It is as difficult to offer a clear definition of town centre, as it is easy to confirm its existence when you encounter one. The high density of business and service activities, the diversity of urban uses, the chief focus on pedestrian and automobile traffic, the intense land utilisation, the high buildings, the small number of residences and the steep land values are all descriptive aspects of a typical town centre, albeit not definitions. Moreover, the fact that different views upon centrality can be seen in various scientific disciplines (urban planning, economics, traffic engineering, sociology, etc.) complicates the attempt to define, and not, as it is the case above, to describe, this very special place in a town. Anybody who has studied town centres can verify that the delimitation of a town centre seems to be dependent its definition. With regard to this issue, P. Cornière argues that 'delimitation of the centre, which at first sight seems to be posterior to the sought definition, in fact encounters the same problems' (Cornière, 1967: 6). However, for each distinct scientific discipline, a precise definition of town centre can be given and a desirable delimitation of it can be attained.

Due to the aforementioned difficulties in defining a town centre, delimitation methodologies, and especially their applications, are confusing. Methodologies of town centre delimitation adjusted to the specific and individual needs of one scientific discipline have been applied to other scientific disciplines without any modification, while a wide variety of centrality estimators, which comprise the variables that the delimitation method will be based on, have been used for each of these methodologies without appropriate theoretical documentation.

Based on the above discussion, the article aims at exploring the literature on town centre delimitation methods. Specifically, the first section explores the content of the term *town centre*, and the content of similar terms used to denote town centre, while the second section proposes an organisation of town centre delimitation research into three main periods. In the third section, several town centre delimitation methodologies of the last sixty years are presented and discussed. For their presentation, athree tiered analysis is introduced by the author. In the first stage the decisions of researchers upon *centrality estimators* are discussed, in the second stage the study focuses on the choices of the *spatial units,* in which the chosen variables will be studied, and in the third stage the study discusses *the methods that are used* to characterise each of the spatial units studied as central *versus* non-central. Based on the analysis, the article concludes that town centre delimitation is an issue which transcends various scientific disciplines and that each of these disciplines conceptualises the centre of a town in a unique way. Thus, no universal definition of town centre, nor a common delimitation method of it, can be developed. However, future methods of town centre delimitation should take into account the choices made in each of the three tiers presented above, and should also link the above choices to the objectives and the theoretical context of the study.

2. Centrality, town centre, central business district and similar terms

The definition of town centre and its delimitation concern the study of centrality at large. The study of centrality values in a town and their generalisation into only two classes yields the division of a settlement into centre and periphery. Thus, studies that are focused either on the delimitation of a certain area or on the study of centrality values must answer the same basic question: what does centrality or a town centre mean?

According to J. Bird (1977: 1), 'centrality is more basic than urbanism, urbanisation, or whatever word is used to cover city formation and development –

more basic and perhaps even more complicated. The complications are entwined within a progression from the straightforward idea of transport to complex symbolism in psychology'. Undoubtedly, the meaning of centrality is highly complicated as it is used in various scientific disciplines (Cornière, 1967: 5; Zafiropoulos et al., 1986: 1). According to A.-Ph. Lagopoulos (1973), centrality can be defined through two distinguished approaches: the functional and the semiotic one. In the functional approach, the study focuses on the functionally organised and constructed space, while the semiotic approach is concerned with space as a vehicle of meaning. Within the functional approach, which Bird defines in relation to the term transportation, a town centre is the place where shops and services are clustered, where maximum pedestrian and vehicle traffic takes place, etc. From the semiotic perspective, which Bird calls 'symbolism in psychology', a town centre can be seen as a place of noetic orientation, as a historical outcome of religious and ritualistic processes, as the domination of a specific world view upon space, etc.

