"Open Cinema Map" - Open Data and Digital Ethnography as a Means for Grasping the Evolving Spatial Pattern of Cinemas – Athens Case Study

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Abstract. Culture, in its various forms, is currently perceived as a key driver for urban development and a sector that lies at the heart of SDGs' attainment; while various studies around the world demonstrate its power in cities' flourishing and achievement of sustainability objectives. However, rapid technological and other developments have severely affected certain facets of culture, with cinema being one of the most impacted ones. This paper explores the evolving spatial pattern of this specific cultural sector, which is perceived as a vital part of local urban socio-economic and cultural development and community invigoration. As case study region, the Athens metropolitan area is considered. The proposed methodological approach is grounded in particular types of open and volunteered geographic data, as well as spatial tools. More specifically, data are sourced from the OpenStreetMap platform and supplementary digital sources through digital ethnography; while errors/discrepancies identified in these data are also addressed and resolved. The time span of the cinemas' spatial pattern exploration in the Athens area is 2005–2022, with specific interest in 2005, 2012, 2019 and 2022 instances. Key findings demonstrate a certain decline of enclosed, single-screen enterprises; a relative stability of open-air, neighborhood and municipal cinemas; and a fragility of multiplexes.

Keywords: Culture/cinemas · Open data · Open Street Map & Volunteered Geographic Information · Local urban development · Spatial analysis

1 Introduction

Culture is nowadays perceived as an integral component of the United Nations' Sustainable Development Goals (SDGs) [1], first defined in 2015 in a call to end inequality and poverty and pave sustainable future pathways for humanity. In this respect, culture, in one of the first times that it is implicitly included in the international agenda [2], is conceptualized as a factor directly and/or indirectly contributing to the SDGs in multiple ways. At the same time, culture is considered to be in need of protection

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and management in both its tangible and intangible aspects. Such ascertainments have definitely informed the United Nations' twenty-year, 17-goal roadmap for sustainable development, gradually adopted by cities around the globe [3].

The UN Agenda 2030 penetrates policy directions of the European Union (EU) as well, with the 17 SDGs demarcating developmental pathways in the European continent. Culture, being pushed towards a "mainstreaming", is considered instrumental to achieving the SDGs in the European context. This is owed to its: intrinsic value, bringing prosperity, social cohesion, and overall well-being; dominance in European identity, image and influence; and potential as a "major economic multiplier". In particular, the Cultural and Creative Industries (CCI) (the two terms will be considered interchangeable for the rest of this paper, despite certain differences in the way they have been historically used) – cinema included – can secure joy, innovation, jobs and profits for the continent [4]. These are transferrable to the local (city) level, with the directions of the New Urban Agenda "localizing" the aforementioned goals, offering practical guidance to interested parties and proposing specific contribution examples [5]. As of this writing, the insistence to propose solutions for cultural development – the "audiovisual sector" included – remains urgent [6].

The role of culture as a significant lever for local urban development is, therefore, definitely recognized. In fact, culture has been conceptualized as an engine of local urban prosperity [7, 8] and a critical component of the "new economy" [9, 10] for over half a century. This view is further galvanized by Florida's proposal [11] on the *creative city*, a concept that has gained worldwide popularity. At around the same time, however, the entire cultural sector suffers from the aftermath of the global 2008 recession [12] and over several years [13]; while local cultural activities are affected even more harshly [14]. The more recent recession, following the outbreak of the Covid-19 pandemic, showcased that culture can be incredibly fragile in times of crises, but also a means for recovery [4]. In the end, culture has long emerged as a significant sector for socio-economic development, worthy of consideration and attentive study; thus, its evolution through time becomes a study priority, in order for more informed policy decisions, supporting and strengthening the role of culture, to be articulated.

Out of all cultural sectors, *cinema* is the focus of this work for several reasons. Firstly, it is a clear engine of multitudinous economic development worldwide, either as an industry or through related activities [15, 16]. Moreover, as one of the CCI [17], cinema has been increasingly regulated since the 1980s and 1990s, both in Europe and Greece [18]. Additionally, cinema's contribution to the social aspect of development is worth mentioning. This is especially witnessed during the first post-war decades, when cinema screens became local reference points, particularly those in smaller neighborhoods. As such, cinemas were spaces of both culture dissemination and socialization, thus strengthening the social cohesion of the population [19]. Since then, various technological, socio-political and demographic changes and crises have reduced the number of cinemas and weakened this relationship. In Greece, for example, such changes relate to the: appearance of television and video; advent of multiplex theaters and the Internet; 1973 and 1979 crises; rise of land prices, affecting the location or even existence of cinemas; shrinkage of production and consumption of local film products and state's apathy; social changes of the '90s; suburbanization of the city of Athens; and piercing economic

recession of 2008. However, cinemas in the city of Athens still maintain their cultural role, thanks to both the existence and intertemporal evolution of smaller, private-owned as well as municipal businesses that emphasize cinema's social role [20] and the legal state protection offered to historically significant cinema buildings [21].

That said, it is worth studying the further protection and preservation of cinema as a future-proof form of cultural expression, with important developmental – social, cultural, economic, etc. – repercussions. In such a context, this article attempts to explore the following research questions: how have recent technological, demographic and economic changes impacted the strength of cinemas as a form of culture? How has the spatial pattern of cinemas evolved in the last twenty years in the specific case study region, i.e. the Athens metropolitan area? Which types of cinema enterprises have been mostly affected – either rewarded or degraded – by these changes and why? The response to these questions forms the ground for further research on the developmental potential and protection needs of cinemas, as part of the broader cultural sector. The article is structured as follows: Sect. 2 provides a brief literature overview regarding new, open and digital methods of acquiring geospatial data. In Sect. 3, the methodological approach is presented; while the study context, time span, as well as data acquisition process, are also described. In Sect. 4, the results are presented, discussed and compared to relevant literature. Finally, in Sects. 5 and 6 respectively, results are critically discussed and conclusions are drawn.

2 Literature Review

Before delving into the specifics of the case study, an overview of recent data acquisition literature is presented in this section. Data acquisition currently allows for access to geospatial data of a more niche interest, such as the one explored in this work, thanks to a number of noteworthy trends in digital data creation from the last twenty years. The first is *crowdsourcing*, which is considered to be the exploitation of the expertise of a large number of users to perform tasks at a lower cost [22]. The early-to-mid-2000s advent of Web 2.0 technologies [23] encouraged the cooperation of users, content providers and companies [24] with the aim of creating large amounts of data. This development resulted in revolutionary methods of information production and dissemination, the premiere example of which is Wikipedia [25]. The second trend was what Goodchild [26] named *Volunteer Geographic Information* (VGI) and defined as "geographic information acquired and made available to others through the voluntary activity of individuals or groups, with the intent of providing information about the geographic world" [27]. VGI is the result of several factors, among which are the spread of personal computers, broadband Internet connections and dynamic maps [28]; the democratization of personal GPS devices, which became affordable after being integrated into mobile phones [29]; and the success of open-source software, leading to the creation of open databases for public benefit [26]. These are synthesized into what Sui [30] calls the "wikification" of geographic information; with one of its most popular examples being the OpenStreetMap (OSM) [31].

