

Who Owns the Means of Production? *Uneven Geographies of Financialization*

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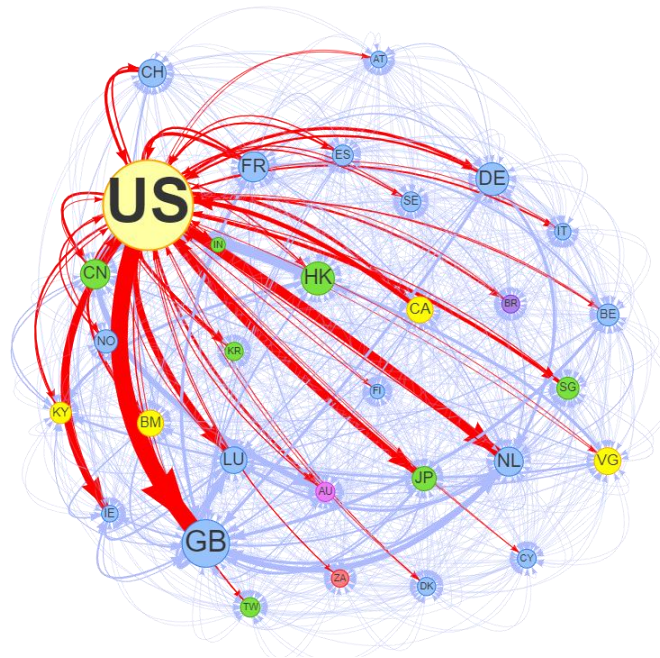


Fig.1. A global corporate ownership network

Abstract— Financialization is a term used to broadly describe the rising importance of finance in the global economy and society at large. In the United States, one of the central characteristics of financialization has been the rise of financiers as the largest shareholders of American firms whereas the share of US capital directly owned and managed by US financial firms has grown from 3 percent in 1945 to at least 62 percent in 2018. Through a series of interactive visualizations developed in *R* using *shiny*, this project empirically explores the question of who owns the means of production in the United States and world at large. By examining an extensive global corporate ownership dataset (provided by the Orbis database), featuring 6.4 million ownership ties of 2.9 million firms around world that add up to \$114.4 trillion in owned capital, I visualize the exceeding influence exerted by US financial firms in the global corporate network and illustrate the extent to which financialization as a new regime of property relations has been a US-only phenomenon. The shiny app can be accessed here: <https://albinagib.shinyapps.io/finance/>

Index Terms—Corporate networks, financialization, geographical analysis, advanced producer services, social network analysis.

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1 INTRODUCTION AND BACKGROUND

Financialization is a term used to broadly describe the rising importance of finance in the global economy and society at large (Epstein, 2005). In the United States, one of the primary

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characteristics of the post-1980 financial turn has been the rising share of corporate profits accrued by the US financial sector (Krippner, 2005). This led to the conceptualization of financialization as a new regime of accumulation where profits increasingly accrue through financial rather than productive channels (ibid). By examining the primary profit-generating activities performed by the US financial sector as a whole and the composition of its income sources and assets, in my Master's thesis (Gibadullina, 2020) I demonstrated that the increased profitability of US finance can largely be

attributed to a transition from credit intermediation (i.e. lending) to the management and ownership of capital. By showing how the share of US capital directly owned and managed by US financial firms has grown from 3 percent in 1945 to at least 62 percent in 2018, I proposed that financialization in the United States should be primarily understood as a new regime of property relations, in which the class of financiers have established themselves as the direct owners of the means of production, having at their discretion ultimate control over the US economy by way of collectively holding the most shares by far in American corporations.

This analysis project extends on the research conducted during my Master's by examining two main questions. First, I want to explore the extent to which financiers have established themselves as the new, dominant owners of capital in other countries or whether financialization as a new regime of property relations has been a US-only phenomenon. Secondly, I want to visualize the global dominance of American financial firms in this global corporate ownership network. The empirical analysis for this project will involve examining 6.4 million ownership ties of 2.9 million firms around world from 2018 that add up to \$114.4 trillion in owned equity (this dataset was obtained through the Orbis database). This project aims to expose a staggering consolidation of power obtained by the US financial sector through a series of static and interactive visualizations and advance our understanding of the influence exerted by American finance in the global economy, contributing to the literatures of financialization, corporate networks, and geographies of advanced producer services. Visualizations were developed using R (e.g. packages for network visualization *visNetwork* and *igraph*, a data visualization package *ggplot2*, an interactive graphing library *plotly*, a data manipulation package *dplyr*, a cartographical package *maps*, a package for creating chord diagrams *chorddiag*, and a package for developing web applications *shiny*). Developed visualizations and analysis will be incorporated in an academic paper that will be submitted to the *Annals of the American Association of Geographers*. The end-users for this project are academics (particularly political economists and economic geographers), as well as journalists who are interested in questions of financialization and globalization.

Part 1: As much of our current understanding of financialization processes has been shaped by the scholarship emanating from either the United States or the United Kingdom, there is a notable lack of comparative studies in this scholarship.¹ The first objective of this project is to develop national estimates of the extent to which corporate ownership and corporate control have become financialized within each nation by measuring the share of national capital that is owned and controlled by domestic financial firms. This

¹ A notable exception is a study by Karkowski et al. (2020) that developed a cross-country analysis of financialization processes (and their distinct characteristics) for seventeen OECD countries.

will be accomplished by aggregating corporate ownership ties between individual firms at the level of national industries (i.e. industries within each country).

Part 2: My second goal is to illustrate the global dominance of American financial firms in this corporate ownership network. As shown in the analysis of the global network of corporate control conducted by Vitali et al. (2011), the corporate ownership structure of 43,000 multinational corporations is highly concentrated with forty-five predominately British and American financial firms exerting control over a third of the (mostly non-financial) multinational corporations. Relying on my Orbis dataset, I will develop spatially sensitive network visualizations that will show the transnational interdependencies of the global corporate network and the patterns of extraction and unequal exchange relations that permeate it.