Due to the lack of a clear definition of centrality, a variety of terms has been assigned to describe the central part of a town. Each term sets forth a specific aspect or characteristic of this area, or defines a bigger or smaller area as a town centre. *Town* or *city centre* is the most familiar term, as well as the one with the most general use and content. *Urban core* is quite similar to the aforementioned term, but has the advantage in that it can be broken down into two sub-areas. The first sub-area is referred to as the *hard core area* or *inner core area*, which is the most central area of the urban core, while the second is termed *core fringe* or *core frame*, which is the remaining area of the urban core when the hard core area is removed. With regard to town centre and urban core, the former is much more neutral than the other, since the latter has been used in a series of studies concerning the *central business district* (CBD) and this use has redefined its conceptual meaning. The term *inner city* is mostly used to describe the part of the city formerly enclosed by walls. If this has 'significant architectural qualities' and 'continuing social life', we would use the term *historic urban centre* (Papageorgiou, 1971: 28). Much more specific in its conceptual meaning is the term CBD and its usage is limited to the economic description of urban space. CBD, as well as historic urban centre, comprise terms that cannot be used to describe the semiotic view of urban space. The term *downtown business district* is similar to CBD.

Most of the studies regarding town centre delimitation use the term CBD. V. Gruen feels that the term is misleading in that it implies that the heart of the city is only meant to serve business (Gruen, 1965: 47). He also comments that it otherwise could be the district of centralised business, but it is too late to change the name now. On the other hand, the usage of CBD (for example in Burgess's concentric zone model, Hoyt's sector model and Mann's model) in conjunction with other zones with characteristically social concepts (i.e., medium-class residential sector) leaves no doubt that the CBD is not a zone defined solely by economics. Last but not least, due to its usage in the classical paper *Delimiting the CBD* of R.E. Murphy and J.E. Vance (1954), which had a tremendous impact on the relevant scientific literature, this term has been used in a series of other centrality studies. As a result, CBD now has a lot of traits that did not originally belong to it, and its meaning coincides with the one of town centre.

3. The main periods of town centre delimitation research

By 1950, town centre delimitation was already a popular subject among urban geographers, urban planners, and businessmen, as there was a rapidly increasing interest in the district where business activities were concentrated and traffic flow as well as land values were reaching their highest levels. In that decade, some of the best-known studies of town centre were published, mainly about American cities. The great majority of these studies were based on a subjective delimitation of the CBD, such as the work of G. Hartman (1950) and D. Foley (1952). However, in 1954, Murphy and Vance published the article *Delimiting the CBD*, in which the first widely accepted delimitation method was described. The method, named *Central Business Index Method* (CBIM), was based on the calculation of central uses percentages in each block of the city. The main stages of this method are:

Calculation of the *Central Business Height Index* (CBHI) and the *Central Business Intensity Index* (CBII). CBHI is obtained by dividing the total floor area of all central business uses by the total ground floor area of the block. CBII is the percentage that total floor area of central business uses makes up of the total floor space at all levels. Central uses were regarded as retail shops and services, offices, factories for city newspapers and some large specialised office buildings.

For a block to be considered as part of the CBD, it should have CBHI > 0.5 and CBII > 1 and also fulfill some other requirements. First, it should be part of a contiguous group of such blocks surrounding the peak land value intersection. Secondly, a block that does not reach the required indices values, but is surrounded by blocks that do, is considered part of the CBD.

The aforementioned method gives reliable results on the town centre delimitation issue and has been widely accepted by the scientific community. The formulation of this method boosted the research in similar issues, such as the internal structure of the CBD, or the recognition of patterns among central uses in the CBD for one settlement alone, or comparatively among groups of settlements (Davies, 1959, 1960; Carol, 1960; De Blij, 1962; Gruen, 1965; Bohnert, Mattingly, 1964; Carter, Rowley, 1966; Allpass et al., 1967; Cornière, 1967; Goddard, 1967; Bowden, 1971). The intense use of the CBIM method until the late 1960s characterises the first period of town centre delimitation research.

The next period begins in the early 1970s and is characterised by two phenomena. The first one is the decentralisation of central town delimitation issue from urban geographers' and planners' interests, which is evident in the limited number of related publications. This could be the result of the wide acceptance of the CBIM as the *paradigm* of the town centre delimitation issue, but can also be explained by the criticism of quantitative geography in the 1950s and 1960s and the fact that it failed to say anything about the growing problems seen in cities (Ley, 1983; Hall, 1998). S. Fotheringham, C. Brunsdon and M. Charlton (2000) stress the opinion that the positive approach to geography and the quantitative methods were under severe criticism, mostly because of their past mistakes. This criticism is not irrelevant to the growth of new paradigms in human geography, such as Marxism, post-modernism, structuralism and humanism, which have attracted adherents united in their anti-quantitative sentiments. However, much of this criticism originated from individuals who had little or no understanding of quantitative geography (Fotheringham et al., 2000: 1-3).

