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Network Analysis for Media Ownership: A Methodological Proposal

Mariia Aleksevych and Tales Tomaz

Department of Communication Studies, University of Salzburg, Austria

Correspondence: Mariia Aleksevych (mariia.aleksevych@plus.ac.at)

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Abstract

Far from being a concern of the past, media ownership concentration is a feature of hybrid media systems. This raises the issue of how to measure the concentration and allow for informed decisions to be made, especially for policymaking. Some of the most popular metrics are the concentration ratio (CR*n*) and the Herfindahl-Hirschman Index (HHI). However, the new hybrid context increasingly renders the usual economic concentration metrics obsolete to understand the power of communication players. This article provides a theoretical overview and methodological considerations on ways to interrogate ownership relations, advancing network analysis and visualization as useful tools to better grasp power relations alongside traditional economic metrics. We illustrate our proposal with an analysis of media ownership data from Denmark and Greece, as provided by the Euromedia Ownership Monitor in 2022. Our article goes beyond the approach of the monitor, as we incorporate additional components, such as the power of beneficial owners over the audience. This approach provides a broader analysis of media ownership concentration and can inspire scholarly work to explore more aspects of this topic.

Keywords

media concentration; media ownership; network analysis; network visualization

1. Introduction

In his account of the history of media, Chadwick (2017) argues that digital media borrowed heavily from traditions and practices of legacy formats, such as print and visual media. Legacy formats, in turn, adapted by importing logics that emerged from the unique features of digitalization. The new media ecosystem is, therefore, a hybrid one. Chadwick recognizes that these hybridisms are neither a matter of mere technological

development nor the result of "powerful interests" seeking a certain impact, but "a combination of these two processes" (Chadwick, 2017, p. 43).

These developments have affected one of the most important areas of the political economy of media, namely media ownership. The concern over concentration has dominated this debate over the years, in an attempt to check opinion power and safeguard a pluralistic media ecosystem (Benson et al., 2025; Picard, 2017; Sjøvaag & Ohlsson, 2019). In this debate, measuring the dispersal of media ownership has been treated as an important step for assessing how much power some media stakeholders have. Classic concentration measures such as the concentration ratio (CR*n*) and Herfindahl-Hirschman Index (HHI) have been instrumental for this goal (Mastrini & Becerra, 2008; Noam, 2016b), but these measures have limitations, which have become more evident with the progressive hybridization of the media. This article addresses two questions:

1. How can media power and its concentration be measured and illustrated in hybrid media markets?

2. What do different centrality measures in ownership networks show, and how can they be interpreted?

In this article, we provide methodological considerations that broaden such an analysis. First, we critically review the concerns on media ownership concentration, pointing out how commercialization and, more recently, hybridization may be associated with the root of these problems. In the following section, we discuss economic metrics and network analysis as two possible methodologies to study media concentration as well as their limitations. We then make a methodological proposal to complement concentration studies with network analysis and visualization, drawing on recent initiatives, such as the Euromedia Ownership Monitor (EurOMo; Tomaz, 2024) and existing media ownership network analyses (Birkinbine & Gómez, 2020; Schnyder et al., 2024), as well as adding a component of "beneficial owner power over audience." Finally, we illustrate this approach with an analysis of media ownership in Denmark and Greece, respectively scoring the highest (world rank #2) and the lowest (world rank #108) scores in the Press Freedom Index among the European Union countries (Reporters Without Borders, 2022). Their similar market size, but different outcomes for press freedom and media ownership structures are useful to illustrate our proposal.

2. Media Ownership and Concentration

Historically, media organizations have operated in clearly distinguished sectors, such as print or broadcasting. Nonetheless, ambitious owners have always tried to advance their businesses into other areas whenever they have seen the opportunity. Foreseeing risks for media pluralism, several countries have put forth restrictions on mergers and acquisitions across markets and sectors (Tomaz, 2024). More often, countries have sought to protect their markets from foreign owners, fearing national security risks and deterioration of cultural heritage. When there was political will, these efforts were relatively successful. With that being said, the hybrid media system emerged after digitalization changed the rules of the game.

At first, the rise of the internet led many to believe that digital media would simply increase the plurality of voices in the information ecosystem, but reality has proven different. The internet has become way more concentrated than expected, and media incumbents predating the commercial internet play a decisive role (Hardy, 2014; Hindman, 2018). Technological affordances of digitalization have created conditions that favor

high concentration (Noam, 2016b). In such a scenario, highly capitalized firms tend to benefit from technological convergence by distributing costs across sectors, making incumbents stronger players. In a nutshell, media concentration is on the rise in the hybrid media system.

Concentration refers to companies or owners possessing high shares in a specific sector and geographical market, particularly by acquiring competitors or promoting mergers. The potential negative effects of ownership concentration on news content, reduced diversity, and journalism's democratic role in a pluralist society have been the main concerns (Baker, 2006; Theine & Sevignani, 2024). Different traditions of the political economy of the media, such as liberal, institutional, and Marxist approaches, have engaged with this concern (Winseck, 2011). Liberal traditions accept a certain level of concentration as stimulating innovation and emphasize the self-regulatory capacity of the market to curb eventual excesses. Institutional and Marxist approaches are more critical regarding concentration, highlighting the risks of oligopoly and monopoly and how concentration threatens pluralism of ideas (Mastrini & Becerra, 2008). Over time, the debate about pluralism has become more complex. Many institutional scholars have emphasized, for example, that ownership concentration is a problem for external pluralism, but internal pluralism can be reached within a single media company if it features a high diversity of topics, perspectives, and representation (Valcke et al., 2015).

Following those debates, a steady body of research has sought evidence regarding ownership concentration issues in hybrid media systems. Some research indicates the risk of homogenization in cross-owned outlets to the detriment of diversity and pluralism. Streamlining of production led to an increased reuse of the articles in elite and popular titles of big Belgian media companies DPG and Mediahuis (Hendrickx & Van Remoortere, 2022). In four outlets of Mediahuis, 51% of the content was reused as of 2018—an increase from 31% in 2013 (Hendrickx & Ranaivoson, 2021). Similarly, content shared between the outlets within big media groups has increased in German media in Switzerland between 2017 and 2022, with TX Group leading in this respect, with a 34 percentage point increase and 50.3% of shared content in 2022 (Fürst & Vogler, 2023, p. 162). Thus, there is evidence that limited structural pluralism accordingly affects content pluralism.

In addition, ownership concentration is linked to journalist self-censorship, diminished watchdog function, and increased corruption as a consequence, besides internal cross-promotions of brands (Germano & Meier, 2013; Goyvaerts et al., 2024; Houston et al., 2011; Neff & Benson, 2021). Furthermore, outlets owned by big media companies tend to create online information flows that keep consumers within networks of outlets with shared ownership, leaving independent voices on the periphery of the hyperlinked environment (Knuth et al., 2024; Sjøvaag et al., 2019).