OSM deserves special mention, as it constitutes one of the main tools for data acquisition in this paper. As a volunteer-made geospatial database, OSM possesses a plethora

of inherent advantages that position it as an ideal source of geospatial data, particularly regarding culture. Firstly, it constitutes a democratic, cooperative and remarkably popular work, aiming to provide free geographic data of global coverage [29]. Simultaneously, its information has a local character, as it is often submitted by a place's inhabitants [32]. Its structure further facilitates its popularity, by differing from traditional databases [33]; and making GPS data submission, processing and categorization – in the form of points, lines and polygons [34] – much easier. OSM is also easy to use and is accessible by third-party platforms (QGIS, etc.); while data provided are available in GIS-compatible formats, organized by theme and country [35]. Its legal status offers more advantages: all OSM data are under the "Open Database License 1.0", thus anyone can share and edit them, as well as produce derivatives, as long as the same terms are kept and originals are cited [36]. Finally, the database is constantly maintained [31] and expanded, up to the final research year of this work [35]. As a result, this volunteer effort can provide global, up-to-date and easy-to-use data with few restrictions, in compatible formats and at zero cost, making them an excellent choice for sourcing scientific research.

However, it is also worth examining OSM data's accuracy and reliability, due to the relative laxness of quality control in volunteer cartography [27]. When judged according to more robust spatial data quality standards [37], OSM datasets display errors due to known parameters. These include the: disparate origin of the data, with a variety of sources in different scales and resolutions; lack of clear standards; users' subjective judgment that can lead to undervaluing of individual records; and users' diversification in experience and level of digital literacy [29, 38]. The result is uneven geometric accuracy, quality and completeness of data, with larger errors appearing in poorer, more rural areas and objects thought of as less significant. Moreover, the spatial accuracy of the records is dependent on the users' attention, with the community showing more interest in adding rather than fixing content. Finally, there is no guarantee of logical continuum and linkages between records, because both depend on the users' input and the database's structure [31, 39]. That said, the above does not preclude the use of these data for scientific purposes; quality control is a crucial topic within the OSM community, which is constantly improving and receiving suggestions [25, 29, 31]; OSM's amateur character can be partly useful [40]; and it remains the fastest, most cost-effective alternative to obsolete "official" geographic information [27].

The paper's theoretical background is complemented by *digital ethnography*, with regard to additional data not found through OSM. Ethnography is a discipline that captures the "social meanings and ordinary activities" of subjects in "naturally occurring settings", spaces that are called "fields" [41]; while in recent decades it has expanded further into the Internet. The result is a variety of new methodological tools for the collection and analysis of online data from wider communities [42], gathered quickly and efficiently [43]. The combination of the above allows for the acquisition of data from non-traditional but reliable sources, given the subject matter's niche interest and lack of documentation in official sources. In practice, this paper relies on personal recollections, blog posts and other miscellaneous non-official sources to obtain data on the opening and closing of cinemas. These sources have been legitimized by the discipline of cultural history, a multi-disciplinarian area between history and anthropology that allowed for

the discipline's expansion into discussing culture, with attention paid to subjectivity and the values of small groups [44].

3 Data and Methodology

The methodological steps of this work are outlined in Fig. 1. More specifically, the proposed steps aim at creating a geospatial database on cinemas, following the previously discussed literature on open-source geodata and the already explored spatial distribution of cinemas in Greece [19, 21]. The data are then processed and analyzed, in order for inferences as to the trajectory of this specific cultural sector in the Athens metropolitan area to be extracted. This effort has a spatial and temporal focus and is accomplished by the use of up-to-date data. Even with the use of rather large, but deliberately selected, time intervals, this intertemporal view offers a broad but accurate picture of the evolution of the specific cultural dimension, questioning also its resilience to various stresses occurring within the selected time span.

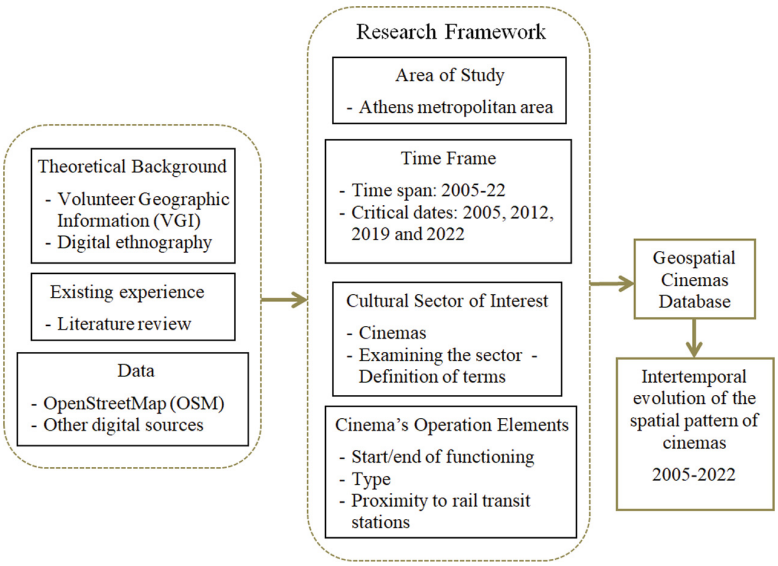


Fig. 1. Methodological flowchart of research, Source: Own elaboration

Before the main data collection process is described, the research is put in its appropriate framing, including the focus region and time span of the study. In particular, the study region concerns the Athens metropolitan area, in an effort to expand upon previous research and focus on an area of specific interest, i.e. the cultural and financial center of Greece [19, 21]. The time span ranges from 2005 to 2022; with data collection being accomplished for the distinct years 2005, 2012, 2019 and 2022. The selected time span encapsulates the two major crises of the last fifteen years in Greece that disturbed consumption patterns in the entertainment market as a whole. The years 2005, 2012, 2019

and 2022 are perceived as 'turning points' in the evolution of consumption patterns of the cinema's cultural activity. In particular, 2005 is considered an indicative year of stability before the Greek financial crisis; 2012 is the year before the recession's peak in the country, which is thought to occur in late 2013 or early 2014, as was reflected in the – at the time – record-breaking unemployment rates [45, 46]; 2019 is thought of as another year of stability before the Covid-19 outbreak [47]; while, finally, 2022 is the year in which the health crisis seems to be over and most institutions resume their "normal" operation. The approach of this work has some disadvantages: e.g., there is a lack of distinction between a cinema's temporary – due to the owner's personal difficulties or possible bureaucracy – and permanent closure. Moreover, no data is available as to the cinemas that were operational in time spans other than those above mentioned (only two such cases were identified in the sample). Nevertheless, the scheme followed provides a satisfactory overview of culture consumption in the study area, apart from a negligible number of exceptions.

