

Hubs and Authorities in the Koch Brothers Network

Patrick Doreian^{a,b,*}, Andrej Mrvar^a

^a University of Ljubljana, Slovenia

^b University of Pittsburgh, United States

ARTICLE INFO

Keywords:

Directed networks
hubs and authorities
Koch Brothers network
Roles in networks

ABSTRACT

The empirical focus is centered on the large social movement network created by the Koch Brothers to further their aims of transforming the US. The network was obtained by using the VOSON web crawler given a starting set of known allies of the Koch Brothers. This produced a large directed network with links between units. We propose using the idea of hubs and authorities as another way of considering the roles played by the units within this network. These roles may be more complex than has been realized. We have included an analysis of the core interests for the members of this network.

This manuscript is constructed as follows. Section 1 introduces the study of large network of allies assembled to promote the libertarian ideas of the KBs to have the US government run to serve their primary interests plus other interests relevant for their allies. Section 2 provides a description of this network and the way it was assembled as a potent force in American politics. A discussion of the ideas of hubs and authorities (Kleinberg, 1999) are presented in Section 3 along with arguments as to why we think these ideas are more useful, at least for our purposes here, than traditional ideas regarding centrality, long a staple approach for network analysts. We describe the main authorities and the roles they play in spreading the most important information through the KB network, especially their most important allies in Section 5. We note that the notion of roles, as studied within the social network tradition, is usually associated with blockmodeling. However, we think that the idea of hubs and authorities can be very helpful for understanding roles, albeit in a very different fashion.

1. Introduction

As has been noted before (see, for example, Doreian and Mrvar, 2020), the inspiration for a far-reaching project to construct the *structure* of the Koch Brothers (KBs) network of allies found its inspiration in two books. One is *Democracy in Chains* (MacLean, 2017) containing a detailed history of the historical intellectual foundations of a substantive approach dovetailing perfectly with the libertarian views of the KBs. The

history has a long pedigree going back to a mere two decades after the founding of the US. The views of John Calhoun, seventh vice president (1825-1832) of the US who defended slavery and promoted state's rights, remain alive, at least in the minds of the KBs, especially state's rights, and the leaders of their allied units. An economist, James Buchanan, following this tradition, developed a theoretical economic and political approach called 'public choice theory'. Its core concern centered on how incentives affected governmental action. For this work, devoid of any genuine empirical data, he received a Nobel Economics Prize. It was, instead, an openly political statement. Charles Koch found Buchanan's arguments fully consistent and most useful for achieving his "unrealized dream of liberty, of a capitalism all but free of governmental interference" (MacLean, 2017: xxiv). Buchanan spent many years working at George Mason University (GMU) which has received huge amounts of money from the KBs (especially during 2005-17). Its Foundation received close to \$86 million. Following closely behind, its Institute for Humane Studies received almost \$35 million and the Mercatus Center receiving a seemingly paltry amount \$9 million from the KBs Greenpeace (2014). All of these contributions had a huge impact in promoting and extolling libertarian ideas across multiple venues.

2. Studies of the Koch Brothers network

Dark Money (Mayer, 2017) lays out in great detail the ways in which many billionaires, including the KBs, drove the rise of the radical right in

* Corresponding author at: University of Ljubljana, Slovenia.

E-mail address: pitpat@pitt.edu (P. Doreian).