This project was a couple of years in the making. Having read the very influential and highly cited study by Vitali et al. (2011) as an undergraduate finance major, I wanted to further understand the influence that financial firms had in these networks and the power and control they were able to exert through their direct and indirect corporate ownership ties. Having completed my Master's degree in a Geography department, I wanted to combine a finance-centric data exploration with a geographically sensitive analysis of the global corporate network and its spatiality. To complete this project, I have received methodological training in social network analysis through the summer schools offered by the University of Oxford and the University of Manchester. Through coursework, I have also gained a broad and relatively in-depth understanding of exploratory data analysis and statistical inference, as well as some training in cartographical methods. I acquired my corporate ownership dataset in March 2020.

2 RELATED WORK

2.1 Global Corporate Networks and Geographies of Financialization

Following the 2008 global financial crisis and the much publicized collapse of Lehman Brothers that exposed how one of the largest US investment banks operated an opaque network of over a hundred highly specialized shell companies and subsidiaries in jurisdictions with little to no financial regulations (Fernandez and Wigger, 2017), interest in understanding the structure and operations of global corporate networks has grown exponentially among heterodox economics scholars. The literature on corporate networks has been proliferating over the past decade with research examining everything from the uses of Special Purpose Vehicles (SPV) for off-balance sheet financing (e.g. Haberly and Wojcik, 2017a; Lysandrou and Nesvetailova, 2015) to the studies of offshore tax havens (e.g. Aalbers, 2017; Fichtner, 2016; Zucman, 2015). Geographers played a particularly central role in these conversations, emphasizing how corporations use space to take advantage of the fragmented regulatory and tax landscape, and in the process of doing so

end up both undermining the authority of their respective nation-states while also directly contributing to the highly unequal and uneven patterns of economic exchange.

Concurrently with the rising interest in corporate networks, the 2008 crisis has also contributed to the proliferation of research projects on financialization. While this literature covers a broad range of topics related to the increasing role played by finance in our contemporary world, French et al. (2011) have identified three main schools of thought: (1) macro-economic literature in the tradition of the French Regulation Theory that sees financialization as a new regime of accumulation which followed the Fordist regime of mass consumption/production, (2) institutional scholarship that emphasizes the rise of the shareholder-value and the consequent financialization of non-financial corporations, and (3) and the socio-cultural literature that examines the financialization of every-day life. My project aims to contribute to this literature by highlighting how the underlying economic transformation that directly contributed to these three distinct phenomena in the United States has been the rise of financiers as the new owners of capital.

2.2 Visualizing Corporate Networks

Existing analyses of corporate networks can be separated into three primary groups based on data types: analyses of corporate board interlock networks, analyses of world city networks, and analyses of corporate ownership networks. The literature on board interlock networks has originated in economic sociology in the 1980s (e.g. Mizuchi, 1983; Mizuchi, 1996) and at a high level examines how economic elites are connected to each other through shared (i.e. interlocking) corporate board memberships with most of the research focusing on links between various clusters of national elites. A notable exception to the national analyses of board interlocks was William Carroll's book "The making of a transnational capitalist class" (2013). On the other hand, the literature on world city networks has originated in economic geography and urban studies in the early 2000s (e.g. Beaverstock et al. 2000; Taylor, 2003) when researchers began to examine the transnationalization of multi-national corporations by exploring the locations of offices of these corporations and their global interconnectedness. One of the results of world city analyses has been the production of city rankings based on their position in the world city network. Finally, the literature on corporate ownership networks has sprung up in the late 2000s in the interdisciplinary space at the intersection of political science, computer science, and geography (e.g. Vitali et al., 2011; Fichtner et al., 2017, Haberly and Wojcik, 2017b). While there were earlier shareholder-centric analyses dating back to the 1980s in economics, analyses of corporate ownership data through a network lens have not been completed till very recently.

One of the implications of this has been that the literature on corporate ownership networks in still its earlier stages and has three gaps that I will be directly addressing in my project. First, the initial analyses of corporate ownership data were largely aspatial (e.g. Vitali et al., 2011). My visualizations

will emphasize the spatial embeddedness of corporate ownership ties by both examining national and transnational ownership ties and seeing how they vary geographically across different industries. Secondly, most of the current analyses provide broader generalizations of corporate ownership dynamics based on analyses of relatively small samples (e.g. Haberly and Wojcik, 2017b examined shareholders of 250 largest multinational firms). My project will be the first systematic attempt to examine almost all the available global data on corporate ownership ties. Finally, there has not been sufficient attention paid to the power exerted by financial firms in these networks. My analysis will also provide the first systematic investigation of the extent to which finance in each individual country owns and controls the domestic economy across various sectors.

3 DATA AND TASK ABSTRACTION

3.1 Domain

This project aims to bridge the methodological gap between the literatures on financialization (e.g. Krippner, 2011, Boyer, 2000), corporate networks (e.g. Fichtner, 2016; Garcia-Bernardo et al., 2017; Peetz and Murray, 2012) and geographies of advanced producer services (e.g. Sassen, 1991; Taylor, 2003) by moving beyond the nation space as a container of financial activity in the post-Bretton Woods era and presenting financialization as a globally interconnected, variegated, and path dependent process happening within and between nation states and developed through the mutual entanglements in the global circuits of capital.

3.2 Data and Task Abstractions

3.2.1 Database Description

I will be relying on the Orbis database, provided by Bureau van Dijk, which offers the most comprehensive co-ownership dataset of firms (both public and private) and state enterprises available to date, covering over 375 million entities around the world, and providing detailed financial and geographical information for each firm and quantifiable ownership ties between them. Although the data coverage is uneven with significantly less information available on firms located in the Global South (see Garcia-Bernardo and Takes, 2018), for each firm Orbis tries to provide basic information on firm's location and industry, financial information from firm's balance-sheets and income statements, as well as data on corporate ownership ties by listing everyone who owns a particular firm and everyone who a particular firm owns.