Of equal importance is a more strict definition of cinemas' exhibition spaces, as well as their formats and operation schemes. Thus, a "cinema" is considered to be "the space of systematic exhibition of motion pictures (at least 4 times per month, for at least one month, over at least 2 years), delivering its services at a non-symbolic amount of money (a ticket costing over 3 euros)". Moreover, a cinema is considered to be operational at any given "turning point" year, provided that it exhibits motion pictures for up to the first half of that year. This period is considered to be comprised of the months of April and May for enclosed enterprises; and May, June or July for open-air ones. Open-air cinemas that were operational only for August 2005 are excluded. The same holds for some specific categories of movie theaters, e.g. adult theaters and drive-ins. Furthermore, excluded from the data set are cinemas displaying the following attributes: businesses that operated for short periods of time and then ceased to show movies and became theaters or community spaces; spaces whose operation was supported by few data; and charities and art institutions organizing free screenings. Finally, two multiplex cinemas began operations late in the year – they opened in November 2005, to benefit from the Christmas shopping period of their co-located malls – and are excluded from that year's data.

"Multiplex cinema" (called simply "multiplex" for the sake of brevity) is another term in need of clarification. Although this type of cinema possesses a set of identifying traits – its coexistence with a lifestyle and business model of conspicuous consumption, a multitude of screens, and a reliance on car-owning patrons [48] –, its definition depends on both place [49] and time. Older literature [19] and the present paper's sources interpreted it differently over the years. This paper used one uniform, albeit retroactive, definition, namely: a multiplex is "any cinema with at least two screens in operation".

The framing of cinema enterprises for guiding data collection leads to the identification of three general types of businesses and two basic dates, describing their operation. The three general types are: i) open-air, enclosed, or mixed; ii) a single-screen or a multiplex; and ii) municipal or privately-owned. The two fundamental dates relate to a cinema's beginning and end of operation (if it had come). Such decisions follow previous literature on the subject [19, 21].

One final element in need of data collection is each cinema's proximity (distance) to a rail mass transit station. The 5- or 10-min walk criterion is used in this respect as "a threshold for the distance people are typically willing to walk in order to reach a bus stop or other local destination" [50]. This can then be turned into a distance by multiplying it by an average walking speed – about 80 m per minute – and rounding it up to 500 m [51]. These distances can then be turned into circular buffers around mass transit stations in a GIS environment. Despite some drawbacks – the hypothesis of 500 m as an "ideal" distance [52], practical objections [50], etc. –, this assumption is commonly used in transportation studies, including previous studies on the subject [21]. For this paper, circular buffers were created around the stations of the most popular track-based public transport system in Athens, the metro, to gauge the spatial relationship between the metro and cinemas. Lastly, these buffers were dynamic, reflecting the expanding works of the Athens metro network [53].

Data acquisition begins with the OSM database, which provides initial information; and continues with additional sources. Data are retrieved and processed in the QGIS freeware (version 2.18.28) and the QuickOSM (version 2.1.0) add-on. The latter locates and downloads specific data packets, based on user-submitted queries [54]. Another add-on, QOSM (version 0.1.1), is used to place a raster level with the OSM platform's overall map, spot the area of study and subsequently save the features shown in Table 1 in shapefile format.

Table 1. OSM spatial data features through the QuickOSM add-on, Source: Own elaboration

Feature Name	Key	Value
Cinema	amenity	cinema
Mall	shop	mall
Metro Station	route	subway

This was followed by a brief preparatory period, during which all cinemas are turned into point data (centroids are generated from enterprises in polygon form); and distinct levels for the metro stations that were in operation each year are created. The metro's final expansion included all stations that were in operation until July 2022. That said, the most impactful change within the area of study was the addition of two stations – the Keratsini and Elaionas stations – in 2012.

The above procedure offers a first, quick view of the inspected cinemas' phenomenon, while also defusing most of the platform's data errors. Thanks to the relatively privileged position of the study area – Athens is the state capital of a European country –, data collected are rich, reliable and relatively up-to-date. The geometric accuracy of cinema locations is also satisfactory. Some individual errors regarding the shape of buildings that housed cinemas due to the mixed quality of orthophotographs used in OSM's source files are identified; and are easily dealt with, through additional geo-referencing. Furthermore, given that the end product refers to point data for geographic use, they do not prove particularly concerning. Descriptive data prove to be less reliable, and time inaccuracies have to be corrected. Different types of enterprises are incorporated in the

above-mentioned cinema categories. Thus retail and outlet stores are grouped with in malls, informal film clubs are thought of as legal cinemas and miscellaneous types of movie theater are included; while several cinemas that had closed the previous years are omitted. The creation of the appropriate tags, the re-organization of categories and the spotting of gaps are manually performed. A sum of *132 cinema enterprises* is located, displaying small but acceptable individual geometry errors that are easily dealt with. Some corrections are carried out to bring the data in line with the above definitions, while omissions are properly filled in.

This first database is complemented, confirmed and expanded thanks to new records from digital sources. The main source of information regarding the cinemas that are open during the aforementioned years is the screening program, provided by the "Athinorama" webpage [55], accessed through the Internet Archive and checked thrice – in January or April, July or August and November or December – for each year. In the case of 2005, additional data is sourced from the online archive of the "Rizospastis" newspaper [56]. Afterwards, details on the history of individual cinemas are identified in specialized blogs, such as "Cinema-Hellas" [57] and "Cinemano" [58]. Specialized books [59] are equally useful for their reproduced material, namely newspaper excerpts, brief interviews with interested parties, photographs, and updated observations. Lastly, the cinemas' official webpages, social media profiles – mostly on Facebook, Twitter and Instagram – and other (mostly local) website news are used to spot operation, pause or reopening announcements, especially for smaller cinema enterprises. All features of existing and new cinemas are tracked and recorded as detailed above. In this way, an extra 70 cinemas are added to the database, most of which had either closed before the creation of the Greek OSM community or had reopened relatively recently. In total, *202 individual cinema enterprises* are identified and organized in QGIS.