<https://doi.org/10.1016/j.socnet.2020.07.010>

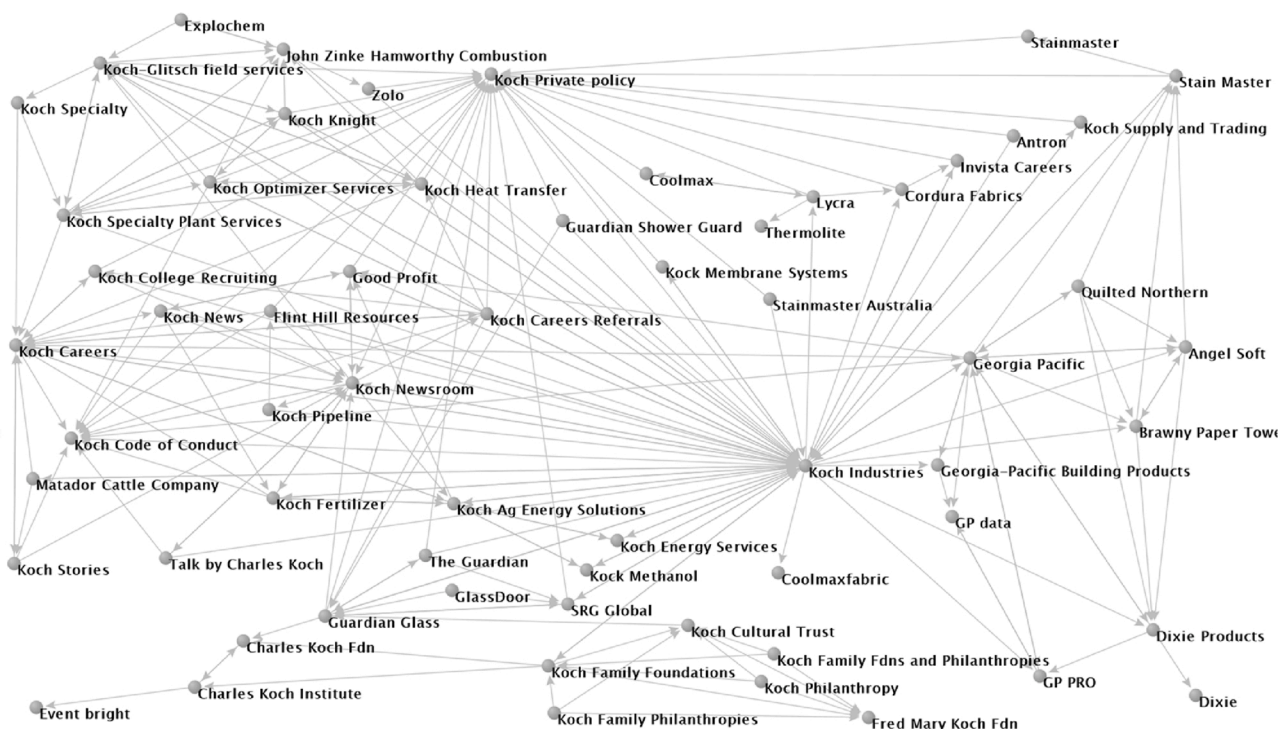


Fig. 1. The Network of units belong to Koch Industries directly or through purchasing or licensing agreements.

the US and its takeover of the Republican party, especially with the current representation of the GOP in Congress (see Krugman, 2019). This is not a new phenomenon. For four decades, the KBs have funded the development of a powerful political movement (Mayer, 2017, xviii) aimed at achieving their goal to operate freely without having to deal with intrusive governmental constraints. See also Skocpol and Hertel-Fernandez (2016) who studied this network.

Our large KB network was constructed as follows. Both *Democracy in Chains* and *Dark Money* provided lists of units known to be among the KB’s active allies. We formed a combined list of these organizations. For each, its URL was located. All of these URLs were combined to form an initial list of organizational URLs. The program VOSON, developed by Ackland (see 2018) is designed to, among other things, identify links between websites in a directed network. The initial list of URLs was submitted¹ to VOSON to identify web links involving the units identified in *Democracy in Chains* and *Dark Money*. There were 176 such URLs² submitted to VOSON. The result of the search was a network with 17, 212 units. Later we had to ‘clean’ this network by removing information streams with widely varying content to focus only on the units in the network of KB allies. The result was a network of 1081 units known as KB allies. All of the data analyses that follow were completed using Pajek (Batagelj and Mrvar, 1998). A fuller description of our methodology is provided in Doreian and Mrvar (2020).

¹ The VOSON analysis was performed by Rob Ackland to generate a Pajek network file which he shared with us. We appreciate greatly his generosity in doing this.

² This is slightly less than the number of URLs in the above assembled list as some identified units were defunct at the time of our search. Also, there were some whose URLs could not be located. More consequentially, perhaps, some required visitors to log in before getting access. However, after reading much of the bile in so many of the websites of KB allies, we opted to not log into them.

The websites for every identified unit were visited repeatedly to extract textual material regarding their identity, ambitions, the organizations they support and some of their many actions taken proudly to promote the libertarian and conservative interests. These were recorded in six large multiple background Word files used to categorize the identified units in terms of their core interests and to extract keywords identifying them. For the first task, the following categories were created: i) Koch Industries (KI) units; ii) KB allies or likely KB allies; iii) units likely to be useful for the KBs but not known as KB allies; iv) units opposed to KB or were likely to be KB enemies – many of which were committed environmental protection groups; v) other units having interests apparently inconsistent with KB interests; vi) national US news media units; vii) local or regional US news media units; viii) news media units in other countries; ix) other non-US units (a reminder that the reach of the KBs is a long international one); x) seemingly neutral units but not media; xi) potentially irrelevant units (that may have survived our efforts to winnow and remove them) and xii) US governmental units. The largest three categories are: KB allies (having 466 units); Koch opponents (163 of them) and 63 Koch Industry (KI) units. This last group is a primary, but not the only, source of the wealth supporting the activities of the KB network of allies.