3.2.2 Filtering Data to Create a Dataset

While Orbis advertises that it has some information on 375 million firms, in 2018 only 8.9 million firms had available information on total assets (a metric relevant to estimating the value of equity and quantifying each ownership tie in dollar terms). As often the case with financial data, the distribution of the "total assets" variable was highly skewed with a small number of firms accounting for a large share of total assets. I filtered my sample of firms based on the total assets variable,

Table 1. Available data attributes

Data attributes	Type of data	Core set of 2.9 million firms	Set of 6.4 million shareholders
Basic information			
Name	Identifier variable	2.9m unique observations	6.4m unique observations
Orbis ID	Identifier variable		
Country	Categorical - Nominal	202 levels	
Consolidation Type	Categorical - Nominal	6 levels	
NACE Industry Classification	Categorical - Nominal	272 levels	
Financial information			
Total Assets 2018	Quantitative - Interval	Range from \$1.0 million to \$5.4 trillion	Range from \$0.001 million to \$5.4 trillion
Total Equity 2018	Quantitative - Interval	Range from \$0.001 million to \$1.2 trillion	
Operating Revenue 2018	Quantitative - Interval	Range from -\$14.8 billion to \$514 billion	
Net Income 2018	Quantitative - Interval	Range from -\$36.7 billion to \$111 billion	
Ownership information			
Name of Shareholder	Identifier variable	6.4m unique observations	N.A.
Orbis ID	Identifier variable		N.A.
Direct Ownership Tie 2018	Quantitative - Ratio	Range from 0% to 100%	N.A.
Direct Ownership Tie Latest	Quantitative - Ratio	Range from 0% to 100%	N.A.
Total Ownership Tie 2018	Quantitative - Ratio	Range from 0% to 100%	N.A.
Total Ownership Tie Latest	Quantitative - Ratio	Range from 0% to 100%	N.A.

collecting information on all firms with at least \$1 million in total assets in 2018. My dataset features 2.9 million unique firms located in 202 countries. I estimate that cumulatively these 2.9 million firms account for 99% of total assets in the Orbis database. For each firm, I collected basic and financial information, as well as information on all of its shareholders (and their respective basic and financial information). My core list of 2.9 million firms has 6.4 million unique shareholders, featuring 6.7 million weighted ownership ties between them, totalling \$114.4 trillion in owned equity.²

² For comparison, at the end of 2018, the market capitalization of all publicly traded domestic firm was \$68.65 trillion (World Bank, 2020). Because Orbis features both publicly traded and privately owned firms, the total value of owned

Information on the available data attributes can be seen in Table 1.

3.2.3 Deriving New Data Attributes

In order to conduct my analysis, I had to derive three new variables:

Sector:

- NACE industrial classification includes 272 possible options
- My derived sector classifications include only 20 levels (one of them is finance)

Finance:

- Finance = “Yes” if NACE Industry Classification \geq 6400 and $<$ 6700, Otherwise “No”

Ownership Tie (in \$):

- Ownership Tie 2018 = Max {Direct Ownership Tie 2018, Total Ownership Tie 2018}
- If Ownership Tie 2018 is missing value, Ownership Tie 2018 = Max {Direct Ownership Tie Latest, Total Ownership Tie Latest}
- If Sum(Ownership Tie 2018) for a firm $>$ 100%, proportionally decrease the value of each ownership tie: Ownership Tie 2018 = Ownership Tie 2018/Sum(Ownership Tie 2018) (this ensures that total ownership of any firm does not add up to more than 100%)
- Ownership Tie 2018 \$ = Total Equity 2018 * Ownership Tie 2018

My derived dataset is composed of (1) the node attributes file where each node is represented by a unique firm, and each node has firm-specific information: Sector, Finance, and Country, and (2) the edge list file where edge weights measure the value of equity (in \$) of each unique firm (from the core list 2.9 million firms) owned by each unique shareholder (from the list of 6.4m shareholders). Information on the derived data attributes can be seen in Table 2.

3.2.4 Aggregating Data at the Level of Countries and Industries

Given that it is next to impossible to properly visualize 6.6 million nodes with 6.7 million edges, I have aggregated information in the derived dataset (described in Table 2) at the level of countries and sectors (see Table 3). This aggregation enables me to visualize the dominance of the domestic financial sector within each country as well as visualize the power of the US financial sector in the global corporate

equity provided by Orbis is much higher than the market capitalization value. Additionally, since Orbis provides information on both consolidated and unconsolidated entities, adding the value of all known ownership ties is likely to be double-counting total equity of consolidated firms with many subsidiaries.

network. Additional edge attribute identifies whether the ownership ties are between sectors within the same country (i.e. domestic) or different countries (international):

Edge Attribute (Domestic or International):

- If Country=Shareholder Country, Domestic
- If Country≠Shareholder Country, International

Table 2. Derived data attributes at the level of firms

Data attributes	Type of data	Description
Node Attributes		
Name	Identifier Variable	6.6m unique observations
Orbis ID	Identifier Variable	6.6m unique observations
Sector	Categorical - Nominal	20 levels
Finance	Categorical - Nominal	2 levels: Yes or No
Country	Categorical - Nominal	202 levels
Edge List		
Source: Shareholder Orbis ID	Identifier Variable	6.4m unique observations
Target: Firm Orbis ID	Identifier Variable	2.9m unique observations
Weight: Ownership Tie 2018 \$	Quantitative - Interval	Range from \$0.001m to \$1.2tril
Edge Type	Categorical - Nominal	1 level: Directed