However, there are arguments that at least some of these negative implications stem from the platformed or hybridized media systems themselves rather than from ownership concentration. Content distribution and advertising revenues increasingly operate in environments designed by tech companies such as Google and Facebook (Newman et al., 2025; Sevignani et al., 2025). Platformized communication infrastructures contribute to financial precarity and increased competition from numerous information publishers converging in digital environments. The entanglement of older and newer media logics, as Chadwick (2017) argues, means that often editorial media depend on platform logics to attract audiences and/or profitability, thus creating incentives for journalistic practices that contradict traditional professional standards of so-called Western journalism. Such deviations may be conflated with undesired consequences of ownership concentration.

More recently, platform studies have developed a more sophisticated understanding of this relational power between platforms and news publishers (Nielsen & Ganter, 2017; Poell et al., 2023). This theoretical framework shows how the relationship between platforms and media organizations is not straightforward, but a space of negotiation. The power asymmetries vary depending on factors such as platform changes, the distinctive stages of media production, and the characteristics of media organizations themselves. In this context, whereby local and small media indeed fluctuate according to platform developments, big organizations have more power, being able even to influence policy, illustrated by the case of the Australian Media Bargaining Code (Bossio et al., 2022) or the Brazilian debate on platform regulation (Tomaz, 2023). This also means relative freedom to incorporate platform logics, such as content personalization or surveillance as monetization, but creates new hybrid logics that undermine "newsworthiness" as the highest value guiding information production.

Competition alone should not be considered a panacea that will necessarily increase the quality of the information ecosystem in a hybrid media system. Cagé (2020) argues that the entrance of a newspaper on a local market decreases the average number of journalists and content diversity due to increased competition for the same audience, and similar excessive competition can be expected with the advance of the internet as a market of information providers. Additionally, differentiation logic can be present within a media company wanting to cater to heterogeneous audiences of different titles (George, 2007; Iosifidis, 2010; Sjøvaag, 2014). At the same time, excessive competition drives mergers of weaker players (European Commission et al., 2022), which, in turn, leads to higher concentration and enables further homogenization through reuse of content of cross-owned outlets.

Finally, problems associated with media concentration, such as homogenization, bias, and commercialization, can also be considered as outcomes of the general profit orientation of media organizations (Benson et al., 2025; Sjøvaag & Ohlsson, 2019). Indeed, the critical scholarship of the political economy of media has always cherished the idea that profit orientation is the actual driver of harm in media systems, which can be attenuated by professionalism, regulation, and competition policy (Baker, 2006; McChesney, 2008; Murdock, 2008). This argument also fits the internal/external pluralism debate, usually tolerating and even welcoming concentration by *public service media*. Since the problem is not external concentration as such, but safeguarding pluralism, the goal could be reached—perhaps even more easily—with a public monopoly. In this sense, ownership and organizational forms would be more important to democratic values than levels of concentration (Benson et al., 2025). A similar argument has been raised regarding the internet and platforms, emphasizing possible harms of further competition in an attention economy and the benefits of removing the commercial driver of platforms (Pickard, 2020; Rahman, 2018; Schiller, 2020).

Therefore, media ownership concentration can be considered a threat to pluralism, but the issue is more complex than such a simple assertion. In any case, the emphasis on concentration from both scholarly work and policymaking has justified a focus on developing approaches to measure concentration and grasp opinion power. As we discuss next, these methodological attempts face important limitations.

3. Two Methodological Approaches in Media Ownership Concentration Research

We consider two major methodological approaches in evaluating concentration in a media system. The first is the use of economic metrics such as CR*n* and HHI. The second is newer and implies the use of social network analysis techniques.

3.1. Economic Concentration Metrics

CR*n* and HHI are used to assess the dominance of the top firms on a market and the level of competition through an analysis of the market share of incumbents. Shares in both methods can be based on revenues or audience. CR*n* is the sum of market shares of the top *n* players (usually the top four firms are considered), whereas HHI sums squared shares of all incumbents and indicates the intensity of competition in a market.

These metrics are used across different industries and have conventional concentration thresholds that are typically adjusted for a specific sector and depend on the context and regulator. The Media Pluralism Monitor adopted concentration ratio of the top 4 firms (CR4) and thresholds of < 25% for low concentration in media, 25–50% for medium concentration, and > 50% for high concentration until 2023. From then onwards, the thresholds were relaxed, and low concentration is considered at < 40%, 40–60% indicates medium concentration, and high concentration starts above 60% (Carlini, 2024). The same thresholds were used by Noam's concentration project (Noam, 2016b), whereas the European Commission et al. (2022) study suggests high concentration beginning even higher, with a CR4 at 70% and above. Notably, in the Media Pluralism Monitor, high ownership concentration has been by far the biggest contributor to media pluralism risks among two dozen indicators (Carlini, 2024).

HHI measures range from 0 to 10,000. A value between 1,500–2,500 typically indicates medium concentration, with measures below and above these thresholds reflecting, respectively, a competitive and concentrated market, following the US Department of Justice, whereas in Europe an HHI of 2,000 or more already indicates excessive concentration (Winseck, 2024, p. 47).

3.1.1. Advantages of Using HHI and CR*n*

Although criticized for being static, both indicators served to bring insights into market structures and trends in different media sectors and countries. Using these indicators for different sectors across 36 countries and in a 10–25-year time span, the International Media Concentration Research Project, led by Eli Noam, has dispelled conventional wisdom that the internet reduced concentration in media and communication. Taking internet service providers and search engines into account, the internet displays high concentration levels (Noam, 2016a). At the same time, online news media were found to be less concentrated compared to newspapers. However, many of the most successful online news companies had strong brands before the internet transition, and "most online news attention by national audiences is focused on a few mass-audience outlets" (Noam, 2016a, p. 1316).

Since HHI inflates the weight of more dominant firms compared to companies with smaller market shares, Noam proposed an alternative metric, which divides HHI by the square root of the number of companies and is designed to indicate ownership diversity level. This approach was used by Angelopulo and Potgieter

(2013) to discover concentration in each media sector of South Africa in the 1990s–2000s, where one to four firms dominated.

Since digitalization prompted media companies to diversify (Doyle, 2014), the mentioned projects adopt a "whole media" approach. They combine the revenues of companies in various sectors and arrive at a share of a company in the whole media economy or an aggregation of sectors. While this approach can make sense at first glance in hybridized media systems, it's questionable whether competitors from all these sectors can be pooled together, as we explain in the following.

3.1.2. Shortcomings of Reliance on Concentration Metrics

While useful to assess market structure and competition in single sectors and markets, HHI and CR*n* are less powerful to reflect the situation when several sectors are combined. They can mask higher concentrations in distribution sectors when merged with content sectors, which is worrisome considering that a distribution monopoly with many competing content producers is also problematic for public spheres (Vizcarrondo, 2013). Therefore, we see a limitation in using revenue-based HHI and CR*n* in aggregated media markets, combining sectors with differing cost and profit structures, as high market shares of revenue-intensive industries become less salient and small market shares become even smaller.

Take the newspaper market in Denmark as an example, particularly its assessment within the Global Media and Internet Concentration Project (2022). In 2018–2022, CR4 amounted to 70–75% (high concentration) and HHI to 1,700–1,800 (moderate concentration), but when traditional and online media are taken as a whole industry, the indicators fall to some 30% and 200–400, respectively (Henten et al., 2024, p. 11). Similar levels are observed in Austria: 73% in CR4 and 1,931 in HHI for the newspaper market alone, whereas less than 30% in CR4 and 300 in HHI for the whole traditional and online media industries in 2022 (Sparviero et al., 2024, pp. 31, 41–42). What, then, is the actual market power of individual Danish and Austrian news companies operating in broadcast, print, and online markets? A bare analysis of revenue-based CR4 and HHI cannot tell the full story.