Visiting the KI websites was remarkably frustrating but not at all surprising given the secretive nature of the KBs regarding many of their activities. This was especially the case regarding financial information. Fig. 1 shows a network image of Koch Industries. While being very secretive internally on their websites, they do have many links between their websites and other units to other units to which they are linked. These were obtained by using the VOSON web crawler. Of course, these are ‘indirect’ links and can only serve as proxies for the real connections involving KI units. But given their complete secretiveness, this is the best data we can have.

It is not surprising that KI has the most links. Included in this figure

are units providing funding to other members within the Koch Industries umbrella. Other production units have been brought into this fold through mergers, acquisitions and licensing agreements. Examining the KI websites provides no mention of their polluting actions and their creation of unsafe workplaces. Leonard (2019a) noted that David Koch recognized very early that dealing with environmental cleanup issues greatly threatened the profits of KI. Leonard (2019b: 187-190) goes much further in documenting the repeated accumulation of fines by Koch Industries for environmental pollution. Mayer (2017: 338) reported that in 2012, KI was the top producer of toxic waste. She (2017: 155), quoted a representative of The Center for Public Integrity (a unit in the set of KB enemies identified in our network), that the KI's "pattern of pollution was striking not just for its egregiousness but also for its willfulness." Layzer (2012) documented the opposition of conservatives, in recent times, to environmental regulation of all sorts.

While issues regarding climate change may be viewed as less central overall, they are among, if not the, core motivating issues for the KBs. This has been noted extensively by Dunlap et al. (2016), Elsasser and Dunlap (2013), Carroll et al. (2018), Brulle et al. (2016), Supran and Oreskes (2017) and Farrall (2016). Another line of thought is relevant featuring Oreskes and Conway (2010) in their book, *Merchants of Deceit*. See also Begley (2007) and Bardon (2019). Among other things, deceit involves obstructing the truth, especially about science. One prominent target of the climate change deniers is the Intergovernmental Panel on Climate Change (2001). See also National Research Council (2001), McCright and Dunlap (2003) and Brownlee (2005).

3. Hubs and Authorities

Given the immense profusion of software designed for analyzing networks in recent decades, network analysts have a huge variety of tools to employ in their research designed to help promote our understanding of both the structure of networks and the processes generating them. While being *fully aware* of the prominence of using centrality measures (Freeman 1979), we wonder if they have been overused, especially when researchers compute all possible centrality measures before inductively choosing those best serving their narrative interests. See also Hummon et al. (1990) for a general view of this early literature. They pointed to a separation of substantive issues and experimental pursuits that inspired the creation of centrality measures. In essence, creating and computing centrality measures became an end in its itself. Here, we focus instead on the computer algorithm, HITS, developed by Kleinberg (1999), one designed for ranking Web pages linked in a directed network – *exactly* what the VOSON search was used for.

It seems that the terms hubs and authorities, while defined precisely by Kleinberg, now have multiple meanings. This is not unreasonable. Soldano et al. (2017) present a method for identifying hub-authority cores in directed networks in which they search for dense cores in the form of having vertices that are highly connected. This is an important problem, one fully worthy of further attention. The network we study here is directed, and as they put it, the vertices have attributes in the form of identified units. But our concern here is not to identify densely connected communities of units as we want to identify units as either hubs or authorities in the sense of Kleinberg (1999).

Hubs are vertices pointing to other vertices thought to be important in the operation of directed networks. Authorities are these vertices. Put differently, good hubs point to many authorities while a good authority are vertices pointed to by good hubs. While this appears to be rather circular in its execution, the algorithm leads to useful measures of the extent to which vertices are hubs and authorities. More importantly, they point to the *roles* played by units in any network that, most likely, is

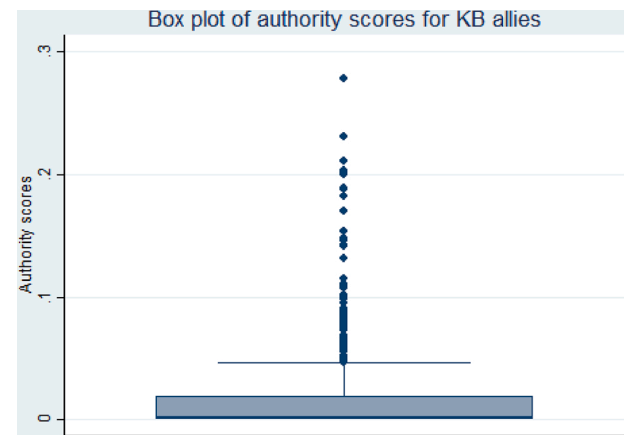


Fig. 2. A box plot for the authority scores for the KB allies.

obscured when focusing solely on measures of centrality.