The second phenomenon, which in my opinion is linked to the above discussion, is the characteristically simplified approach of the town centre delimitation issue. K. Robertson's study (1983) concerning the CBD as it was delimited by the U.S. Bureau of the Census, E. Lawrence's study (1986), which is based on an intuitive perception of the CBD limits across the streets, S. Brown's study (1987), in which he delimits the CBD empirically, and J. Curtis's study (1993), in which he delineates the CBD by applying an equivocal method based on commercial establishment density, are all examples of this simplistic approach.

The third period is characterised by the use of modern quantitative methods of spatial analysis and begins with the promising method of M. Thurstain-Goodwin and D. Unwin (2000), which offers interesting and applicable solutions to the town centre delimitation issue by exploiting the potentialities of geographical information systems (GIS) and geostatistics. Even if the work of researchers that embrace modern tools and techniques of spatial analysis (see: Thurstain-Goodwin, Unwin, 2000; Borruso, 2003; Borruso, Porceddu, 2009; Taubenböck et al., 2013) offers interesting technical solutions for town centre delimitation, the theoretical justification of the proposed methods remains weak. These weaknesses will be discussed in detail in the following sections. It should also be noted that town centre delimitation is not the only example of weak theoretical justification of the application of modern techniques in urban analysis. I. Pissourios et al. (2012) have already stressed the need for clearer and more stable theoretical ground, on which the introduction of spatial statistics into the corpus of urban analysis has to be based.

4. Critical presentation of main town centre delimitation methodologies

Town centre delimitation methodologies use a variety of techniques and centrality estimators in or-

der to achieve an accurate and the least subjective result possible. What is of great importance for our study is that all of the delimitation methodologies presented below can be divided into three logical stages. At every stage, the researchers make nodal decisions about their methods, i.e., decisions that have a decisive effect on the method's outcome. Particularly, in the first stage the researchers decide on a *centrality estimator*, which concerns the selection of the variable, or the variables, that the delimitation method will be based on. In the second stage, they define the *spatial unit* in which the chosen variables will be studied. In the third and last stage, they decide *what to regard as town centre* and what should not be regarded as such, based on previous calculations. For example, in CBIM these three stages successively concern: (a) the option of central business floor space use as the most appropriate centrality estimator and the formation of the Central Business Height and Intensity Indices, (b) the option of blocks as the basic spatial reference unit, and (c) the thresholds of 1 and 0.5 for the aforementioned indices successively, used for the classification of blocks as central or non-central. Consequently, an analysis of several well-known options that a researcher can use in a town centre delimitation attempt, separately at every stage, will follow.

4.1. Centrality estimators

Various centrality estimators have been used in town centre delimitation as a result of the absence of a clear town centre definition. All centrality estimators that have been applied or checked for their applicability in various methodologies are based on descriptive aspects of the centrality phenomenon and can be arranged into five major groups.

Urban estimators: (a) the percentage of the total area of residences out of the total floor space at all levels in a block (Murphy, Vance, 1954). The rationale of this estimator is based on the fact that town centres are essentially lacking in permanent residents. Even if in the 1950s this may have been a common observation in several cities, nowadays city centres, especially the historic ones, gain much of what they lost in the previous decades due to their environmental regression; (b) building height (Murphy, Vance, 1954; Taubenböck et al., 2013). It is a common observation that a town centre is the district in which the tallest buildings of the city are located. However, building height may be controlled by normative provisions and thus is not an unbiased estimator. Such common provisions are the maximum permissible height of buildings, the maximum exploitation of land, or even provisions relevant to the conservation of historic urban centre architecture and its morphology; (c) the urban uses typology encountered in the core fringe (Cornière, 1967; Lawrence, 1986). The main weakness of this criterion is that the typology is altered through time or among different towns. Even for a specific town, the formation of such a typology is posterior to the delimitation of its centre; (d) the percentage of central uses area, or frontage per block (Murphy, Vance, 1954; Davies, 1959; Scott, 1959; De Blij, 1962; Bohnert, Mattingly, 1964; Carter, Rowley, 1966; Hartenstein, Staack, 1967; Curtis, 1993; Thurstain-Goodwin, Unwin, 2000). Even if the criterion of central use area is widely supposed as the most objective estimator of centrality, this is not without drawbacks, which will be presented later in detail, as this centrality estimator is widely applied in several methodologies.