Table 3. Derived data attributes at the level of countries and industries

Data attributes	Type of data	Description
Node Attributes		
Country Industry	Identifier Variable	2490 unique observations
Country	Categorical – Nominal	202 levels
Sector	Categorical – Nominal	20 levels
Finance	Categorical – Nominal	2 levels: Yes or No
Edge List		
Source: Country Industry	Identifier Variable	2144 unique observations
Target: Country Industry	Identifier Variable	2040 unique observations
Edge Attribute: Domestic or International	Categorical – Nominal	2 levels: Domestic or International
Weight: Ownership Tie 2018 \$	Quantitative – Interval	Range from \$0.001m to \$4.5tril
Edge Type	Categorical – Nominal	1 level: Directed

3.2.5 Deriving New Data Attributes

For each country, I will estimate the national rate of financialization of corporate ownership by measuring the share of national capital (i.e. total equity) owned by the domestic financial sector in a particular economic sector.

National rate of financialization of corporate ownership for Country *i* in Sector *j*:

$$\frac{\sum_{Country\ i, Sector\ j, owned\ by\ finance} Ownership\ Tie\ 2018\ \$}{\sum_{Country\ i, Sector\ j, All\ sectors} Ownership\ Tie\ 2018\ \$}$$

Given the complex corporate structures of multinational corporations today, I need to be able to differentiate between ownership ties within the same corporation vs. ownership between different corporations. I plan on accounting for the intra-firm subsidiary connections by excluding ownership ties belonging to holding companies. I will recalculate all the rates of financialization with these corrections in mind.

3.2.6 Selecting Appropriate Design Idioms

The selected idioms for the national rates of financialization of corporate ownership need to:

- Visualize the differences in the financialization rates between countries;
- Visualize the corporate ownership structure at the level of industries within each country

The selected idioms for the global rates of financialization of corporate ownership need to:

- Visualize the corporate ownership connections/ties between countries;
- Visualize the dominance of the US financial sector in the global corporate network

4 METHODS AND TOOLS

Visualizations were developed using various packages for data visualization and manipulation in *R*. The interactivity was added using a package for creating web applications *shiny*. The project webpage was developed using an extension of the *shiny* package called *shinydashboard*. *R* was chosen because of its open-source code and ability to easily share and replicate my analysis, a great variety of available libraries, and a significant community of users that work on resolving various issues that arise in the process of data visualization and analysis. The following *R* packages were used: network visualization packages *visNetwork* and *igraph*, a package producing interactive chord diagrams *chorrdiag*, a data visualization package *ggplot2* (including *scales*), an interactive graphing library *plotly*, a cartographic package *maps*, data manipulation packages *dplyr*, *tidyr* and *forcats*, a package *DT* providing an *R* interface to the JavaScript Library 'DataTables', and a package containing color palettes *RColorBrewer*. For this project, I will be developing six distinct types of visualizations (shown below).

Proposed visualization idiom # 1: Interactive bar charts

Goal: Visualize the differences in the financialization rates across different economic sectors between a selected number of countries

Marks:

- Lines represent rates of financial ownership over equity in each industry for a given country

Channels:

- Vertical and horizontal positions of row and column facets represent different countries (listed in an alphabetical order, 202 levels)
- Horizontal length/height of bars represents share of financialization of capital ownership for a given sector in each country: value between 0% and 100%
- Vertical position within each facet represents different industries (20 levels)
- Color hue represents different industries (listed in an alphabetical order, 20 levels)

Interactions:

- Filter included countries from a list of all countries
- Filter countries based on continent
- Filter countries based on how much capital they own
- Filter industries from a list of all industries
- Change the number of columns in a visualization
- Change the height of the visualization
- Increase/decrease the font of y-axis
- Increase/decrease the font of the numeric label
- An option to reset all inputs

Solution: Generate an interactive bar chart using *ggplot2* and *facet_wrap* function, interactivity added using *shiny*

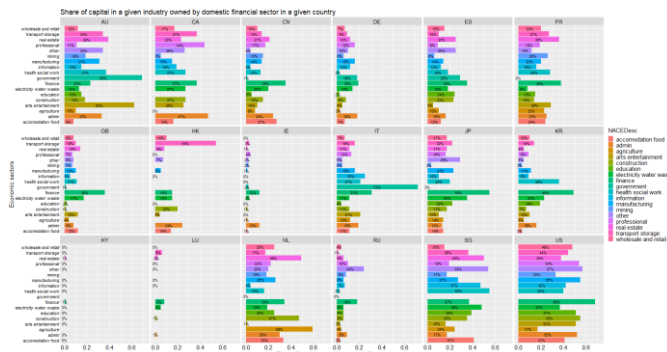


Fig. 1. An example of a static faceted bar chart of financialization of corporate ownership by country

Proposed visualization idiom # 2: Interactive scatterplots

Goal: Visualize the differences in the financialization rates of capital ownership between all selected countries

Marks:

- Points represent individual countries

Channels:

- Vertical position represents the share of capital in sector A (to be selected) owned by shareholder industry (to be selected, e.g. finance), value between 0% and 100%
- Horizontal position represents the share of capital in sector B (to be selected) owned by shareholder industry (to be selected, e.g. finance), value between 0% and 100%
- Size represents the value of total equity owned by firms located in that country: value between 0.1\$ mil and 15\$ trillion
- Colour represents different continents (7 levels)

Interactions:

- Filter included countries from a list of all countries
- Filter countries based on continent
- Filter countries based on how much capital they own
- Select industry of the shareholder
- Select sector A (plotted on the y-axis)
- Select sector B (plotted on the x-axis)
- Select whether the shareholder will be domestic, foreign, or global
- An option to reset all inputs

Solution: Generate an interactive scatterplot using *ggplot2* and *plotly* packages, interactivity added using *shiny*