As noted above, roles have been seen as being identified within the blockmodeling tradition. They have been identified, primarily, through the links that vertices have to other vertices. In this sense, this is strictly structural. A second sense, but integrally connected to the first sense, is that this is also culturally defined, especially in well-defined contexts. One clear example is school systems with administrators, teachers and students who have clearly identified roles. We have absolutely no quarrel with this line of thinking. But in the context of the KB network considered here, it seems abundantly clear that there are units within KB network of allies that produce documents and statements designed to persuade allies in joining them while condemning opponents. They clearly have roles. Identifying them as authorities is critically important. But so too, is identifying hubs whose role, in this network, is to direct others to the important authorities. These roles are complementary and need to be examined separately. We acknowledge that this is expanding the notion of 'roles' but that this is a useful extension.

In Kleinberg's (1999) approach, each vertex, i , has two non-negative weights assigned to them. Let x_i be the authority weight for vertex i and let y_i be the hub weight for i . HITS starts with each i having arbitrarily assigned nonzero values. Let A denote the adjacency matrix of the directed network and A^T its transpose. The two sets of weights are updated by successive iterations. Each x_k is updated by the operation $(A^T A) x^{(k-1)}$. Similarly, y_k is updated by $(A A^T) y^{(k-1)}$ where k denotes successive iterations.

This introduces another consideration as whether the approach we have adopted is preferable to computing the eigenvalues of $A^T A$ or $A A^T$. We use an iterative algorithm (updating) for computing hubs and authorities since it is *much faster* than computing these eigenvectors. It works for large networks as well. But it is known that iterative algorithm gives accurate results already with low number of iterations. In case of this Koch Brothers network, only 17 iterations are needed for 6 valid decimal places of Hubs and Authorities scores.

Fig. 2 shows a box plot of the authority scores for units in the network identified by the VOSON web crawler. Clearly, this distribution is highly skewed. Without surprise, some authorities are far more important than others – this is to be expected as the money flows supporting this network vary greatly. The units deemed more important for promoting 'the messages' receive more resources. Exactly the same holds for the



Fig. 3. The Cato Institute as an authority.

box plot of hub scores. Our primary attention is focused on the *most important* authorities while also considering the important hubs in this directed network. While we acknowledge that identifying communities as densely connected subgraphs is an important problem, this is not our focus here as it features roles, as modified by our above description, rather than communities of authorities that do not identify roles.

4. Hubs and authorities in the Koch Brothers network

We focus our narrative attention in this section on some of the top ten authorities as identified by the HITS algorithm as implemented in Pajek (Batagelj and Mrvar, 1998). However, for reasons of space we consider only a few of them here.

The top ten authorities are the Cato Institute (a libertarian think tank headquartered in Washington, D.C) and funded heavily by the Koch brothers. Indeed, Charles Koch turned his private foundation into the Cato Institute. It supports total economic freedom for the likes of the Koch brothers; the Reason Foundation which has also received funds from by the KBs. It promotes outsourcing public services to private corporations within a program advocating shrinkage of the national government (MacLean, 2017: 143); the Heritage Foundation, founded by Joseph Coors, stressing, among other things, solutions based solely on the principles of free enterprise, limited government, individual freedom, traditional American values and a strong national defense.

Some of its funding comes from Koch Family Foundations; the Foundation for Economic Freedom (FEE) seeking to ‘spare’ private enterprises from ‘governmental intrusion’; the Independent Institute (following the generic von Mises approach³ for protecting private enterprise and property rights); the Heartland Institute, founded in 1973, is an organization promoting climate change denial, along with obstructing all efforts for protecting the environment. It was founded in 1984 and is a part of the second wave of conservative mobilization (Skocpol and Hertel-Fernandez, 2016); the Mercatus Center (also a heavily funded unit by the KBs at George Mason University); the Foundation for Individual Rights in Education (FIRE) devoted to expunging the alleged liberal influence in academia.

Fig. 3 shows the links to the Cato Institute as an authority. The structure is quite simple. Every unit shown on the right is a known ally of the KBs. All point to the Cato Institute as an authority. However, there are three reciprocated links, shown in solid black lines, which could be viewed as unusual. But all of them are programs within the Cato Institute. There is another link to Human Progress from the Cato institute. However, it is another one if its projects. We have noted that many of the larger units in the KB network are umbrella outfits containing multiple units with coordinated agendas supporting the broader libertarian agenda of the KBs. Thinking of them as separate ‘independent’ units is nonsensical. They are joined in an extensive network of KB allies.