Economic estimators: Economic estimators are based on the fact that in town centres, the major exploitation of land leads to high demand and normally to high rents and land values. It is crystal clear that the use of such estimators is restricted to capitalist societies only: (a) rents (or rents normalised by the frontage of the building) per building, lot, or block (William-Olsson, 1960 in Carter, 1972). This criterion is flawed due to the inaccessibility of relevant data and because of the fact that rents are also related to the architectural and construction qualities of the constructed space; (b) Gross Ratable Values (Carter, Rowley, 1966). These comprise a fair reflection of rents, though not available in most of the countries; (c) appraised or assessed land values (Murphy, Vance, 1954; Davies, 1959; Carter, Rowley, 1966; Cornière, 1967). There are two main problems with appraised land values regarding their use as centrality estimators. First, this kind of data is not available in all towns and secondly, land values may fluctuate due to normative provisions concerning the allowed type of land use. On the other hand, assessed land values are mainly used for tax purposes and do not reflect the true land value defined by the market.

Demographic estimators: pattern of employment (Murphy, Vance, 1954; Thurstain-Goodwin, Unwin, 2000). The rationale of this criterion is based on the controversial view that the town centre coincides with the CBD, in which the chief concentration of business, commercial and service activities occurs. Also, it is difficult to obtain such data.

Traffic estimators: (a) pedestrian count, or daytime population (Foley, 1952; Murphy, Vance, 1954; Cornière, 1967). Here, the rationale is not that chief pedestrian movements occur in the town centre, but that due to this major concentration of pedestrians, seeking to satisfy their need for services, goods and information, a district is called a town centre. Even if the pedestrian count is theoretically a good estimator, in practice it is almost impossible to count pedestrians, as movements that are not associated with the existence of the central area in which they occur have to be excluded (e.g., movements of factory workers or students on their way home from a downtown high school); (b) traffic flow (Murphy, Vance, 1954; Davies, 1959; Cornière, 1967). The same rationale as pedestrian count, but with the obvious flaws that, first, a great deal of traffic flow occurs in areas far away from what we call the town centre (e.g., in ring roads), second, a substantial volume of traffic flow does not originate or end in town centres, and third, that the prohibition of vehicles occurs in many town centres, especially historic ones.

From the abovementioned centrality estimators, density of central uses is the one most often selected in town centre methodologies. The conceptual meaning of central use, as it has been applied in these methodologies, coincides with that of spatially centralised urban use. Based on the fact that some urban uses are characterised as central, it is clear that some others are characterised as non-central. Most urban geographers who studied town centre delimitation also studied the assignment of urban uses to central and non-central uses. M. Bowden (1971: 123), on the basis of Carol's (1960) and Murphy and Vance's (1954) insights, argues that 'any wholesaler and manufacturer localised more by the pull of centrality than by another factor (or the sum of other factors) is a potential central business or CBD-forming establishment'. J. Allpass et al. (1967: 103) offer a rather ambiguous definition of central uses, claiming that a use which has not yet left the CBD is a central use. Even if this definition illustrates the empirical reality of central uses allocation within cities, it does not provide any substantial help in the classification of urban uses as central or non-central.

On the other hand, Murphy and Vance (1954: 203) noticed that 'there is a considerable difference … between a church, engulfed by CBD development, and a department store, which depends upon the advantages that a CBD location has to offer'. On the basis of this observation, they designated retail shops and services, offices, factories of city newspapers, and some large specialised office buildings as central uses. On the other hand, 'absence of the normal profit motive excludes from the characteristic CBD list municipal and other governmental buildings and parks, churches and other religious establishments and land, public and other non-profit making schools, organisational establishments such as the quarters of fraternal orders, and several other types of space occupancy' (Murphy, Vance, 1954: 203). The concept of 'normal profit motive' in Murphy's and Vance's view, which seems to be the basis of CBD *versus* non-CBD uses designation, is greatly connected to the concept of direct monetary profit. The centralised location of a public service, resulting in better customer service, seems to be ignored by the aforementioned authors as a benefit of the location. Even if that location is evaluated under the direct monetary profit concept, a centralised location of a public service allows its customers to minimise their commute to and from it, which undoubtedly can be translated into monetary profit on behalf of the customers, who happen to be its owners too.