Finally, it has to be noted that the errors spotted during data collection are in line with previous studies on the same subject [19] and are similarly corrected. There are few cases where no reliable data could be found as to the founding and operation of cinemas in remote areas, resulting in the removal of 3 such cases from the database. Moreover, individual sources sometimes disagreed with regard to dates, and particularly information as to when a cinema opened. Even then, however, the discrepancies are rather insignificant – a few months on average, with the biggest outlier being 5 years – and are attributed to the imperfections of human memory. In those cases, the dates chosen are those confirmed either from multiple sources or the most authoritative one, i.e. the one closer to the original cinema owners. Finally, name and address changes are combined into one record, with the older data merely being referenced.

4 Empirical Results

Before examining how the cinemas are spatially organized, their overall numbers and related trends are presented, demonstrating the number of cinemas in the years perceived as 'turning points' and related changes in between time intervals (Table 2).

The overall downward trend in the number of cinemas in Athens merits further investigation. Firstly, the peak in the number of cinemas appears in the year 2005, while the cinemas' lowest point and greater losses occurred in 2012, well before the Greek

recession peak. Moreover, the number of cinemas in 2019 showed a small rise. Finally, although the 2020 pandemic has affected the number of cinemas in the 2020–2022 time span, this remains larger in 2022 than that of its overall low point in 2012.

Table 2. Operational cinemas by type in 'turning point' years and changes in between time intervals, Source: Own elaboration

Year / Cinema Type	2005	2011-2005 number (%)	2012	2019-2012 number (%)	2019	2022-2020 number (%)	2022
Total	174	-36 (-26.1)	138	9 (6.1)	147	-6 (-4.3)	141
Single-Screen	139	-31 (-28.7)	108	7 (6.1)	115	-3 (-2.7)	112
Multiplex	35	-5 (-16.7)	30	2 (6.3)	32	-3 (-10.3)	29
Open-Air	96	-12 (-14.3)	84	9 (9.7)	93	1 (1)	94
Enclosed	63	-23 (-57.5)	40	0 (0)	40	-6 (-17.7)	34
Mixed	15	-1 (-7.1)	14	0 (0)	14	-1 (-7.7)	13
Private-Owned	128	-29 (-29.3)	99	6 (5.7)	105	-7 (-7.1)	98
Municipal	46	-7 (-18)	39	3 (7.1)	42	1 (2.3)	43

Focusing on the specific types of screens is also productive. One can see that the same overall pattern is observed for single-screen and multiplex cinemas, with both exhibiting the same peaks and valleys. However, the former are affected worse than average in 2012 and showed greater resistance in 2022; while the latter behave in the exact opposite way. Open-air cinemas are hit relatively lightly by the pre-2012 changes, while also increasing their numbers in the following years. The exact opposite was observed in the – already relatively lower – number of enclosed cinemas, with greater-than-average losses, especially around 2012 (only stable numbers in 2019); and the much smaller number of mixed cinemas that align with the overall trend, but show greater stability in all instances. Lastly, private-owned cinemas are largely in step with the overall trend, even if they exhibit slightly worse valleys and gains percentage-wise; while municipal cinemas, aside from their smaller-than-average losses in 2012, saw a continuous rise in numbers, even as late as 2022.

A total of 59 cinemas closed during the research period. Mapping of these results for each time interval is shown in Fig. 2a.

From the results obtained, certain inferences can be drawn. The first concerns the date of closure: by far, the greatest number of enterprises (38 cinemas) closes during the research period's first interval (2005–2011), particularly between 2005 and 2008 (31 enterprises). Far fewer cinemas close in the following years, namely 14 in 2012–2019 and 7 in 2020–2022. Those closures also exhibit an interesting spatial variation.

In 2005–2011, closures are observed in the Athens city center, with the western suburbs being most profoundly affected, followed by the southern and eastern ones and the city center itself, to a lesser extent; and several neighborhoods at the north-eastern part of the Athens metropolitan area, such as Artemida, Keratea, Porto Rafti, Rouf, etc. The neighborhoods with the greatest number of closures were those of Piraeus, Kallithea and Plateia Amerikis.

In the 2012–2019 time span, closures are limited to the city center and the previously affected nearby neighborhoods, namely Kallithea, Marousi, Nea Smyrni, Neos Kosmos and Victoria; as well as selected settlements to the north and south, such as Agioi Apostoloi, Agios Stefanos, Lagonisi. The closures beyond 2019 are largely concentrated on the city center – the Kolonaki and Pagkrati neighborhoods – and the already affected or tourism-adjacent neighborhoods, e.g. Glyfada, Neapoli, Palaio Faliro and Amerikis Square. The specific types of cinemas that ceased functioning are also worth highlighting. Thus enclosed cinemas are by far the most stricken at 38 enterprises, 23 of which close between 2005 and 2011; single-screen cinemas suffer 45 closures, with 28 of them occurring between 2005 and 2011; multiplexes also steadily lose their power, decreasing by 10, 2 and 2 enterprises for each interval respectively. Moreover, 50 out of the total closed cinemas are private-owned, while municipal ones keep their strength by exhibiting no losses after 2011.

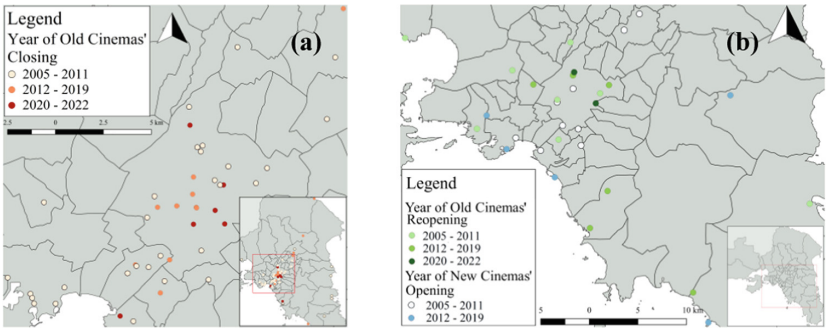


Fig. 2. Map of a) cinema closures, and b) openings and re-openings, by time interval explored, Source: Own elaboration