The second authority is the Mercatus Center shown in Fig. 4. As

³ From <https://mises.org/profile/ludwig-von-mises>, a clear statement of his approach is made evident. He claimed that “the expansion of free markets, the division of labor, and private capital investment is the only possible path to the prosperity and flourishing of the human race.” It is not surprising that this perspective fits well to interests of the KBs and many conservatives.

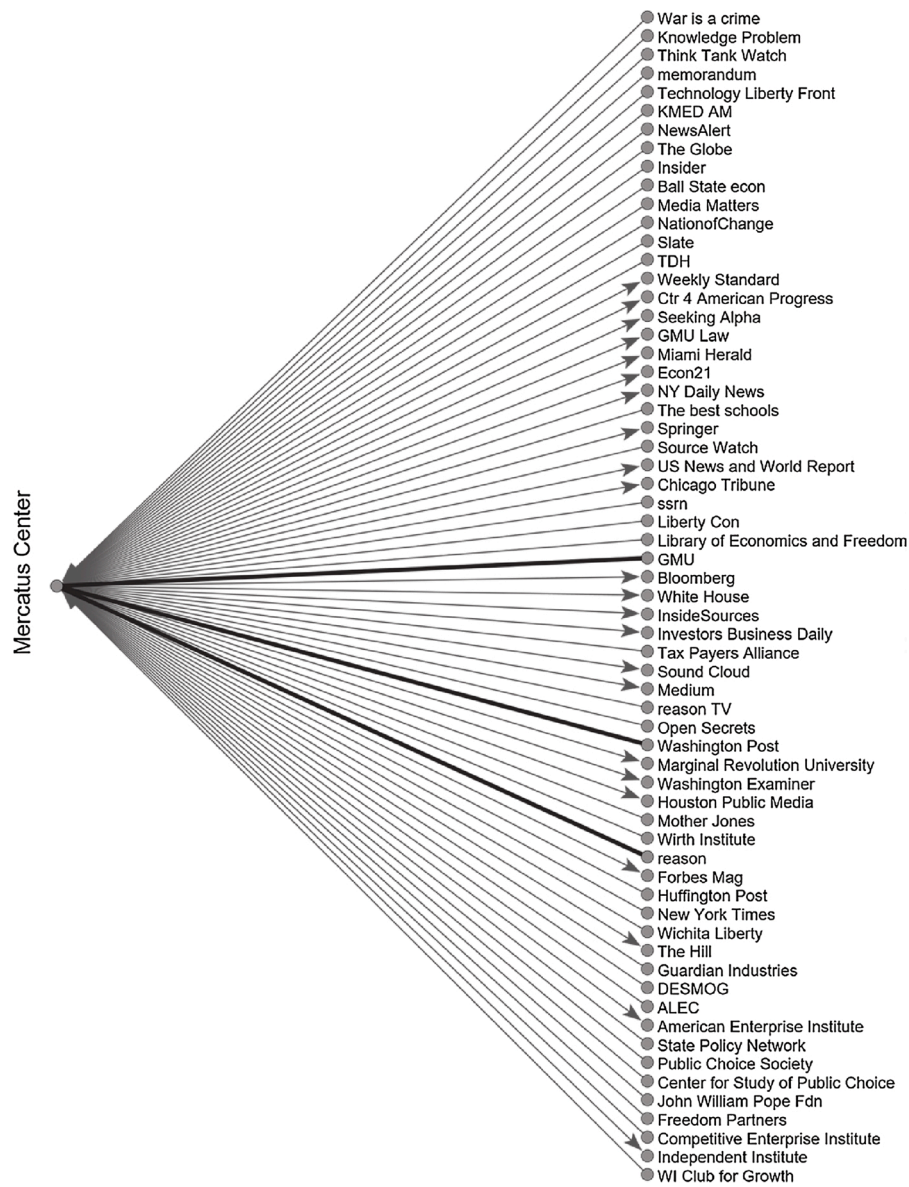


Fig. 4. The Mercatus Center as an authority.

noted above, it is a core unit at the George Mason University where two programs have been, in essence, taken over by the Koch Brothers through their massive financial investments in them. One is the Antonin Scalia Law School with the other being its Economics Department. They each contain many programs devoted to promoting the libertarian agenda of their funders. We note that most of the units listed in the right do belong to the KB network – but not all. Most of the 24 citations from the Mercatus Center, something thought to be unusual for authorities, are to units fully involved in the KB network of allies. But others are not. We think that the apparent divide between hubs and authorities may be far more complex than has been realized. We speculate that academics in the two units funded heavily by the KBs are alert to publications in the

general literature and will seek to rebut them in economic and legal outlets sympathetic to their views.