The concept of normal profit motive is basically inadequate with regard to offering an accurate distinction between central and non-central uses. The fact that wholesale trade could be assigned to neither or both of these categories (some types of wholesale trade seem to be central uses while others are not), as well as the statement of Murphy and Vance, that this classification is merely subjective and qualitative factors should be taken into account (Murphy, Vance, 1954: 221; see also Carter, 1972: 200), leaves the issue open to discussion. This fact was obvious to later researchers who, in their vast majority, altered Murphy and Vance's classification. J. Bohnert and P. Mattingly, who studied town cen-

tres over the years, acknowledged the fact that classification of central uses is altered throughout time. For example, in 1954 factories for city newspapers could be designated as central uses, but obviously today this does not stand. Lagopoulos (1977: 56) argues convincingly that this classification highly depends on the culture and the production system in which the urban uses occur. Thus, the use of spatial location criteria can only result in a chronically and spatially local classification, a classification that cannot attain the targets of objectivity and global use.

Last but not least, in most applications handling central uses as centrality estimators entails the assumption that the floor space area that central uses occupy will be used for centrality calculations (with the exception of Curtis's study based on commercial establishment densities). However, this assumption is not based on any theoretical framework. In which way or view would a centrally located exhibition room of 400 square meters and ten also centrally located retail shops of 40 square meters each generate the same 'amount of centrality'? This assumption is vulnerable due to its lack of theoretical documentation and to empirical observation of urban space.

4.2. Spatial reference units in delimitation methods

As it has already been stipulated above, Murphy and Vance referred to blocks for calculating Central Business Height and Intensity Indices, a decision mainly related to the standardisation advantages that blocks offer. However, this decision has certain drawbacks. As Murphy and Vance argue (1954: 207--208), 'frontage is admittedly more realistic since the tendency for land use to differ by streets rather than by blocks is a matter of common observation'. The selection of blocks sets aside the fundamental town centre concept, which is the spatial concentration of central uses. Bird (1977: 85) points out that 'two department stores have more than double the significance of one, because if located sufficiently close together they generate a "centrality" along the shopping strip between them.' In other words, pedestrian flow, as spatially related to streets, is handled in a disruptive and not in a synthetic way when blocks are selected as spatial reference units. Furthermore, in the case that, for example, ten retail shops are located around a square, thus not located in one but in several blocks, the CBHI and CBII will yield much lower scores than in the case where these 10 retail shops are located in one block, constituting a shopping mall. It is obvious that the selection of blocks as spatial reference units is biased with regard to the central use's concentration, in which their functional unity coincides with the spatial unit of reference. Moreover, significant divergence is marked when central uses are not uniformly allocated within the block. D. Davies (1959) confronted this shortcoming by splitting those blocks in which substantial occupancy of central uses occurred on one side of the block, but dwelling dominated on the other. However, this cannot be regarded as a permanent rectification for the aforesaid flaw, as this split can only be performed subjectively.

Blocks and frontages are the most well-known applied and scrutinised spatial reference units. These two are similar in that both are traced in physical/constructed space contrary to the other two spatial reference units, which are technically defined. The first one, which has been used by J. Goddard (1967) and by M. Bowden (1971), is a system grid uniformly applied over urban space. The CBHI and CBII are calculated for each cell separately. This method rectifies a great deal of the flaw that Davies (1959) pointed out. Bowden (1971: 124) argues that 'if a grid system is adopted, which divides a low intensity city block into six parts, it is likely that at least two of the grid blocks will be classified as non-CBD'. Undoubtedly, the grid system eliminates the devaluation of the CBHI and CBII scores in blocks in which central uses are not uniformly allocated. However, the precise definition of the grid size is a matter of objectivity. Cells that are too large will have the same drawbacks as blocks, while cells that are too small will yield a cartographical representation similar to the representation of single urban uses. Last but not least, the substantial difference in block sizes between cities, or even between different districts of one city (e.g., historic urban districts have smaller blocks than new city plans), makes the selection of the optimum cell size even harder (see also Borruso, 2003: 180, 182).