The opening of new cinemas is far more limited, but still worth mapping (Fig. 2b). Only 14 new cinemas open, mostly during 2005 and 2006 and none after 2016, which is a clear sign of the recession of the Greek economy. Furthermore, only half of those – either mall multiplexes or municipal cinemas – manage to survive till 2022. During the first time interval, the new cinemas are opened in proximity to the city center and the western/southern neighborhoods. Between 2012 and 2019, however, they begin to spread to the southern and western suburbs as well as the eastern neighborhoods of the Athens metropolitan area. Among the cinemas that closed, 1 is located in the Lagonisi neighborhood and the rest are in the city center or its relative proximity; 4 of them are multiplexes within malls, 2 are open-air ventures close to or connected to another commercial activity, and 1 is a similar enclosed case. The opposite is true of the surviving ones, which tend to be located in southern and western suburbs and eastern neighborhoods: 2 are mall multiplexes and 1 is an enclosed multiplex; while all the rest are open-air enterprises, with one being municipal. A more robust trend refers to the 16 reopened cinemas after 2005 – 8 in the first time interval, 6 in the second and 2 in the third one –, all of which remained operational until 2022. These cinemas – mostly open-air (11) and 5 enclosed ones – began appearing in western and southern neighborhoods, but edged closer to

the city center after each interval; most are private-owned businesses, though 5 of the earliest reopened enterprises are municipal ones.

It is also worth examining how the aforementioned changes influence the spatial pattern of operational cinemas. Although the overall pattern appears to be strongly concentrated, certain tendencies towards dispersion in later years are noticeable; while as seen in Table 3, more interesting are the results from the patterns of individual categories.

Table 3. The nearest neighbor index (and z-score) of operational cinemas by type and year, Source: Own elaboration.

Year Cinema Type	2005 neighbor index (z-score)	2012 neighbor index (z-score)	2019 neighbor index (z-score)	2022 neighbor index (z-score)
Single-screen	0,51673 (−10,900044)	0,544041 (−9,065023)	0,603457 (−8,135231)	0,627019 (−7,551378)
Multiplex	0,820383 (−2,032885)	0,886375 (−1,1906)	0,905266 (−1,025212)	0,999401 (−0,006176)
Open-air	0,611639 (−7,279517)	0,592359 (−7,147411)	0,64812 (−6,491835)	0,674314 (−6,040789)
Enclosed	0,729975 (−4,100194)	0,830307 (−2,053172)	0,794371 (−2,487972)	0,875122 (−1,393018)
Private	0,438124 (−12,161193)	0,452915 (−10,413650)	0,486532 (−10,065574)	0,537284 (−8,763111)
Municipal	0,869768 (−1,689765)	0,842208 (−1,885165)	0,861426 (−1,718061)	0,865699 (−1,684782)

More specifically, although some categories follow the overall trend, others diverge in interesting ways. Three cinema types – private-owned, open-air, and single-screen ones – remain strongly concentrated for almost the entire research period, but show slight signs of this pattern loosening and easing towards dispersion with time. Another type – municipal cinemas – also displays clustering patterns but weaker, tightening and easing in 2012 and 2022 respectively. Lastly, two categories – enclosed cinemas and multiplexes – switch from a clustered pattern to a random one. The former actually starts as clustered, is weakened with time and ends as random in 2022; while the latter starts from a relatively strong concentrated pattern, which becomes random over the next years and exhibits additional tendencies towards dispersion. As for mixed cinemas, they are too few in number – less than 30 – for their spatial pattern to be meaningful [60]; but they are mentioned here to complement the observations regarding multiplexes, as the two categories overlap significantly. This final category begins in a random pattern and evolves more and more towards a strongly dispersed one.

The above information is easier to comprehend by visualizing the moving average of all points for each year by category (Fig. 3).

Despite the small changes noticed for all operational cinemas – with all points concentrated in the Zografos neighborhood and moving first to the east, then south-west – the

individual types exhibit different concentration patterns and routes. The average coordinates of open-air cinemas are clustered between the Papagos and Zografos neighborhoods and follow a trajectory towards the south-west; and municipal ones are concentrated in the city center – the Syntagma and Monastiraki neighborhoods – and follow a western path that deviates slightly south-wise. On the contrary, enclosed cinemas circle the Kolonaki neighborhood and drift towards the east; and private-owned ones follow a similar curve, starting from Zografos and Papagos. Multiplexes and mixed cinemas, the types with the greatest mobility, both move from Neapoli to Kipseli, towards the north, with the latter one category also exhibiting a slight tendency towards the west. Furthermore, single-screen cinemas remain in the Zografos neighborhood and move mainly to the south, with a small inclination towards the east.

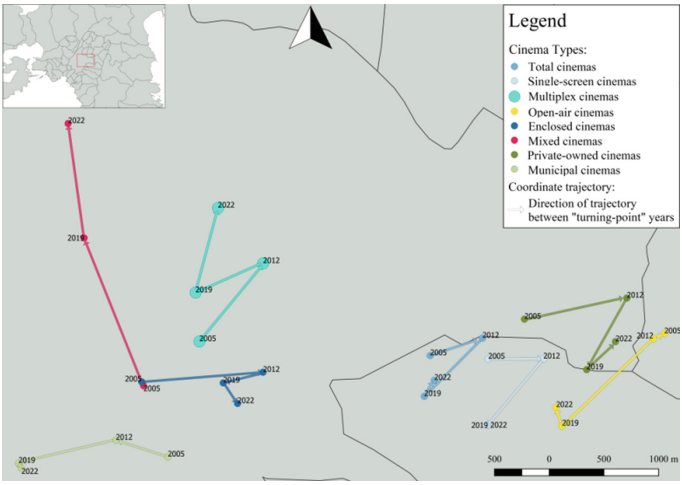


Fig. 3. Map of the average coordinates of Athens cinemas, by type and turning-point year, Source: Own elaboration

Finally, the cinemas' distance from the metro network stations and their subsequent successful operation (i.e. the business remains open up to the year 2022) is examined (Table 4).

By interpreting results presented in Table 4, it appears that the number of cinemas that are located in proximity to the metro decrease, despite the network's expansion and accessibility improvements. Results in the year 2005 actually display the impact of metro infrastructure (deployed in 2004). In fact, the metro's early operation causes slight changes in the functioning of cinemas for the next period. As time goes on, however, improved accessibility gradually loses its influence. The cinema types that benefit the most from this change are private (a total of only 7 municipal cinemas appeared, all of which are enclosed, despite a small reduction in their numbers) and open-air ones to a lesser extent, with their percentages rising in accordance to the aforementioned broader trend. On the contrary, there is a significant number of cinemas (11 specific multiplexes) that are steadily supported by their proximity to metro stations, especially after 2012.