The third authority we display is the Reason Foundation as shown in Fig. 5. Again, many hubs point to it. As we understand them, hubs and authorities are thought to play *very different* roles in directed networks. If so, this viewpoint may need to be expanded to reflect a more complex view of reality given that the Reason Foundation, also funded very heavily by the Koch brothers, is also a very prominent hub. This suggests this unit is more *structurally important* for promoting the KB interests as it plays two roles. It provides useful ‘knowledge’ for many KB allies while pointing to other authorities having value in this network.

Even so, it is more important to consider authorities in conjunction,

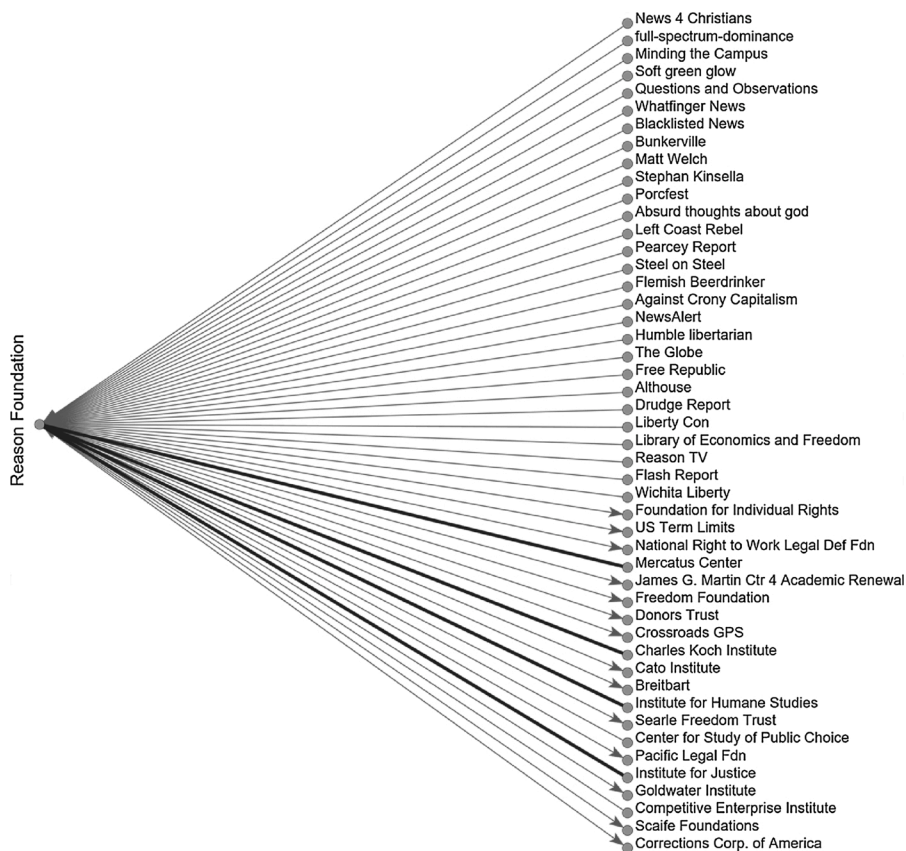


Fig. 5. The Reason Foundation as an authority.

given their huge potential for coordinated influence on other actors in this network rather than view them as separate entities. Fig. 6 displays part of the KB network for which the top ten authorities are placed in a small central circle. Without surprise, there are links between them given their shared interests and coordinated actions. There are many links between these authorities and their allies. While this figure is not that large, it is merely one part of a much larger network. Even so, it shows the reach and coordination of a network seeking to control the US economy and political discourse to serve the interests of the KBs.

Without surprise, the network structure of the hubs in the KB network is very similar to those of the authorities. There is little value in reporting them here even though its distribution is slightly less skewed. However, as with authorities, it is important to consider them in conjunction. Fig. 7 provides the relevant image. The units with the top hubs scores are: The Reason Foundation (described above); its TV unit devoted to catering to followers of its vision with core messages being displayed in visual formats while attacking enemies; Wichita Liberty (a known KB ally); ARRA News Service (a very far-right news venue devoted to promoting far-right views and attacking many perceived opponents); the State Policy Network⁴ (a non-profit outfit, which is an umbrella organization supporting the conservative and liberation agendas at the state level Mayer (2017: 272). It promotes laws constructed in conjunction with the American Legislative Exchange Council⁵ (McLean (2017: 210)) to promote copy-cat laws obstructing

democratic laws at the state level. The John William Pope Foundation (funding many right-wing causes in North Carolina); Forbes Magazine discussing free-market issues; The Globe (a Canadian news outlet); News Alert (promoting, among other things, libertarianism, property rights, the struggle against the ever-expanding 14th Amendment, governmental corruption, the struggle against socialism and MAGA; and the Free Republic (another very far-right venue). In the main, these strong hubs point to authorities promoting the KB agenda. We acknowledge the arguments of Soldano et al. (2017) regarding the study of combined hub communities and authority communities. But these are separate issues. At some point, we hope that they will be combined.