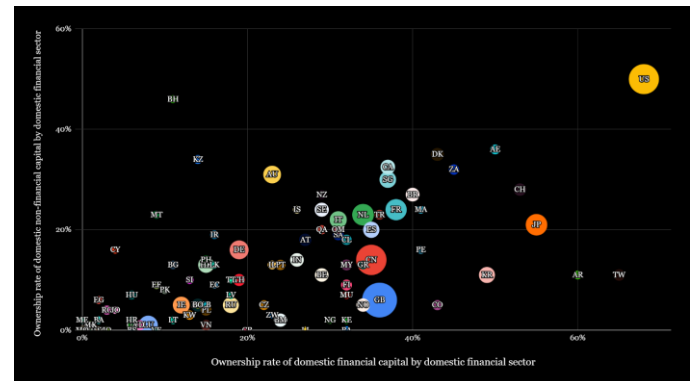


Fig. 2. An example of a static scatterplot of financialization of corporate ownership by country

Proposed visualization idiom # 3: Interactive world map

Goal: Visualize the differences in the financialization rates between countries using an interactive world map

Marks:

- Areas represent individual countries

Channels:

- Vertical position represents the vertical coordinates of the country
- Horizontal position represents the horizontal coordinates of the country

- Colour (sequential palette) represents rates of ownership by the selected shareholder in a selected main industry, value between 0% and 100%

Interactions:

- Select industry of the shareholder
- Select main industry
- Select whether the shareholder will be domestic, foreign, or global
- An option to reset all inputs

Solution: Generate an interactive world map using *map* package, interactivity added using *shiny*

Childlessness and Gender Gap Index Data

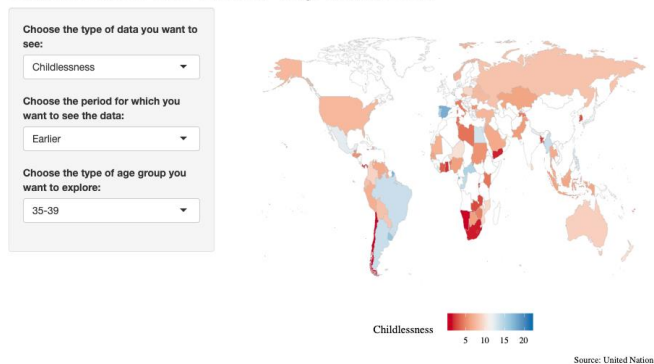


Fig. 3. An example of an interactive world map developed in *shiny* using *map* package³

Proposed visualization idiom # 4: Small multiple network visualizations

Goal: Visualize the differences of corporate ownership structures at the level of industries within each country for multiple countries simultaneously

Marks:

- Points represent industries (20 levels) within individual countries
- Lines represent ownership ties (in \$) between industries within each country

Channels:

- Vertical and horizontal positions at the macro-scale correspond to different countries
- Size represents the value of total equity owned by an industry in an individual country
- Colour represents different economic sectors (20 levels)

Interactions:

- Select multiple countries from a list of all countries
- Filter industries from a list of all industries
- Select whether to include self-loops
- Filter edges based on weight (capital ownership tie)
- An option to reset all inputs

Solution: Generate a small-multiple network visualization of corporate ownership structure using *visNetwork* package and *facet_wrap* command for the most significant countries (sort and filter based on the value of total equity of firms located in that country).

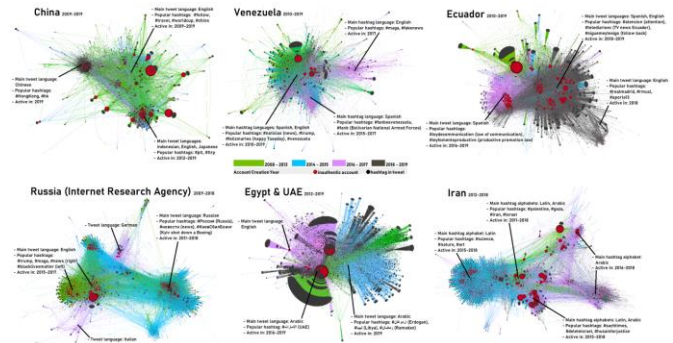


Fig. 4. An example of small multiple network⁴

Proposed visualization idiom # 5: Spatial network visualizations

Goal: Visualize the corporate ownership connections/ties between countries

Marks:

- Points represent countries (202 levels)
- Lines represent ownership ties (in \$) between countries

Channels:

- Vertical and horizontal positions represent centrality of countries in the network (determined by the)
- Size represents the value of total equity owned by an individual country
- Colour represents continents (7 levels)

Interactions:

- Filter included countries from a list of all countries
- Filter countries based on continent
- Filter countries based on how much capital they own (weighted degree)
- Select whether to include self-loops (both domestic and international ownership ties)
- Filter edges based on weight (capital ownership tie)
- An option to reset all inputs

³ Source: <https://rviews.rstudio.com/2019/10/09/building-interactive-world-maps-in-shiny/>

⁴ Source: <https://medium.com/swlh/watch-six-decade-long-disinformation-operations-unfold-in-six-minutes-5f69a7e75fb3>

Solution: Generate a network visualization using *visNetwork* package, interactivity added using *shiny*

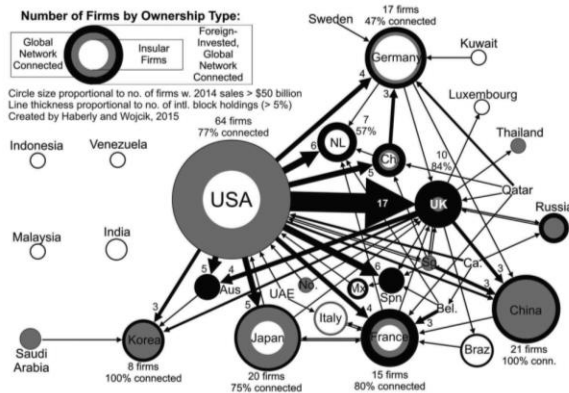


Fig. 5. An example of corporate ownership network between countries from Haberly and Wojcik (2017b)