In addition, despite their relevance, revenues can be misleading in defining levels of concentration in media industries. Because news media typically do not compete in prices, and media products are demand-inelastic, higher concentration does not necessarily lead to unification of the products, and higher competition does not necessarily lead to product differentiation. In other words, a concentrated media conglomerate may try to fill in all the different niches to prevent new entrants, and the fierce competition can lead to a situation where different media start to mimic each other, trying to cater to the average person. Therefore, while the revenue-based market concentration indices borrowed from other industries can indicate economic power, they are not an accurate reflection of owners' influence on the media's performance of their social functions. An alternative is the use of audience share metrics. It is not perfect, as Iosifidis (2010) argues, since it does not include the quality of media consumption, but in the absence of such a complex combination of data, audience share can reflect media power in the sense of news exposure (Tewksbury & Rittenberg, 2015). It is precisely because audiences are sold to advertisers that their shares are seemingly better at grasping the potential influence of owners.

Apart from issues with each specific form of measurement, the use of market metrics is, in general, not spared from critique. Des Freedman (2014) warns against viewing data provided by commercial companies as free from biases, and highlights the need for careful contextualization of these data. Birkinbine and Gómez (2020) point out that measures based on revenues and market shares can be delusive: Sometimes media firms do not in fact compete but have mutual arrangements and/or enterprises. They suggest that a network analysis approach is more suitable to examine media structures and relations.

3.2. Social Network Analysis Approaches

A newer approach to examine media ownership is social network analysis. Through the analysis of networks connecting global media companies such as Time Warner, The Walt Disney Company, News Corp, and Bertelsmann with local media organizations and overlapping board members of different companies, Arsenault and Castells (2008) concluded that globalized, digitized, and deregulated media environments are characterized by concentrated ownership, "organized around networked forms of production and distribution, the backbone of which is provided by a core of multinational media corporations. In these networks, the global shapes the local but the local also influences the local" (p. 743). The authors noted a networking logic that businesses follow aimed at commodifying culture and subordinating communication to profit. These media networks are further interlinked with finance, production, advertising, technology, research, and politics through multiple points of connection.

In their research, Schnyder et al. (2024) analyzed ownership networks in Austria, Hungary, Slovenia, and Turkey at three time points. They used Freeman's centralization measures (degree centrality measures of nodes) along with the distribution of eigenvector centrality scores in media ownership networks to assess how information flows are channeled by ownership relations. Centrality measures are based on the number of connections a node has in a network. While degree centrality measures the simple number of connections a node has, eigenvector centrality accounts for the number of connections of neighboring nodes and is a proxy for the "importance" of a node in a network. Schnyder et al. used these measures to track changes in media ownership structures towards greater centralization with implications for information diffusion against the backdrop of growing authoritarian populist tendencies.

Several studies do not build ownership networks but confirm assumptions about the importance of ownership for information diffusion. Sjøvaag et al. (2019) investigated how the links on news websites send users to other sources. Shared ownership appeared as one of the predictors of a higher centrality measure, leaving independent local outlets digitally isolated and perpetuating the power of well-established, resourceful companies in Scandinavia. Knuth et al. (2024) analyzed networks of linkage of news online sources with user data and detected a somewhat similar pattern in Germany: Established companies' news outlets tend to be conduits to cross-owned media or the end points of the user experience.

3.2.1. Advantages of Network Analysis

Network analysis helps overcome some of the shortcomings of the economic metrics we have described. While competition is assumed based on the distribution of market shares, it does not necessarily imply incumbents' competitive behavior, as Birkinbine and Gómez (2020) illustrate with network analysis. The scholars mapped joint ventures of global media firms as of 2017 and found ties between them in

network analysis; for instance, outlining that Twenty-First Century Fox, Comcast Corporation, and The Walt Disney Company together owned Hulu while being seemingly competitors on the global media market. In fact, these companies can be even more entangled. For example, Comcast Corporation and The Walt Disney Company, which currently together own the Hulu platform (Palmer, 2024), share their biggest investors: Vanguard Group (10% of Comcast Corporation and 8.67% of The Walt Disney Company), BlackRock (8.41% of Comcast Corporation and 7.32% of The Walt Disney Company), and State Street Corporation (4.58% of Comcast Corporation and 4.4% of The Walt Disney Company), according to Yahoo Finance (2025a, 2025b).

By focusing on relations between several legal entities and owners—especially when these networks reach the ultimate owners—networks help identify "truly independent" groups from each other by providing a count of linked components. In addition, density and centrality measures can be useful to see how integrated (concentrated) media ownership is and how influence in the network is distributed. The scores, in turn, provide input for further statistical tests.

Similarly, such entanglements can be discovered by mapping overlapping management board members of various media companies, which may have implications for media performance. Robles-Rivera and Cárdenas (2023) have suggested that "networking among business elites precedes media capture as it organizes access to the media and collective mobilization of resources" (p. 308). Having a relation to a media company gives a possibility to influence its operations, and unpacking networks of ownership relations helps trace possible influences.

3.2.2. Shortcomings of Reliance on Network Analysis

The main shortcoming of network analysis in media ownership research lies in its still limited application, which restricts the ability to draw bold or far-reaching interpretations. As more ownership network analyses are conducted and begin to accumulate, a richer empirical foundation will emerge. This will enable researchers to identify structural patterns, recurring power configurations, and their implications for information environments.

Yet, tackling methodological problems persists. One being the use of eigenvector centrality to see influence and its distribution. While ownership relations are directed and weighted by their nature, eigenvector centrality is applicable only in undirected networks (Jia et al., 2019; Saxena & Iyengar, 2020). Hence, it is possible to use this measure only when assuming that ownership relations create other undirected symmetric relations such as information, resources, and practices sharing.

3.3. Proposal for Media Power Concentration Analysis

Considering the advantages and shortcomings described above and increasing interest in network analysis for ownership networks, we advocate for using the advantages of both concentration metrics and network analysis, as well as clarifying the use of some of the network statistics for ownership graphs, as explained in the next section.

Our approach is based on these three pillars:

1. Tracking full media ownership chains and identifying beneficial owners of outlets.
2. Combining content markets based on audience and calculating shares of attention each owner receives from their outlets on different markets.
3. Examining different centrality measures in different modes of networks (directed/undirected and weighted/unweighted) and carefully interpreting the results.

4. Data and Elaboration of the Method

We drew on the EurOMo database for the samples of newspapers, radio stations, TV channels, and online outlets. The database includes media with "opinion shaping" relevance, qualitatively understood as high audience and/or agenda-setting potential, and their ownership structure as of 2022 (EurOMo, 2024). We treat legacy outlets and their online versions as one media brand. We have constructed our node and edge list and included all known legal ownership relations in the ownership chain of a brand, direct and indirect owners. For representation as a network, each person, company, and media must be a node connected to each other by their shareholdings. We have constructed our database of media brands in Denmark (n = 10) and Greece (n = 23). We revised, complemented, and, when necessary, corrected the information from the EurOMo database consulting websites of companies, media regulators, and the European Audiovisual Observatory. The report by Maragoudaki (2024) served as a source of ownership connections of the Vardinogianni family in Greece. Below, we elaborate on our method according to the three pillars set out above.