Table 4. Comparison between cinemas within and outside a 10-min distance zone from the nearest metro station, Source: Own elaboration

Year	Cinemas in 10' Zone [number/(%)]	Cinemas out of 10' Zone [number/(%)]	Cinemas in 10' Zone in 'turning point' years in operation in 2022 [number/(%)]	Cinemas in 10' Zone in 'turning point' years in operation in 2022 [number/(%)]
2005	42 (24.14)	132 (75.87)	26 (61.91)	93 (70.46)
2012	41 (29.71)	97 (70.29)	30 (73.18)	87 (89.7)
2019	41 (27.89)	106 (72.11)	36 (87.81)	101 (95.29)
2022	40 (28.37)	101 (71.64)	40 (100)	101 (100)

Simultaneously, there is a large – and after 2012, rising – number of unaffected cinemas outside the 10-min zones, and the percentages of success for each group rise with time.

5 Discussion

Interpreting the findings is complex, since despite the existence of a clear downturn, the results for cinemas are mixed. By far the most affected category is that of enclosed, single-screen cinemas, possibly due to their limited operation window and intense competition from the rising, feature-rich multiplexes. Those cinemas, on the other hand, are trickier to maintain due to the steadily increasing costs [61]. The Covid-19 pandemic caused additional friction, leaving them with either limited or no revenue for several months [4]. The resilience of both types is non-existent, which could be worrying for the sector's overall health in the Attica Region.

The above inference is in line with worldwide trends; however, there are additional complexities to consider. Firstly, the greatest number of losses did not occur during the recession's peak in 2013–2014, but in the time span 2005–2008; while before the Covid-19 outbreak, cinema numbers were making a small recovery. At the same time, the resilience of both open-air and municipal cinemas is noteworthy. In fact, the increase of open-air cinemas is unprecedented and a counter to the overall trend, and could be justified by their lower maintenance costs [19], their connection to tourism [62], and the Greek public's nostalgic affinity for them [21]. In addition, alignment with post-pandemic safety protocols [63] also accounts for the boosting of their attendance and their prominence after 2021. This reveals that the multiple cinema types, which operate in distinct modes and possess different needs, should perhaps be considered separately in terms of study, policy and support.

The multitudinous nature of cinemas as part of the cultural sector is further witnessed in their geographical spread. Firstly, the creation of new cinemas outside the city's center correlates with the suburbanization and population relocation trends of the last few decades in the Attica Region in general and the metropolitan city of Athens in particular, especially the movement towards the northern and eastern suburbs and the creation of multiple peripheral centers [64]. Moreover, and aside from the peripheral neighborhoods,

the center of Athens is one of the most affected areas, with multiple closures and few new cinema businesses. This could be a side-effect of the previously-observed rise of land prices [65]; and is owed in part to Greece's entrance into the Eurozone as well as the extensive works in public transit and facilities when the country hosted the 2004 Olympic Games [52, 66]. The competitive, already saturated market could be another factor, as the cinemas which opened in relatively lower-cost areas, where fewer similar businesses are located, seem to be more successful. Simultaneously, the multiple re-openings of smaller cinemas indicate both the emergence of a nostalgic/dormant audience that converge on the neighborhood's remaining screens and the need to utilize valuable and legally-protected real estate [21].

This complexity is reflected in the moving average coordinates: the placement and mobility of cinema groups correspond to particular reclassifications within the space of Attica. Multiplexes and mixed cinemas – two categories that often overlap – moved towards the more expensive northern suburbs [66], but also to the more downgraded western ones, where, due to the many closures of older enterprises, there is little competition. Moreover, municipal cinemas tend to be located in those more traditionally working-class areas, as they tend to be some of the last remaining cinema enterprises in these neighborhoods. This combination of effects covers open-air cinemas as well, which also move towards the southern, more expensive suburbs [66], taking advantage of this nostalgic resonance with audiences of all ages. At the same time, the badly affected enclosed cinemas maintain their traditional concentration around the city center [21], but move eastwards and towards the relatively more upper-middle-class eastern neighborhoods, as this population group can afford leisure spending after the recession more easily. All the above arise from both socio-economic trends and the aforementioned ongoing suburbanization of Athens.

Finally, the metro is a factor that does not, by itself, guarantee a cinema's success, contrary to previous research [20], but only complicates Attica's culture consumption market. It is apparent that the rail network itself cannot reverse the sector's overall trends, but only delay them and preserve – rather than actively support – the enterprises within its reach. The metro has also intensified the co-existence of different modes of cinema-going: rail-supported multiplexes adapt from a car-first service model [48] and accept inflows of people from distant areas – with downtown benefiting either way –, while neighborhood cinemas rely on nearby patrons. Finally, the market somehow rebalanced after the relative novelty of the metro's introduction in 2004, with a significant number of cinemas being completely unaffected.

6 Conclusions

The focus of this paper is on the study of the evolving pattern of cinemas (2005–2022) as a cultural expression and a matter of spatial, social, economic and developmental concern in the Athens metropolitan area. Recent evolutions in geospatial data creation, management and dissemination make the study of the sector significantly easier. Results obtained clearly display a certain decline of the sector that is – in one way or another – felt by most of the multiple types of enterprises in operation. It also unveils the interplay of economy, technology and demographic change as complex issues that are difficult to deal with, while identifying the survival of cinema.

Nevertheless, studying the operation of cinemas and their spatial distribution is not fruitless. Movie-going remains a popular leisure activity, as indicated both by the consistently rising number of open-air and municipally-owned enterprises and the recent boom in attendance, especially after the end of the Covid-19 pandemic. The discovery of more detailed data on the impact these specific businesses have on their local markets, as well as insights into their operation, would greatly enhance those given points.

The presented results should aid in the follow-up to the next parts of this research. Firstly, additional quantitative data – on land values, types of businesses neighboring cinemas and number of tickets per screen – will further illuminate the evolution of the cinemas' phenomenon. Secondly, the addition of qualitative data – interviews and questionnaires with selected cinema owners and exhibitors – will add the perspective of stakeholders involved in the sector; and highlight their particular views and struggles. Both of these steps will highlight important issues that will have to be handled with care and will feed data-enabled policy proposals, addressing the protection of cinema and the enhancement of its role in local urban development.