Proposed visualization idiom # 6: Chord diagrams

Goal: Visualize the corporate ownership connections/ties either between countries or between industries within a country

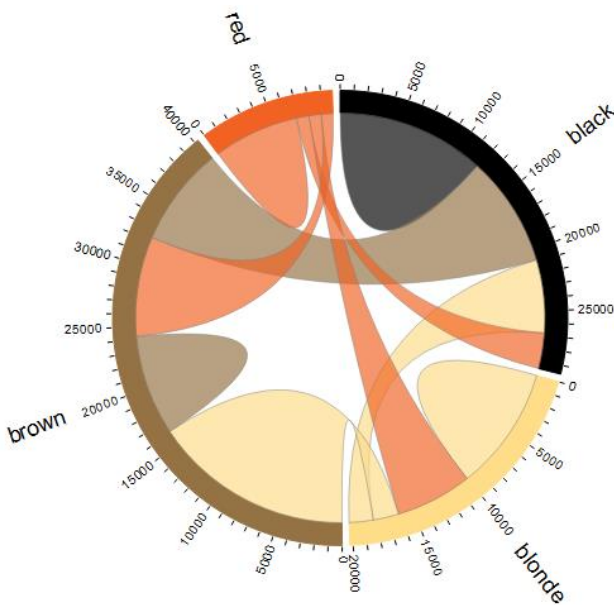


Fig. 6. An example of chord diagram produced by *chorddiag* package

Marks:

- Lines represent countries (202 levels) or industries (20 levels)
- Shapes represent ownership ties (in \$) between countries or industries

Channels:

- Vertical and horizontal positions represent the position of countries or industries sorted alphabetically
- Length represents the value of total equity owned by an individual country or industry
- Colour represents continents (7 levels) or industries (20 levels)

Interactions:

- Filter included countries from a list of all countries
- Filter countries based on continent
- Filter countries based on how much capital they own (weighted degree)
- Filter industries from a list of all industries
- Select whether to include self-loops
- Filter edges based on weight (capital ownership tie)
- An option to reset all inputs

Solution: Generate a network visualization using *chorddiag* package, interactivity added using *shiny*

5 ANALYSIS

The primary project outcome has been to produce a shiny app in a form of a dashboard that can be accessed using this link: <https://albinagib.shinyapps.io/finance/>. All the code for this app was written in R and will become publicly available after the project's publication. The dashboard structure allowed me to incorporate multiple (eleven) visualizations (each on a separate page) in one single place, allowing the end user to produce all the needed visualizations in a clear step-by-step process.

While the initial rationale for the project has been to produce a series of static visualizations for an academic paper, it became clear that the interactivity elements enabled by shiny has significantly expanded my ability to explore the data and highlight its various dynamics. As mentioned previously, the dataset I have been able to analyse using the Orbis database is the first (known to me) systematic attempt to extract almost all of the available data on corporate ownership ties around the world. The research novelty of this project thus partially comes from the uniqueness of the dataset itself and its exceptional geographical coverage.

Despite the many research opportunities offered by this particular dataset, one of the primary challenges of working with large transnational datasets has been the pressure to produce accurate representations of global and domestic patterns in a finite number of visualizations. Given the lack of comparative studies in the studies on financialization, it was important to ensure a significant geographical coverage in the analysis. The shiny dashboard addresses this challenge head-on by allowing the end user to easily produce unique visualizations for a combination of selected countries. This means that even though the final static visualizations might not be able to cover every place on Earth, one can produce relevant visualizations for any given country using the app.

Project overview:

When a user opens the shiny app, the first page provides an overview for the whole project. Here, one can find a short project description along with the project rationale, as well as a description of the dataset and methods used. The page also lists an overview of the visualizations one can produce using this app by including examples of eleven types of visualizations followed by a quick description of each. These visualizations can be accessed in an interactive form using the Sidebar located in the top left corner of the dashboard.

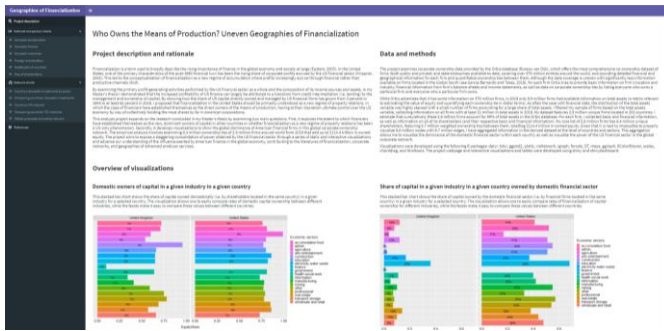


Fig. 7. An overview of the project description page

Visualization #1: Domestic shareholders

The first visualization is a faceted bar chart showing the share of capital owned domestically (i.e. by shareholders located in the same country) in a list of selected industries for a list of selected countries. The visualization allows one to easily compare the rates of domestic capital ownership between different industries, while the facets make it easy to compare these values between different countries. The colours correspond to economic sectors (listed alphabetically) and the countries are listed alphabetically in facets (see Figure 8). The bar chart was produced using *ggplot2* package.



Fig. 8. Share of capital in a given industry in a given country owned by domestic shareholders (default values).

The end user has an option not only specify the list of countries (by selecting the countries or continents they are interested in or by filtering countries based on how much capital they own), as well specify the industries using the select menu at the top of the page but they can also modify the visualization by changing the overall height of the graph,

the number of facet columns, and the font for the numeric labels and the y-axis labels. The ability to modify these aspects of the visualization become particularly helpful when the user wants to include a large number of countries within the same visualization (see Figure 9 for an example).