4.1. Tracking Full Media Ownership Chains and Identifying Beneficial Owners of Outlets

Following the recommendations of the European Media Freedom Act and the Anti-Money Laundering Directive (AMLD), we sought to include all beneficial owners, understood as "any natural person(s) who ultimately owns or controls the customer and/or the natural person(s) on whose behalf a transaction or activity is being conducted" (Directive of the European Parliament and of the Council of 20 May 2015, 2015, Article *3*(6)).

Nonetheless, identification of beneficial ownership is not without challenges. For instance, the Danish newspaper and website Information is published by A/S Information. The company has more than 4,500 owners, three of them with at least 5% of interests, namely Informations Medarbejderforening, Foreningen Informations Venner, and AkademikerPension. As the name suggests, the latter is a pension fund owned by 170,000 academics. As it is a legal entity itself, it should not be represented as a beneficial owner, who must always be a natural person. However, it is impossible to name all academics who contribute to the fund and elect its board. In this case, we created a separate node for the collective of individuals and called it "Academics." Similar cases were treated accordingly. We have not included treasury shares of companies in the networks since they belong to the companies themselves and in no case exceed 5%. When a part of a company's ownership was unknown, we created nodes of unknown owners and a respective shareholding relation.

In some cases, there are no legal owners at all (e.g., public broadcaster DR in Denmark). When that is the case, the AMLD demands that the person(s) occupying the highest decision-making positions be considered beneficial owners. We also created collectives such as "Boards" to play this role. Ideally, the individual board members should be coded, similarly to Robles-Rivera and Cárdenas's analysis (2023), but data for this information are even more scarce.

Our data had a caveat. In rare cases, not all the share amounts were available in the ownership structure. When this happened, we assumed the equal distribution of the shares between the known owners with an unidentified number of shares. Table 1 provides all such cases and the equal shares that were assigned, as well as illustrates the structure of our edge list.

Table 1. Edge list with shares assigned equally to all known owners. Shareholdings represent percentages.

Source	Target	Shareholding	Attention
	Denmark		
Harald Halberg Holding A/S	Holdingselskabet for Kapitalandele i Harald Halberg Holding A/S	25	0.030
Harald Halberg Holding A/S	Ann-Julie Grøsfjeld Halberg	25	0.030
Harald Halberg Holding A/S	Lee-Emilie Grøsfjeld Halberg	25	0.030
Harald Halberg Holding A/S	Ole Einar Halberg	25	0.030
Aktieselskabet Svendborg Avis (Sydfyns Tidende)	Halberg A/S	50	0.125
Aktieselskabet Svendborg Avis (Sydfyns Tidende)	Ellekilden Svendborg Aps	50	0.125
A/S Politiken Holding	Politiken-fonden	50	3.820
A/S Politiken Holding	Ellen Hørups fond	50	3.820
	Greece		
Antenna Radio BV	Antenna Greece BV	100	0.100
Globecast Holdings S.a.r.l.	Theodoros Kyriakou	100	0.950
Makedonia TV Anonymos Etaireia	Media Capital Partners ICAV	100	1.570
Radiofoniki Epikoinonia Monoprosopi Anonymi Etaireia	Paxana Holdings Limited	100	0.120

As the structure of our edge list in Table 1 suggests, we focus on flows of audience attention captured by media brands along the ownership chain to beneficial owners. The final attention share that a beneficial owner receives is indicated as their node attribute. This allowed us to calculate CR4 and HHI and see if attention is concentrated or dispersed across owners and media groups. The other node attributes were type (company, person, brand) and country of registration for companies. The "Attention" attribute of an edge represents the share of attention that the ownership connection transfers to the next node.

4.2. Identifying Attention Shares of Owners Across Sectors

To identify owners' attention shares across media sectors, we took each outlet in the sample and defined its audience share. For the print outlets, we used circulation figures and related their proportion to the total circulation in the sample. For the online outlets, including the web versions of the legacy media, we used the

share of visits relative to total visits. For the TV channels and radio stations, we used available daily audience reach measures. In all cases but two, we used data from EurOMo. The exceptions are the European Audiovisual Observatory (2024) for Danish TV channels, and the DR report (2022) for the share of the radio station P1.

Then, we calculated the share of attention for each media brand to arrive at their attention across sectors. For this, we used the percentages of the use of different types of media in each country from the Eurobarometer Flash Survey (European Parliament, 2022) that were derived from aggregating answers to the question: "Among the following, what media have you used the most to access news in the past 7 days?" The respondents could choose several answers, so the sum of use of each media type for the news exceeded 100%. We then normalized the percentages so that they add up to 100 in order to identify the relative importance of each media sector and enable the identification of the media power of owners across sectors as a share of the attention their outlets receive. We then calculated the sum of the audience shares weighted by the normalized shares of the respective sectors for each brand. For example, the Greek ALPHA TV has a 12% television audience and 4% visits on their website. The relative importance of the TV sector in Greece is 37.5%, whereas the online sector has 39.4% (all numbers are rounded). The attention share of the ALPHA TV brand is $0.12 \times 0.375 + 0.04 \times 0.394 = \sim 6\%$.

Lastly, we multiplied the brand attention shares by the beneficial owners' shares of these brands. In doing so, we could arrive at the attention share that the ultimate media owners receive from each brand and sum the attention shares from all owned brands for each beneficial owner.

4.3. Visualizing the Ownership Networks and Examining Various Centrality Measures

We built ownership graphs in Gephi, displaying the belonging relationships as the direction of edge arrows to reflect the attention flows. We colored nodes representing outlets, companies, and persons (including collectives) differently and arranged the size of beneficial owners by their power, understood as the audience share explained above.

We then looked at the graph structures and used built-in Gephi filtering and network statistic functions to examine the graphs. We filtered nodes of companies with domestic registration to see the share of foreign entities in the network. Next, we looked at the number of weakly connected components and their size to see how many unconnected, "independent" media ownership groups are on the market. A bigger size of the largest component points to a higher resourcefulness of a bigger media group that can sustain the administrative costs of running multiple companies or a potential to pull resources from different ownership subgroups comprising the large constellation of companies owning a media outlet.

We then looked at density and average weighted degree. Density shows the percentage of connection in the network out of all possible connections, that is, the integration of the network. Hierarchical networks such as ownership networks are sparse (Schnyder et al., 2024). This means the density measure is usually small. This number is not very informative for a non-dynamic ownership network, since it requires only one edge between any two nodes from different connected components to merge these components into a single one. However, with longitudinal data, an increase in density would mean either a higher concentration of ownership in general, or a decrease in the number of beneficial owners, which is also a concentration, or closure of outlets, since nodes in the beginning and the end of ownership chains have only one connection. Any of these possibilities

hamper pluralism. We are presenting this measure in the results to enable comparison with the potential future analyses on the newer data, given the anticipated update of the EurOMo database at the end of 2025. The average weighted degree is a result of the division of the sum of all weights by the number of nodes. In ownership networks with shareholdings as weights, it can indicate whether, on average, media are owned solely or divided between owners. A lower number indicates more beneficial owners since the networks are typically hierarchical. However, caution should be exercised in interpreting the number when there are cliques present within the graph, because then ownership is divided by two entities that both belong to another entity. The cases of division of ownership into multiple companies that belong to one entity at the end of the ownership chain would be even more problematic, as this further lowers the average weighted degree.