References

1. What are the Sustainable Development Goals? https://www.undp.org/sustainable-development-goals. Accessed 10 Mar 2023
2. United Cities and Local Governments (UCLG): Culture in the sustainable development goals: A guide for local action (2018). https://www.uclg.org/sites/default/files/culture_in_the_sdgs.pdf. Accessed 11 Jan 2023
3. Hosagrahar, J.: Culture: at the heart of SDGs. UNESCO Cour. (1), 12–14 (2017)
4. Vries, G.D.: Culture in the Sustainable Development Goals: The Role of the European Union (2nd revised edition). Institut für Auslandsbeziehungen, Stuttgart (2020)
5. United Cities and Local Government (UCLG): Culture in the Sustainable Development Goals: A Guide For Local Action. https://www.uclg.org/sites/default/files/culture_in_the_sdgs.pdf. Accessed 10 Mar 2023
6. The Council of the European Union: Council Conclusions on the Work Plan for Culture 2019–2022. Official Journal of the European Union, 2018/C 460/10, 21.12.2018. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52018XG1221(01)&from=EN. Accessed 10 Mar 2023
7. Jacobs, J.: The Death and Life of Great American Cities. Vintage Books, New York (2016). ISBN: 0-679-74195-X
8. Hall, P.: Creative cities and economic development. Urban Stud. **37**(4), 639–649 (2000). https://doi.org/10.1080/00420980050003946
9. Brooks, D.: Bobos in Paradise: The New Upper Class and How they Got There. Simon and Schuster, New York (2018). ISBN: 0-684-85378-7
10. Kotkin, J.: The New Geography: How the Digital Revolution is Reshaping the American Landscape. Random House, New York (2000). ISBN: 0375501991
11. Florida, R.L.: The Rise of the Creative Class. Basic Books, New York (2004). ISBN-13: 978-0465024773
12. Mermiri, T.: Private Investment in Culture 2008/09: the Arts in the 'New Normal'. Arts & Business, London (2010). http://cymraeg.aandbcymru.org.uk/uploads/PICS_08-09.pdf. Accessed 24 Mar 2023

13. Bonet, L., Donato, F.: The financial crisis and its impact on the current models of governance and management of the cultural sector in Europe. ENCATC J. Cult. Manag. Policy **1**(1), 4–11 (2011). https://www.encatc.org/media/2703-journal_vol1_issue1_dec2011512.pdf. Accessed 12 Jan 2023
14. Antoneloul, D., Hatzinikolaou, A.: The Effect of the Recession on the Cultural Activities of the Municipality of Nikaia-Agios Redis. Technological Educational Institute of Peloponnese, Sparta (2017). (in Greek)
15. Scott, A.J.: On Hollywood: The Place, The Industry. Princeton University Press, Princeton (2005). ISBN: 9780691162102
16. Grammatikopoulou, A.: Attracting Foreign Cinema Producers to Greece: Institutions, Production Companies and Communication Strategies. Possibilities and Prospects. Hellenic Open University, Athens (2019). (in Greek)
17. Garnham, N.: From cultural to creative industries: an analysis of the implications of the "creative industries" approach to arts and media policy making in the United Kingdom. Int. J. Cult. Policy **11**(1), 15–29 (2005). http://nknu.pbworks.com/f/FROM+CULTURAL+TO+CREATIVE+Industries.pdf. Accessed 26 Feb 2023
18. Kontou, M.A.A.: The Character and Evolution of Greek Film Policy. Aristotle University of Thessaloniki, Thessaloniki (2012). (in Greek)
19. Georgikou, A.: The Geographic Distribution of Cinema Screens in the Second Half of the 20th Century in Athens. Harokopio University, Athens (2015). (in Greek)
20. National Center of Social Research: The State of the Exhibition System in Greece. (in Greek). https://www.ekke.gr/projects/estia/gr_pages/gr_cinema/Cinema99/Cinema99.htm. Accessed 10 Mar 2023
21. Paraskevoudakis, M: Cinema and the City: Analyzing the Geographo-temporal Imprint of Athenian Screens during the 1950–2016 Period. National Technical University of Athens, Athens (2017). (in Greek). https://dspace.lib.ntua.gr/xmlui/handle/123456789/45280?locale-attribute=el
22. Tapscott, D., Williams, A.D.: Wikinomics: How Mass Collaboration Changes Everything. Portofolio, New York (2006). ISBN: 978-1-59184-138-8
23. Harrison, T.M., Barthel, B.: Wielding new media in web 2.0: exploring the history of engagement with the collaborative construction of media products. New Media Soc. **11**(1–2), 155–178 (2009). https://doi.org/10.1177/1461444808099580
24. Hudson-Smith, A., Crooks, A., Gibin, M., Milton, R., Batty, M.: NeoGeography and web 2.0: concepts, tools and applications. J. Locat. Based Serv. **3**(2), 118–145 (2009). https://doi.org/10.1080/17489720902950366
25. Haklay, M., Singleton, A., Parker, C.: Web mapping 2.0: the neogeography of the GeoWeb. Geogr. Compass **2**(6), 2011–2039 (2008). https://doi.org/10.1111/j.1749-8198.2008.00167.x
26. Goodchild, M.F.: Citizens as voluntary sensors: spatial data infrastructure in the world of web 2.0. Int. J. Spat. Data Infrastruct. Res. **2**, 24–32 (2007)
27. Elwood, S., Goodchild, M.F., Sui, D.Z.: Researching volunteered geographic information: spatial data, geographic research, and new social practice. Ann. Assoc. Am. Geogr. **102**(3), 571–590 (2012). https://doi.org/10.1080/00045608.2011.595657
28. Perkins, C., Dodge, M.: The potential of user-generated cartography: a case study of the OpenStreetMap project and mapchester mapping party. North West Geogr. **8**(1), 18–32 (2008). ISSN 1476-1580
29. Sehra, S.S., Singh, J., Rai, H.S.: Assessment of OpenStreetMap data - a review. Int. J. Comput. Appl. **76**(16), 17–20 (2013). https://doi.org/10.5120/13331-0888
30. Sui, D.Z.: The wikification of GIS and its consequences: or Angelina Jolie's new tattoo and the future of GIS. Comput. Environ. Urban Syst. **32**(1), 1–5 (2008). https://doi.org/10.1016/j.compenvurbsys.2007.12.001