Fig. 9. An example of visualization #1 for 40 countries

The share of capital owned by domestic researchers can be used to identify various offshore tax and regulatory havens, as well as to examine the extent to which ownership of capital in a particular country has become internationalized. One can easily spot a number of well-known tax havens in Figure 9 by identifying countries with a significant share of capital owned by foreign investors, including Bermuda, Cayman Islands, Hong Kong, Ireland, and Netherlands. Providing the rates of domestic ownership by sector rather than at an aggregate level also provides a quick way to compare the rates of internationalization for various economic activities.

Visualization #2: Domestic finance shareholder

My second visualization is a faceted bar chart showing the share of capital owned by the domestic financial sector (i.e. by financial firms located in the same country) in a list of selected industries for a list of selected countries. The visualization allows one to easily compare the rates of financialization of capital ownership for different industries, while the facets make it easy to compare these values between different countries. As previously, the colours correspond to economic sectors (listed alphabetically) and the countries are listed alphabetically in facets (see Figure 10). The bar chart was produced using *ggplot2* package.



Fig. 10. Share of capital in a given industry in a given country owned by domestic financial sector

With an option to modify the height of the graph, the number of facet columns, as well as the font of labels, it is possible to include as many or as few countries as one would like. Figure 11 showing rates of financialization for 60 countries demonstrates how relatively easy it is to modify the view to fit your needs. One of the primary empirical findings offered by this visualization is to highlight the unusual rates of financialization of capital ownership present in the United States. While there is significant variation of financialization rates across different sectors for many countries, in the United States the domestic financial sector appears to be the majority shareholder of all the economic sectors except for agriculture. No other countries demonstrate such high levels of financialization consistently across all economic sectors. In case you wanted to go back to showing all the default values, there a button to reset all input values in the top right corner.



Fig. 11. An example of visualization #2 for 60 countries

Visualization #3: Domestic shareholders by sector

The third visualization is a faceted stacked bar chart breaking down domestic shareholders by different industries, showing the share of capital that each type of domestic industry owns in each sector in a given country. The visualization allows one to simultaneously compare the primary domestic shareholders within each industry and between countries. In contrast with the first two visualizations, the colours now correspond to economic sectors of the shareholders and the countries are similarly listed alphabetically in facets. The bar chart was produced using *ggplot2* package.

Figure 12 highlights that while in the United States, finance (shown in green) is the largest domestic shareholder, this is not the case for either the United Kingdom or China (both of which have a more spread out distribution of primary shareholder sectors). In the UK particularly the professional sector as well as individuals directly own as much capital as its financial sector. This contradicts much of the existing literature on financialization which views both the UK and the US as ideal types of highly financialized economies.



Fig. 12. Share of capital in a given industry/given country owned by type of domestic shareholder

Visualization #4: Foreign shareholders

The fourth visualization is a faceted bar chart providing information on the composition of foreign investors in each industry for a given country, showing the share of capital that other countries own in each sector of the selected country. The colours correspond to countries of foreign investors (listed alphabetically) and the economic sectors are listed alphabetically in facets (see Figure 13). The user is also given an option to limit the number of economic sectors one is interested in, to limit the selection of foreign investors, as well as to modify the format of the visualization by changing the number of facet columns, the height of the graph, and fonts of labels. The bar chart was produced using *ggplot2* package.

Figure 13 provides a visualization of foreign investors for the United States, but one can easily select a different country. Here, the United Kingdom stands out as the biggest foreign investor in almost all the US economic sectors, followed by Canada, Cayman Islands, and Japan.



Fig. 13. Share of capital in a given industry in a given country owned by foreign investors

Visualization #5: Scatterplot of countries

The fifth visualization is a scatterplot showing country-level differences in the rates of capital ownership for different types of shareholders for two selected economic sectors (one plotted on the x-axis, another on the y-axis). The primary advantage of the scatterplot compared to the bar chart visualizations is

the ability to include as many countries as one would want without cluttering the view. The scatterplot also makes it very easy to compare the rates of capital ownership for different sectors between all the countries simultaneously. The colours correspond to different continents and the size of points corresponds to how much capital each country owns (see Figure 14). The bar chart was produced using *ggplot2* and *plotly* packages.

The user has an option to include/exclude any countries they want (by selecting the countries or continents they are interested in or by filtering countries based on how much capital they own), as well as specify the two primary sectors that they want to examine (plotted on the x-axis and the y-axis), the industry of the shareholder, and the type of the shareholder: domestic, foreign, or global. Figure 14, for instance, shows country-level differences in the share of capital owned by domestic finance in the aggregated non-financial sector (shown on the x-axis) and the financial sector (shown on the y-axis) for all countries with at least 50 billion USD in owned capital, once again highlighting the incredibly high rates of financialization present in the United States. The additional interactivity offered by the *plotly* package enables the user to get additional information by moving their mouse cursor over the selected country and having a hover label appear with a name of the country, the continent, as well as some numerical information (see Figure 15 for an example).