Finally, we look at the measures of "influence" in a network. In Gephi, it is possible to calculate eigenvector centrality and Katz centrality scores. Eigenvector centrality scores should be calculated in undirected networks (Gómez, 2019). It is impossible to infer about ownership based on this influence measure in an undirected network, but some other processes, like information exchange (Schnyder et al., 2024), can be assumed. We, however, include and discuss this measure to illustrate its futility for inferences about ownership influences. Katz centrality is an extension of eigenvector centrality for directed networks. The measure assesses nodes' number and quality of connections, i.e., the number of connections of their ego-net. The distribution of the scores is the network centralization score and can indicate whether the influence is concentrated or distributed. One of the ways to see the distribution is the Gini index calculation (Bienenstock & Bonacich, 2022). Katz centrality requires specification of the dumping factor α (between 0 and 1 in Gephi since eigenvalues are normalized); α closer to 1 increases the number of node's indirect connections that are included in the calculation of the score. In line with our goal to discuss methodological implications of network analysis for ownership networks, we discuss the application of the two centrality measures on our illustrative examples in different modes of networks: undirected and unweighted—for eigenvector centrality; directed and unweighted, directed and weighted by shareholdings, and directed and weighted by attention shares (acting similarly to actual shares of the outlet)—for Katz centrality.

5. Media Ownership Structures and Attention Flows in Denmark and Greece

5.1. Denmark

Visually, the strength of the public service broadcaster DR and the state commercial broadcaster TV2, owned by the Ministry of Culture, is prominent, as can be seen in the graph of the Danish media ownership structure (Figure 1).

The third-biggest node belongs to the Van Thillo family that owns the Belgium-based DPG media group. Their ownership chain is the only one that contains foreign companies on the graph: Out of 32 companies, three have foreign registration. The Van Thillo family node is followed by boards of foundations that own Ekstra Bladet and Politiken in terms of size, reflecting the amount of attention. In terms of concentration of attention, the Ministry of Culture (28.73%), the Board of DR (17.59%), the Van Thillo family (11.94%), and the Board of Jyllands-Postens fond (7.65%) have together 66%, which indicates a high concentration. The state and public broadcaster together have 46% of attention. Fourteen out of 20 beneficial owners have an attention share of less than 1, and this contributes to the competitive attention market with HHI at 1,367. Without the state broadcaster, the score falls to 541. We can see that the state broadcaster and public media in Denmark are

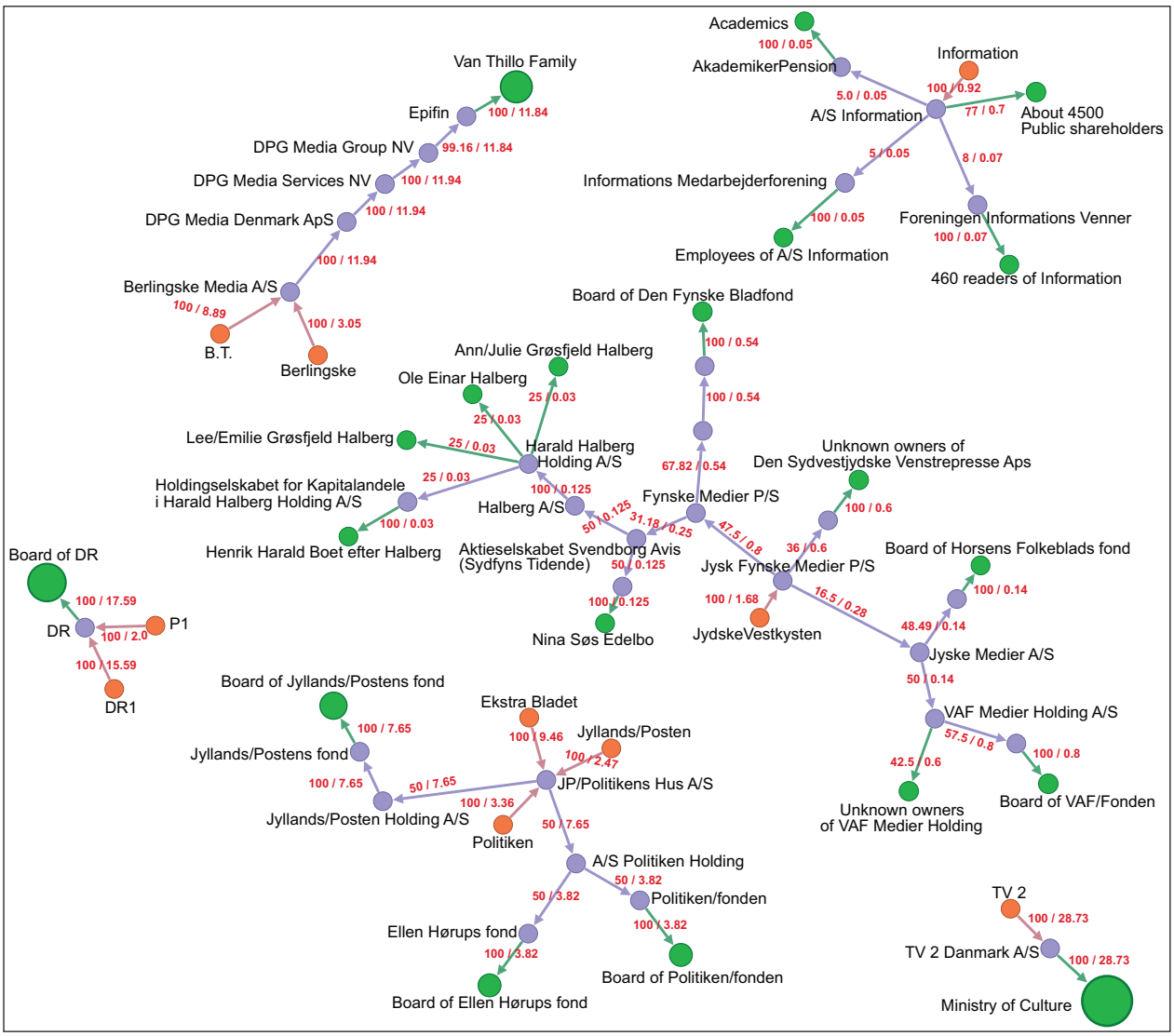

Figure 1. Media ownership networks graph for 10 news brands in Denmark. Notes: Node colors represent ultimate owners (green), companies (violet), and brands (orange); the size of green nodes indicates how much media audience share ultimate owners/decision-makers have; the arrows indicate the direction of belonging; red edge labels are percentages of shares of the receiving node and attention the edges carry to it.

strong, and competition is observed in private media. The presence of strong public service media is associated with more diverse online environments, internal pluralism, better news quality, and a more knowledgeable public (Cushion, 2022; Humprecht & Esser, 2018).