31. Girres, J.F., Touya, G.: Quality assessment of the French OpenStreetMap dataset. Trans. GIS **14**(4), 435–459 (2010). https://doi.org/10.1111/j.1467-9671.2010.01203.x
32. Goodchild, M.F.: Commentary: whither VGI? GeoJournal **72**, 239–244 (2008). https://doi.org/10.1007/s10708-008-9190-4
33. Goodchild, M.F.: Geographical data modeling. Comput. Geosci. **18**(4), 401–408 (1992). https://doi.org/10.1016/0098-3004(92)90069-4
34. RDF Working Group: W3C Recommendation 10 February 2004. https://www.w3.org/TR/2004/REC-rdf-primer-20040210/. Accessed 6 Mar 2023
35. Zhou, Q., Wang, S., Liu, Y.: Exploring the accuracy and completeness patterns of global land-cover/land-use data in OpenStreetMap. Appl. Geogr. **145**, 102742 (2022). https://doi.org/10.1016/j.apgeog.2022.102742
36. Open Data Commons: Open Data Commons Open Database License (ODbL) v1.0. https://opendatacommons.org/licenses/odbl/1-0/. Accessed 6 Mar 2023
37. Guptill, S., Morrison, J.: Elements of Spatial Data Quality. Pergamon, Oxford (1995). ISBN 978-0-08-042432-3
38. Elwood, S.: Volunteered geographic information: future research directions motivated by critical, participatory, and feminist GIS. GeoJournal **72**, 173–183 (2008). https://doi.org/10.1007/s10708-008-9186-0
39. Haklay, M.: How good is volunteered geographical information? A comparative study of OpenStreetMap and ordnance survey datasets. Environ. Plan.B Urban Anal. City Sci. **37**(4), 682–703 (2010). https://doi.org/10.1068/b35097
40. Coleman, D., Georgiadou, Y., Labonte, J.: Volunteered geographic information: the nature and motivation of produsers. Int. J. Spat. Data Infrastruct. Res. **4**, 332–358 (2009). https://doi.org/10.2902/1725-0463.2009.04.art16
41. Brewer, J.: Ethnography. Open University Press, Buckingham (2001). ISBN: 978-0-335-20268-3
42. Kozinets, R.V., De Valck, K., Wojnicki, A.C., Wilner, S.J.: Networked narratives: understanding word-of-mouth marketing in online communities. J. Mark. **74**(2), 71–89 (2010). https://doi.org/10.1509/jm.74.2.71
43. Beaulieu, A.: Mediating ethnography: objectivity and the making of ethnographies of the internet. Soc. Epistemol. **18**(2–3), 139–163 (2004). https://doi.org/10.1080/02691720420000249264
44. Burke, P.: What is Cultural History? Polity, Cambridge (2008). ISBN-13: 978-0-7456-4409-7
45. Tagkalakis, A.O.: The unemployment effects of fiscal policy: recent evidence from Greece. IZA J. Eur. Labor Stud. **2**(1), 1–32 (2013). https://doi.org/10.1186/2193-9012-2-11
46. Triandafyllidou, A., Mantanika, R.: Migration in Greece: Recent developments in 2014. Report prepared for the OECD Network of International Migration Experts, Paris, 6–8 October, Hellenic Foundation for European and Foreign Policy, Athens, Greece (2014)
47. Akser, M.: Cinema, life and other viruses: the future of filmmaking, film education and film studies in the age of Covid-19 pandemic. CINEJ Cinema J. **8**(2), 1–13 (2020). https://doi.org/10.5195/cinej.2020.351
48. Hanson, S.: Screening the World: Global Development of the Multiplex Cinema. Palgrave Macmillan, London (2019). ISBN 978-3-030-18994-5
49. Park, Y.S., Ham, S.: Spatial analysis of various multiplex cinema types. Front. Archit. Res. **5**(1), 63–73 (2016). https://doi.org/10.1016/j.foar.2015.11.001
50. Moran, M.M.: Walking the Walk: An Assessment of the 5-Minute Rule in Transit Planning. University of Texas, Austin (2013). https://repositories.lib.utexas.edu/bitstream/handle/2152/22683/MORAN-MASTERSREPORT-2013.pdf?sequence=1&isAllowed=y. Accessed 25 Jan 2023
51. O'Sullivan, S., Morrall, J.: Walking distances to and from light-rail transit stations. Transp. Res. Rec. **1538**(1), 19–26 (1996). https://doi.org/10.1177/0361198196153800103

52. Foda, M.A., Osman, A.O.: Using GIS for measuring transit stop accessibility considering actual pedestrian road network. J. Public Transp. **13**(4), 23–40 (2010). https://doi.org/10.5038/2375-0901.13.4.2
53. Efthymiou, D., Antoniou, C.: How do transport infrastructure and policies affect house prices and rents? Evidence from Athens, Greece. Transp. Res. Part A Policy Pract. **52**, 1–22 (2013). https://doi.org/10.1016/j.tra.2013.04.002
54. QuickOSM. https://plugins.qgis.org/plugins/QuickOSM/. Accessed 8 Mar 2023
55. Cinema movies (in Greek). https://www.athinorama.gr/cinema/guide/all/cinemas/. Accessed 8 Mar 2023
56. Cinemas (in Greek). https://www.rizospastis.gr/story.do?id=2926137. Accessed 8 Mar 2023
57. List of Cinemas (in Greek). http://cineanamnisi.blogspot.com/2012/09/blog-post.html. Accessed 8 Mar 2023
58. Cinemas from A to Z (summary list) (in Greek). https://mymovie-diary.blogspot.com/2018/02/blog-post_6.html. Accessed 8 Mar 2023
59. Fyssas, D.: The Cinemas of Athens 1896 – 2013. Histories of the Urban Landscape. Ebooks4greeks, Athens (2019). (in Greek)
60. Waugh, D.: Geography. An Integrated Approach. 3rd ed. Nelson, Surrey (2000). ISBN: 978-0174447061
61. Squire, J.E.: The Movie Business Book. McGraw-Hill Education, New York (2006). ISBN-10: 0335220029
62. Gerasimou, S., Perdicoúlis, A.: Urban renaissance on Athens southern coast: the case of Palaio Faliro. Int. J. Energy Environ. **3**(4), 178–185 (2009)
63. Shah, M.H., Yaqoub, M., Wu, Z.J.: Post-pandemic impacts of COVID-19 on film industry worldwide and in China. Glob. Media J. Pak. Ed. **XIII**(2), 28–44 (2020)
64. Salvati, L., Venanzoni, G.: Work in (slow) progress: latent suburbanization, economic restructuring, and urban–rural convergence in a South Eastern European city. J. Urban Aff. **39**(3), 436–451 (2017). https://doi.org/10.1080/07352166.2016.1251195
65. OECD: OECD Economic Outlook 2012. OECD Publishing, Paris (2012). https://doi.org/10.1787/eco_outlook-v2012-1-en
66. Iliopoulou, P., Stratakis, P.: Spatial analysis of housing prices in the Athens Region, Greece. RELAND Int. J. Real Estate Land Plan. **1**, 304–313 (2018). eISSN 2623-4807