5. The core interests of the KB allies

In a separate study, we constructed a list of important keywords describing their interests in detail. The list of keywords in alphabetical order is: against political correctness, American heritage and traditional values, anti-affirmative action, racism, anti-feminist and hostility to women, anti-immigrant, anti-labor action and opposing minimum wage laws, arbitration enforcement, attacking Social Security and the social safety net, attacking liberal bias in academia, blocking Obamacare and subsequent healthcare reform, blocking environmental regulation, Christian faith, climate change denial, conservative, criminal justice reform, economic growth, evangelical, free markets, grass roots, gun rights, heritage, Islamophobia, jerrymandering and redistricting, less governmental regulation, libertarian, liberty, limited government, mainstream media bias, monitoring and restricting voting, obstructing consumer protection, opposing abortion, opposing campaign finance

⁴ This unit is a prominent authority ranking fourteenth among all authorities.

⁵ This unit is also a prominent hub in the eighteenth place among hubs.

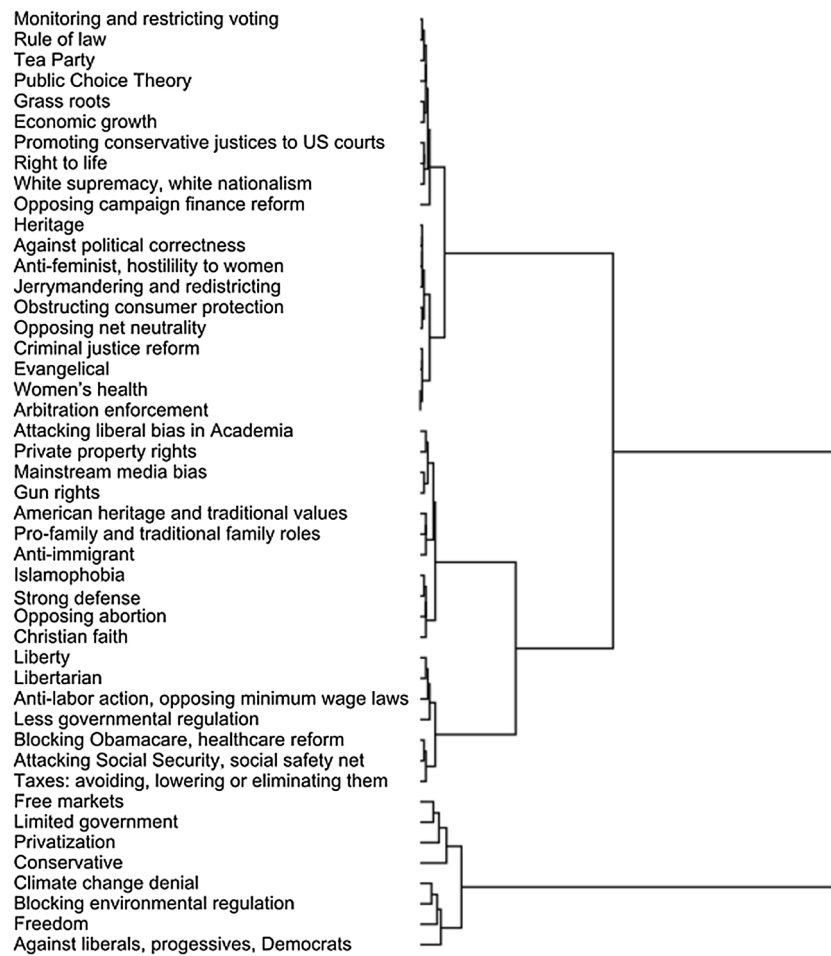


Fig. 8. The dendrogram for the clustering of the core interests of the KB allies.

that others will find this approach for their studies of directed networks and the roles of units within them.

References

Ackland, Robert, 2018. Virtual Observatory for the Study of Online Networks (VOSON) Software for Collecting and Analysing Online Networks (2004-2018). <https://researchers.anu.edu.au/publications/140076>.

Bardon, Adrian, 2019. *The Truth About Denial: Bias and Self-Deception in Science, Politics, and Religion*. Oxford University Press, Oxford.

Batagelj, Vladimir, Mrvar, Andrej, 1998. Pajek - A Program for Large Network Analysis. *Connections* 21 (2), 47–57.

Begley, Sharon, 2007. August 13. The truth about denial, vol. 150. *Newsweek*, pp. 20–29.

Brownlee, Jamie., 2005. *Ruling Canada: Corporate Cohesion and Democracy*. Fernwood, Halifax.