We look at the number of weakly connected components and their size. In our case, since the sample is illustratively small, it is visible on the network graph (Figure 1) that there are six independent media groups. Gephi returned the same number of connected components. Each independent ownership group has around 1.6 brands in Denmark. The components vary in size from 3—the network of state and public broadcasters—to 25—the group owning JydskeVestkysten. The second-biggest component is almost half as big as the biggest component. It is the ownership chain of Ekstra Bladet, Politiken, and Jyllands-Posten with 14 nodes. Without brands and persons in the network, the JydskeVestkysten group has 12 nodes, and the ownership structure of Ekstra Bladet, Politiken, and Jyllands-Posten includes six companies.

The Danish media ownership graph is sparse, with a density of 0.015. This means existing edges form 1.5% of all possible connections. The average degree is 67, which is the average shareholding in media ownership.

Lastly, we have analyzed how different centrality scores are attributed and distributed (Table 2). The highest eigenvector centrality scores are assigned to the outlet's publishers (JP/Politikens Hus A/S, Jysk Fynske Medier P/S) and their immediate owners (A/S Politiken Holding, Fynske Medier P/S, Jyske Medier A/S), as they are connected to companies owning several brands and start branches of different owners. Nodes of Halberg A/S, VAF Medier Holding A/S, Harald Halberg Holding A/S, and A/S Information—the publisher of Information—are in the top five by this score. The dispersed ownership gives a lot of connections to the nodes. However, it is disputable if the companies are influential or rather influenced—many owners influence their operations. Similarly, the high-scoring node of Aktieselskabet Svendborg Avis (Sydfyns Tidende) holds several branches of owners together. Katz centrality of the unweighted network treats companies that have several incoming connections (typically publishers: JP/Politikens Hus A/S, Berlingske Media A/S, DR) and their immediate owners and their neighbors as important (A/S Politiken Holding, DPG Media Denmark ApS, foundations owning JP/Politikens Hus A/S). It is sensible to assume that publishers are immediate decision-makers about outlets, but only if the allocative power of ultimate owners has instilled such practices. With shares as weights, Katz centrality assigns high scores to decision-makers; however, the

Table 2. Top 10 nodes by influence measures in the ownership network of the Danish media sample.

Eigenvector centrality (undirected, unweighted network)	Katz centrality, $\alpha = 0.1$ (directed, unweighted)	Katz centrality, $\alpha = 0.1$ (directed, shareholding as weights)	Katz centrality, $\alpha = 0.1$ (directed, attention as weights)
Jysk Fynske Medier P/S	JP/Politikens Hus A/S	Van Thillo family	Van Thillo family
JP/Politikens Hus A/S	Berlingske Media A/S	Epifin	Ministry of Culture
Harald Halberg Holding A/S	DR	Henrik Harald Boet efter Halberg	Epifin
Fynske Medier P/S	A/S Politiken Holding	Board of Den Fynske Bladfond	DPG Media Group NV
A/S Information	Jyllands-Posten Holding A/S	DPG Media Group NV	Board of DR
Jyske Medier A/S	DPG Media Denmark ApS	Holdingselskabet for Kapitalandele i Harald Halberg Holding A/S	DPG Media Services NV
Aktieselskabet Svendborg Avis (Sydfyns Tidende)	Board of DR	Ann-Julie Grøsfjeld Halberg	TV 2 Danmark A/S
A/S Politiken Holding	Ellen Hørups fond	Lee-Emilie Grøsfjeld Halberg	DPG Media Denmark ApS
Halberg A/S	Politiken-fonden	Ole Einar Halberg	Board of Jyllands-Postens fond
VAF Medier Holding A/S	Jyllands-Postens fond	Board of Jyllands-Postens fond	Jyllands-Postens fond
Gini: 0.37	Gini: 0.20	Gini: 0.95	Gini: 0.22

distribution of influence is very unequal because many of the shareholdings are 100% and the score is sensitive to the length of the paths, where longer ones receive higher scores. Finally, Katz centrality and the shares of a brand's attention, rather than of the source node, assign higher scores to nodes receiving higher shares from the paths leading to them and may indicate a decision-making influence. Here, Katz centrality can be understood as an ability to influence public opinion through the attention that is given to the owned outlets and by virtue of decision-making power over editorial lines and media business operations. The top-scoring nodes by Katz centrality in this mode include ultimate owners and decision-makers of influential media brands—Van Thillo family, Ministry of Culture, Board of DR, and boards of foundations owning Ekstra Bladet, Politiken, and Jyllands-Posten—and the companies that they immediately own. With a Gini coefficient of 0.22, some level of equality in such influence is present.

5.2. Greece

In Greece, the biggest relative power is with individuals and families (Figure 2). Themistocles Alafouzos (17.03%), Evangelos Marinakis (13.31%), and the Vardinogianni family (8.1%) have the most attention in the ownership structure, followed by the Savvidis family (7.23%) and Loannis Alafouzos (7.02%). Their nodes are