The second technically defined spatial reference unit has been proposed by A. Gatrell (1994)

and applied for town centre delimitation purposes by Thurstain-Goodwin and Unwin (2000), as well as by G. Borusso (2003). The aforementioned researchers exploited geographic information system potentialities by using kernel density estimation procedures to transform centrality estimator point values into continuous surfaces of spatial densities (see also the application of Borusso, Porceddu, 2009, in which the density surface is mapped with the use of isolines). The mentioned points are the result of the substitution of unit postcodes, which are polygon areas, with their centroids, which are points. The values, referred to in the text as 'centrality estimator's point values', are the statistics of the unit postcodes which have been treated as centrality estimators. The whole procedure results in a raster, in which each pixel comprises the basic spatial unit and has a certain centrality value. This technique has potentialities in applications in which distinguished objects (i.e., points, lines or polygons) should be transformed into continuous surfaces. However, this method should be carefully applied because of the assumptions that have to be made, such as the selection of the kernel type and its bandwidth (Brunsdon, 1995; Gatrell et al. 1996). Also, some thought must be given to the *edge effect*, whether or not relative corrections have been embodied in the algorithms, in case that commercial GIS software is going to be used (see: Bailey, Gatrell, 1995; Fotheringham et al., 2000).

4.3. Central versus non-central areas

The scientific community eagerly waited for an objective and standardised method for town centre delimitation even before Murphy and Vance's publications. In 1952, Foley admitted that such a method had not been devised despite his and his partner's efforts (Foley, 1952: 539). Murphy and Vance also put forward the objectives of a widely acceptable and practicable method. However, even if the CBIM fulfills much of these criteria, its application in several settlements demonstrated that the CBHI and CBII thresholds were subjectively altered by researchers. The alteration of these thresholds occurred due to the application of the CBIM in settlements substantially different from those that Murphy and Vance had studied. These settlements sized between 100,000 and 230,000 habitants and in such cities the CBHI and CBII scores could easily exceed 1 and 0.5 successively. However, other researchers studied much smaller settlements. Bohnert and Mattingly (1964) worked on settlements with 10,000 to 90,000 habitants, in which the said indices could hardly exceed the stated thresholds. On the other hand, other researchers studied much bigger cities. Davies (1960) applied the CBIM in Cape Town, a city of 700,000 habitants, and delimited the CBD by altering the thresholds to 4 and 0.8 for the CBHI and CBII successively, while W. Hartenstein and G. Staack (1967) studied six German cities that varied from 500,000 to 800,000 residents, by modifying the thresholds of the CBHI and CBII to either 1.5 and 0.5, or 2 and 0.6 successively.

However, modification of threshold values has not always been a matter of the researcher's subjective decision. For example, Davies (1960) has constructed frequency polygons of the CBHI and CBII values (numbers of blocks plotted against the CBHI and CBII values) and defined the optimal thresholds based on the breaks of their slopes. On the one hand, this technique fulfills the scientific requirement of objectivity but, on the other hand, it anticipates the objective of practicability as a substantially greater area of the town centre district has to be studied in order for breaks in the slope to be identified. We should bear in mind that Murphy and Vance studied only the area which seemed to be the town centre, plus a perimeter zone.

At this point, some discussion should occur about the contemporary objectives of centrality studies, as these require a lot of other corollaries to be revealed. If in the 1950s a dissection of central and non-central districts was sufficient, nowadays our expectations expand to the identification of how much more central one block is than another, or how centrality values fluctuate within the city plan. The CBIM, based on two indices (CBHI and CBII) and the criteria of the CBHI>x and the CBII>y, is inadequate to sort blocks by their centrality value (however adequate they are to separate central from non-central blocks). This could be attained if it were possible to relate these two indices in order to construct a mathematical formula and, as a result, to express the centrality of one block based on the CBHI and CBII values (for example: $\alpha CBHI + \beta CBII = \gamma_{Centrality}$, where α and β are coef-

ficients that express the participation of each index participation in centrality and $\gamma_{Centrality}$ is the resulting centrality value).