Brulle, Robert J., Aronczyk, Melissa, Carmichael, Jason, 2016. Corporate promotion and climate change: an analysis of key variables affecting advertising spending by major oil companies, 1986-2015. <https://doi.org/10.1007/s10584-019-02582-8>.

Carroll, William, Graham, Nicholas, Lang, Michael K., Yunker, Zoe, 2018. The Corporate Elite and the Architecture of Climate Change Denial: A Network Analysis of Carbon Capital's Reach into Civil Society. *Canadian Review of Sociology* 55 (3), 425–450.

Doreian, P., Mrvar, A., 2020. The Koch Brothers and their climate change denial social movement. In: Tindall, D., Stoddart, M.C.J., Dunlap, R.E. (Eds.), *Handbook of Anti-Environmentalism*. Edward Elgar Publishing.

Dunlap, Riley E., McCright, Aaron M., Yorosh, Jerrod H., 2016. The Political Divide on Climate Change: Partisan Polarization Widens in the U.S. *Environment* 58 (5), 4–23.

Everett, Martin G., Borgatti, Stephen P., 2013. The dual-projection approach for two-mode networks. *Social Networks* 35, 178–203.

Everett, Martin G., Borgatti, Stephen P., 2020. *Partitioning multi-mode networks*. Chapter 9 in.

Elsasser, Shaun W., Dunlap, Riley E., 2013. *Leading Voices in the Denier Choir: Conservative Columnist's Dismissal of Global Warming and Denigration of Climate Science*. *American Behavioral Scientist* 57 (6), 754–776.

Farrall, Justin, 2016. Corporate funding and ideological polarization about climate change. *Proceedings of the National Academy of Science, U.S.A.* 113 (1), 92–97.

Freeman, Linton C., 1979. Centrality in social networks: Conceptual clarification". *Social Networks* 1 (3), 215–239.

Greenpeace, 2014. *KOCH POLLUTION ON CAMPUS: Academic Freedom Under Assault from Charles Koch's \$50 million Campaign to Infiltrate Higher Education*.

Hummon, Norman P., Doreian, P., Freeman, Linton C., 1990. *Analyzing the Structure of the Centrality-Productivity Literature*. *Knowledge* 11 (4), 460–481. <https://www.greenpeace.org/usa/global-warming/climate-deniers/koch-pollution-on-campus/>.

Kleinberg, Jon, 1999. Authoritative sources in a hyperlinked environment. *Journal of the Association for Computer Machinery* 46 (5), 604–632.

Intergovernmental Panel on Climate Change, 2001. *IPCC Third Assessment Report: Contributions of IPCC Working Groups*. IPCC, Geneva, Switzerland.

Krugman, Paul, 2019. *The Party that Ruined the Planet: Republican climate change denial is even scarier than Trumpism*. New York Times. Dec. 12, 2019.

Layzer Judith, A., 2012. *Open for Business: Conservatives' Opposition to Environmental Regulation*. MIT Press, Cambridge, MA. USA.

- Leonard, Christopher, 2019a. David Koch was the Ultimate Climate Change Denier. *New York Times*. Aug 13, 2019.
- Leonard, Christopher, 2019b. *Kochland: The Secret History of Koch Industries and Corporate Power in America*. Simon & Schuster, New York.
- MacLean, Nancy, 2017. *Democracy in Chains: The Deep History of the Radical Right's Stealth Plan for America*. Penguin Random House, New York.
- Mayer, Jane, 2017. *Dark Money: The Hidden History of the Billionaires Behind the Radical Right*. Anchor Books, New York.
- McCright, Aaron M., Dunlap, Riley E., 2003. Defeating Kyoto: The Conservative Movement's Impact on U.S. Climate Change Policy. *Social Problems* 50 (3), 348–373.
- National Research Council, 2001. *Climate Change Science*. National Academy Press, Washington, DC.
- Oreskes, Naomi, Conway, Erik M., 2010. *Merchants of Doubt: How a Handful of scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. Bloomsbury, New York.
- Supran, Geoffrey, Oreskes, Naomi, 2017. Assessing ExxonMobil's climate change communications (1977-2014). *Environmental Research Letters* 12, 1–18.
- Skocpol, Theda, Hertel-Fernandez, Alexander, 2016. The Koch Network and the Rightward Shift in U.S. Politics. In: Presented at the Annual Meeting of the Midwest Political Science Association. Chicago, IL, 2016.
- Soldano, Henry, Santini, Guillaume, Bouthinon, Lazega, Emmanuel, 2017. Hub-Authority Scores and Attributed Directed Network Mining. *IEEE International Conference on Tool with Artificial Intelligence*.