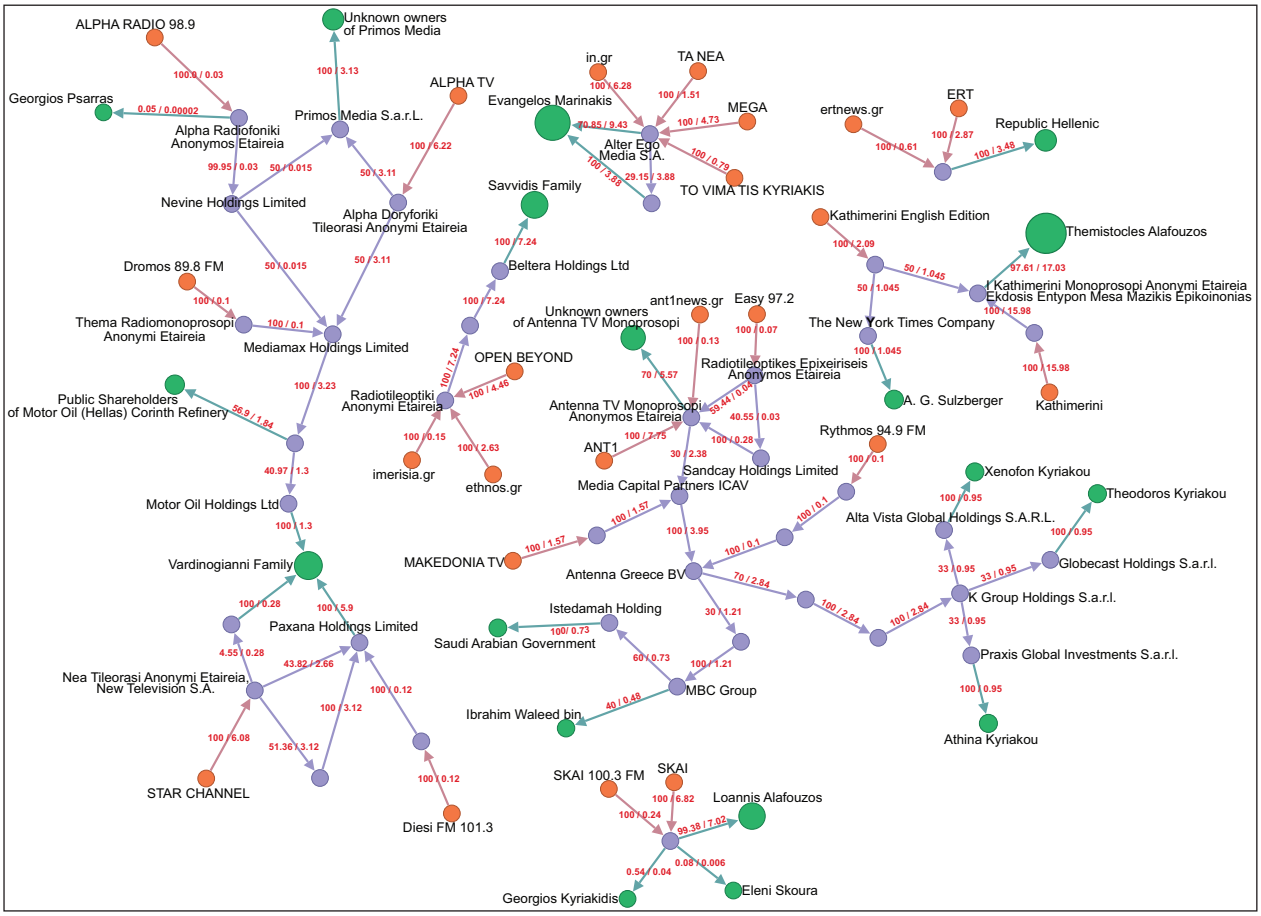

Figure 2. Media ownership networks graph for 23 news brands in Greece. Notes: Node colors represent ultimate owners (green), companies (violet), and brands (orange); the size of green nodes indicates how much media audience share ultimate owners/decision-makers have; the arrows indicate the direction of belonging; red bold edge labels are known percentages of the shares of the receiving node and attention the edges carry to it.

several times bigger than the node of the owner of the public service media. Private family ownership is associated with political instrumentalism (Benson, 2018; Hanretty, 2014; Theine et al., 2025). The CR4 score is 45.67%, which is close to, but is not yet, concentration. This observation is not surprising, since the Greek media market is characterized by excessive media supply relative to demand (Papathanassopoulos et al., 2021). An HHI of 696 also indicates competition. There is a considerable amount of foreign ownership on the graph. Out of 45 companies, 26 have foreign registration.

Including beneficial ownership in the Greek ownership networks (Figure 2) revealed relations that are hidden if we take media groups as a unit of analysis. The node of the Vardinogianni family connects two media groups that own the ALPHA channel, the STAR channel, and other outlets. There are seven connected components in the network of 4 to 28 nodes in size. The biggest component includes the mentioned groups, and the second biggest is a chain of owners of MAKEDONIA TV and ANT1 and consists of 22 nodes. The rest of the subnetworks have 4 to 8 nodes. Each independent ownership group has around 3.2 brands.

The network is sparse, as expected, with 1.2% of all possible connections formed. The average weighted degree is 78%. However, considering the cliques formed by ownership directed at nodes of Evangelos Marinakis and Paxana Holdings Limited, and of Antenna TV Monoprosopi Anonymos Etaireia, an average owner possesses an even larger portion of brands in their group. This means ownership is rather consolidated than distributed, with implications for operational decision-making.

Table 3 presents different centrality scores calculated with different modes of the network. Expectedly, the highest eigenvector centrality scores are assigned to (a) nodes of publishing companies (Antenna TV Monoprosopi Anonymos Etaireia—the publisher of ant1news.gr and broadcaster of ANT1; Alter Ego Media S.A.—publisher of three newspapers and websites owned by Evangelos Marinakis; Nea Tileorasi Anonymi Etaireia—STAR Channel's broadcaster; and Radiotileoptikes Epixeiriseis Anonymos Etaireia—the broadcaster of Easy 97.2 connected further to Antenna TV Monoprosopi Anonymos Etaireia), (b) their immediate neighbors—nodes of companies that hold the publishing companies (Paxana Holdings Limited, Media Capital Partners ICAV, and Sandcay Holdings Limited), and (c) nodes of companies that link several ownership groups (Media Capital Partners ICAV, Antenna Greece BV, as well as the node of the Vardinogianni Family that holds two media groups). Apart from the latter category of nodes, which are instrumental in bringing together different groups of entities in media ownership, publishing companies and their owner could be rather thought of in terms of receiving rather than spreading influence.

Most of the mentioned nodes, mainly publishing companies and their immediate owners, have the highest Katz centrality scores in the directed, unweighted network because they receive many incoming edges from brands they own, and this influence propagates further through the network. In smaller subnetworks, this transferred influence can reach beneficial owners, which is the case of Evangelos Marinakis' node—the new node in the top 10 list of the influential nodes by Katz centrality in the unweighted and undirected network. Other new nodes in the top 10 by Katz centrality, Radiotileoptiki Anonymi Etaireia—the broadcaster of OPEN BEYOND and publisher of imerisia.gr and ethnos.gr—and Primos Media S.a.r.L.—a company with an unknown beneficial owner with shares in ALPHA TV and ALPHA RADIO 98.9—receive their high values following the described principle. By weighing the edges by share amounts, the influence is highly unequally distributed, since most of the shareholdings account for 100% with few hubs distributing the shares among different groups of entities. In addition, all nodes with high Katz centrality scores in this configuration belong to the

same connected component due to the high influence of the path length—the group owning MAKEDONIA TV, ant1news.gr, ANT1, and Easy 97.2.

Katz centrality with attention shares carried from each node to the next has proven to be the most suitable importance measure when looking at owners' influence. The top 10 nodes by this score include the nodes of beneficial owners Themistocles Alafouzos, Evangelos Marinakis, the Savvidis family, the Vardinogianni family, and Loannis Alafouzos. Other high-scoring nodes include companies preceding these nodes in the structure. The nodes that connect to other nodes with higher attention shares receive higher scores, like the connection from Kathimerines Ekdoseis Monoprosopi Anonymi Etairia to I Kathimerini Monoprosopi Anonymi Etaireia Ekdosis Entypon Mesa Mazikis Epikoinonias that eventually points to Themistocles Alafouzos. The influence on the network is relatively equally distributed, with the Gini coefficient of 0.25.

Table 3. Top 10 nodes by influence measures in the ownership network of the Greek media sample.