The aforementioned argumentation on current objectives brings to the foreground the fact that the distinction between urban core and core fringe is not based on different phenomena that take place in each of these areas, but on a different degree of the same phenomenon. Davies (1960: 54) states that 'the hard core is that area which displays central business characteristics in their purest form – it is the quintessence of the CBD. […] The difference between the hard core and the CBD is therefore one of degree and not in kind: the one is the heart of the other' (see also: Cornière, 1967: 6; Bowden, 1971: 121). From a similar viewpoint, Murphy and Vance state (1965: 221) that: 'the boundary drawn on any one of the maps is not the boundary of the CBD for that city. To think that it is would be naïve indeed since the edge of the CBD is a zone or belt of transition'. Based on the aforementioned viewpoint, town centre delimitation becomes a controversial objective for urban geography. H. Carter (1972: 203) also wonders about 'what is the whole point and purpose of defining such a boundary'. In my opinion, research in urban geography could be further facilitated by the knowledge of centrality values in each place of the city rather than of the separation of a city into central and non-central areas (see also Pereira et al., 2013: 80). The latter is a generalised view of the former, thus less useful in urban geography. The fact that for statistical purposes, or simplicity, a district is defined as a town centre comprises a highly generalised view of centrality and should constitute a secondary issue in urban geography research. Urban geography needs to be assisted by accurate methods of centrality recognition in research on the complex nature of urban phenomena and the latter cannot be described and understood on the basis of the reductive dipole: centre *versus* periphery (see also Borruso, Porceddu, 2009: 38).

5. Conclusions

In light of the review of the town centre delimitation methodologies of the last sixty years, it is apparent that town centre delimitation can be viewed from the perspective of various scientific disciplines. Each of these disciplines conceptualises the centre of a town in a unique way. Economic geography is concerned with the district in which economic activities are gathered, urbanism with the area in which complex links among urban uses take place, traffic engineering with the place in which bottlenecks are often detected, semiotics with the special place which is understood as the town centre by the residents of a town, and so on. Thus, no universal definition of town centre, nor a common delimitation of the town centre, can be developed. From this point of view, the development of specialised delimitations for each scientific field separately seems unavoidable.

However, on the methodological level significant resemblances can be identified. Specifically, each methodology is based on three stages, in which the choices are made explicit: (a) on the centrality estimator, (b) on the spatial reference unit to be used, and (c) on the method that will be used for the designation of spatial units as central *versus* non-central. These three stages comprise the basic underlying structure of all town centre delimitation methodologies of the last sixty years that have been reviewed. Each selection at every stage may be more or less suitable and appropriate in the context of a certain study, as each selection has advantages and disadvantages. Therefore, the final choice between the alternative options can only be made with reference to the specific objectives of the delimitation research.

The latter conclusion brings to the foreground the fact that any delimitation methodology has to be based on and supported by a relevant theoretical background. The decisions made on each of the aforementioned stages have to be linked to a theory, which ultimately justifies the suitability and the appropriateness of these selections. Even if in the first period of town centre delimitation studies intense discussions on the appropriateness of alternative selections were put forth, such discussions have been seriously limited in the next two periods. In the last one especially, the focus has been mainly on the exploitation of modern advancements in GIS and geostatistics, while the documentation of certain technical decisions (for example, the selection of the kernel type and its bandwidth that are used)

and the influence of these decisions on the outcome of the study has been neglected.

Consequently, the article calls for further elaboration on the affiliations and linkages between: (a) a theoretical framework that explains what a town centre is, or any other term used to denote a central area of a town, in the context of a specific scientific field, and (b) the selections that are made in each of the three stages and lead to the construction of a certain delimitation methodology. Such linkages are of great importance due to the fact that, on the one hand, the formation of a theoretical framework enables the structuring of several alternative methodologies, while on the other hand they make clear the difference between desirable and attainable selections that can be made in each of the three methodological stages. Developing methodologies without a respective theory blurs their main objectives, as methodologies are often limited to attainable objectives, failing to quest or state the desirable ones, contributing in this way to an empirical approach to the issue.

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