Eigenvector centrality (undirected, unweighted network)	Katz centrality, $\alpha = 0.1$ (directed, unweighted)	Katz centrality, $\alpha = 0.1$ (directed, shareholding as weights)	Katz centrality, $\alpha = 0.1$ (directed, attention as weights)
Antenna TV Monoprosopi Anonymos Etaireia, Antenna TV Single Member S.A.	Antenna TV Monoprosopi Anonymos Etaireia, Antenna TV Single Member S.A.	Xenofon Kyriakou	Themistocles Alafouzos
Paxana Holdings Limited	Alter Ego Media S.A.	Theodoros Kyriakou	I Kathimerini Monoprosopi Anonymi Etaireia Ekdosis Entypon Mesa Mazikis Epikoinonias
Alter Ego Media S.A.	Vardinogianni family	Athina Kyriakou	Evangelos Marinakis
Media Capital Partners ICAV	Mediamax Holdings Limited	Praxis Global Investments S.a.r.l.	Savvidis family
Nea Tileorasi Anonymi Etaireia, New Television S.A.	Paxana Holdings Limited	Globecast Holdings S.a.r.l.	Beltera Holdings Ltd
Mediamax Holdings Limited	Radiotileoptiki Anonymi Etaireia	Alta Vista Global Holdings S.a.r.l.	Kathimerines Ekdoseis Monoprosopi Anonymi Etairia
Radiotileoptikes Epixeiriseis Anonymos Etaireia	Evangelos Marinakis	Saudi Arabian Government	Alter Ego Media S.A.
Antenna Greece BV	Media Capital Partners ICAV	K Group Holdings S.a.r.l.	Vardinogianni family
Sandcay Holdings Limited	Antenna Greece BV	Istedamah Holding	Dimera Media Investments Ltd
Vardinogianni family	Primos Media S.a.r.L.	Ibrahim Waleed bin	Loannis Alafouzos
Gini: 0.39	Gini: 0.4	Gini: 0.95	Gini: 0.25

To summarize, media ownership is consolidated in several individual hands who cross-own several brands, while attention to these brands and the possibility to influence publics are distributed relatively equally, pointing either to heightened competition in an oversupplied information market and/or, possibly, to market fragmentation (Kalogeropoulos, 2024).

6. Discussion and Conclusion

We show a way to analyze media concentration and ownership structures with attention shares as a point of reference for combining different sectors and measuring nodes' influence. We considered different network statistics and argued that Katz centrality with attention shares of outlets as edge weights in the networks representing relationships of belonging is the most suitable to reflect the power of media owners to shape public opinion. We briefly summarize our exercise by outlining which questions can be answered with which measures in Table 4.

Table 4. Questions on media concentration and useful measures.

Question	Measure
Are attention flows concentrated in media ownership structures?	Weighted attention shares, CR4, and HHI
How many independent groups are in the media market?	Number of weakly connected components in the network
Has ownership concentration grown?	Change in the density of the network, decrease in the number of weakly connected components
Are media owned solely or is ownership dispersed?	Average weighted degree
What are the most influential entities, and how is influence distributed?	Katz centrality with shares of outlets or their audiences as edge weights, and its Gini coefficient

Due to the hybridity of media structures, old ways to think of concentration, competition, pluralism, and diversity are becoming obsolete. We suggest that aggregating content markets with audience attention and analyzing ownership structures, including beneficial owners, are useful approaches to analyze potential owners' influences on public opinion.

With this approach, we have observed dominance of state and commercial broadcasters in Denmark, with private media ultimately owned by several entities and individuals. Our results indicated much higher concentration, 66% in CR4 and 1,376 in HHI, than the revenue-based estimations of 30% CR4 and 200–400 HHI by Henten et al. (2024). This discrepancy reflects the discussion that platforms strip content producers of traditional revenues, and the well-established media organizations remain the fittest to survive the hybrid reality. With the exception of the DPG group, the Danish content media market is characterized by dispersed ownership with foundations and professional organizations as stakeholders. In Greece, we observed the contrasting situation, with a more competitive market of private and state players where ultimate media ownership is predominantly consolidated within individuals and families. These owners are also active in shipping and industry, and some have ties to politicians (Maragoudaki, 2024). Accumulating evidence shows that state and public ownership, if independent, aligns with public interest media content, whereas private family ownership risks political and economic instrumentalization (Benson, 2018; Theine et al., 2025).

Our results can inform the discussion of ownership concentration vis-à-vis the institutional logic of owners. Countries with a more competitive media market have a lower Press Freedom Index. This corresponds to the observations regarding market structure conditions for media freedom by Trbojević et al. (2025); it is not the concentration but the defunding of content media after the rise of platforms that is the problem. When news is no longer a lucrative business, other considerations than profit may prevail to encourage investments in media. In Denmark, a high quality of media performance is sustained with strong public media and newspaper foundations that spare media logics from commercial pressures. The dominance of several media owners seems not to be a problem if the owners are the public. In Greece, with an oversupplied market, ownership of media in the sole hands of individuals and families puts additional pressure and strain on journalism, with the potential for instrumentalization that is often exercised (Maragoudaki, 2024). Although media ownership in Denmark is more concentrated, ownership influence is more evenly distributed compared to Greece's more competitive media landscape. This underscores the significance of structures built by ownership constellations and suggests that they deserve attention alongside market performance.

Our approach resembles the one used by the German Commission on Concentration in the Media (KEK), since it is also based on audience shares. However, the proposed method underpins the need and shows a way to interrogate the power of media owners across all sectors weighted by their use. This could better inform competition policy than rather arbitrary cross-ownership caps. Today, when policymakers cannot effectively restrict concentration without risking the reduction of sources of information that otherwise would not survive the market conditions that are ever shaken by technological advancements, network analysis could help move from a company-centered perspective and distinguish between multiple or few beneficial owners in the market of news. Our analysis and this recommendation should not mean that concentration is acceptable, but that power exercised via media ownership must be considered in a more complex perspective that integrates metrics, audiences, and connections between organizations and owners.

Limitations to our research can be addressed two-fold. First, our use of audience attention shares. Comparing the attention dedicated to outlets from different sectors may seem counterintuitive due to the varying intensity of information consumption via different types of media (newspaper readers are usually more attentive than radio listeners, for example). We argue that the level of consumption, which is an audience share, in effect reflects owners' chances to exercise influence, their social capital. The question of the consequences of these acts lies beyond the question of power itself, since it is "about the material coordination of flows of information, communication, and culture such that persuasion and coercion, as well as expression and interpretation, are most effectively able to take place" (Freedman, 2015, p. 274).

A second limitation of our approach is data availability. We have used a limited sample of the relevant news outlets as an illustration. Ideally, concentration analysis should consider the full media landscape; however, transparency of media ownership remains a gap in many countries. Still, we encourage others to build and analyze more networks with the data available so that there is sufficient accumulated experience and compared topologies to arrive at a kind of standard to orient research. Extant work shows no thresholds or ideas of "good" or "bad" networks that would impose specific implications for media ownership. To that end, we provide a way for such research. However, we welcome further explorations of network analysis methodology to analyze communication structures. As an extension of our approach, future studies could add the attention the outlets receive on social media and map the managing boards and editors on the networks to assess the entanglement of the governing and operational structures.

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Conflict of Interests

The authors declare no conflict of interests.

Data Availability

The ownership and other data used to compile the dataset are available at https://media-ownership.eu/databases/owners. The ready dataset can be provided by the authors upon request.

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About the Authors

Mariia Aleksevych is a doctoral candidate and researcher at the Division of Media Policy and Media Economics at the University of Salzburg. Her research interests include the effects of media ownership as well as the interrelations between the development of media, technology, power, and social justice.

Tales Tomaz is an assistant professor at the Division of Media Policy and Media Economics at the University of Salzburg. He currently heads the Euromedia Ownership Monitor 2025 project. His research interests are normative theories of news media, news media structure, and digital communication governance.