Fig. 14. Share of capital owned by a selected shareholder in chosen industries

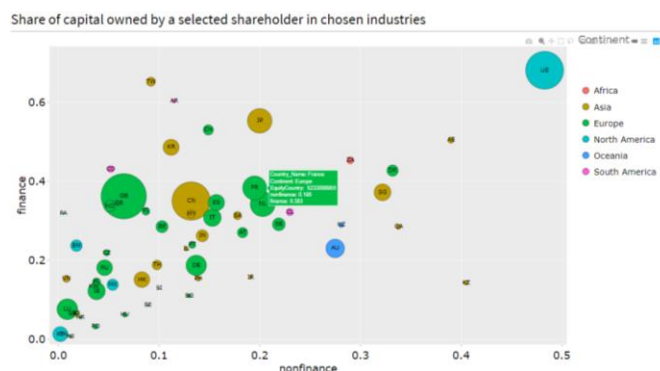


Fig. 15. Visualization #5 with hover label for France

Visualization #6: An interactive map + table

The sixth visualization is an interactive map showing country-level differences in the rates of capital ownership for different types of shareholders for each selected economic sector. The user has an option to specify the industry that they want to examine, the industry of the shareholder, and the type of shareholder: domestic, foreign, or global (a combination of domestic and foreign investors). The map was produced using *map* package while the table was produced using *DT* package. The map provides an alternative view of visualizing information shown in a scatterplot (visualization #5) where the geographical information is presented in a more conventional way, making it potentially easier to compare rates of capital ownership for countries from the same or different regions for a given shareholder.

In Figure 16, the map shows the share of capital owned by global finance in each country's financial sector, while the table provides further numerical information shown on the map, reflecting the selected inputs. From Figure 16, we can observe that not only the US financial sector is also owned at very high rates by global finance (82.6%) but also the Australian financial sector (84.9%) in addition to financial sectors of a number of countries in Central Africa.

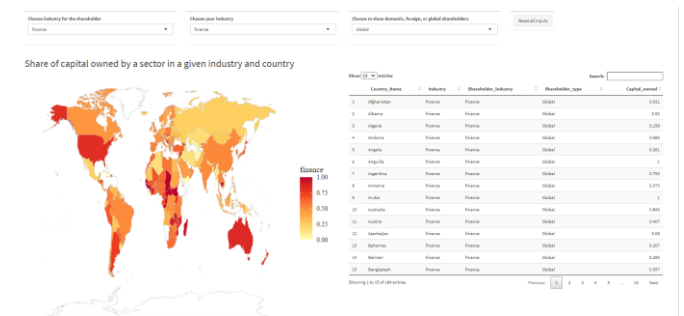


Fig. 16. An interactive map and table showing the share of capital owned by a sector in a given industry and country

Visualization #7: Domestic investments: two views

The seventh visualization shows domestic ownership ties between industries for a selected country. The information on domestic investment flows are represented into views: a chord diagram shown on the left and a network shown on the right (see Figure 17). This visualization allows one to examine the largest domestic shareholders for each sector and explore the ownership ties between various sectors. The user has an option to specify which country to examine, which sectors to include, whether to include self-loops (investments within a sector), and an option to filter edges based on their weight (the monetary value of the ownership tie in \$). The colours correspond to economic sectors (listed alphabetically) using the same colour scheme applied in the first three bar charts (visualizations #1 to #3). The chord diagram was produced using *chorddiag* package while the network was produced using *visNetwork* package.

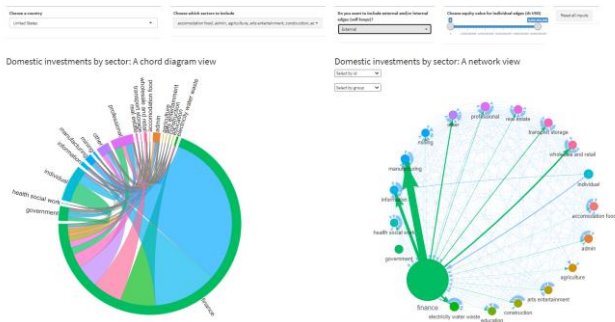


Fig. 17. Domestic investments between sectors

While the two visualizations rely on the same information, they have different ways of representing and highlighting said data. The chord diagram provides numerical information on total capital owned by a particular sector when you move a mouse cursor over the selected sector. At the same time, it can also provide numerical information on investments between two sectors when one moves a mouse cursor over an edge as seen in Figure 18. The network, on the other hand, can highlight edges connected to a selected node (see Figure 19).

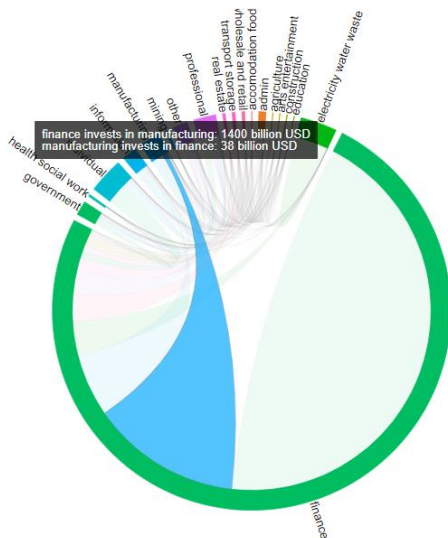


Fig. 18. A chord diagram of domestic investments



Fig. 19. A network of domestic investments

The default country for visualization#7 has been set to the United States and what both views highlight is the exceeding dominance of the US financial sector. The chord diagram shown on Figure 18 reveals that over 75% of all domestic investments in the US emanate from its financial sector. More surprising is the extent to which the US financial sector is invested in itself: among \$7.7 trillion of its domestic investments, \$4.5 trillion are invested in US finance.

Visualization #8: Comparing countries’ domestic investments (chord diagram view)

The eighth visualization provides chord diagrams of domestic investments for two countries. This visualization allows one to compare the largest domestic shareholders for each sector between two countries. The user has an option to specify which two countries to examine, which sectors to include, whether to include self-loops (investments within a sector), and an option to filter edges based on their weight (the monetary value of the ownership tie in \$). The chord diagrams were produced using *chorddiag* package.

Figure 20 shows chord diagrams of domestic investments for the United States (on the left) and the United Kingdom (on the right). Confirming our analysis on the differences between rates financialization between the United States and the United Kingdom seen in visualization #3, the chord diagrams highlight that the UK does not have a single shareholder that dominates the whole economy in contrast to the US where over half of 75% of its capital is directly owned by finance.

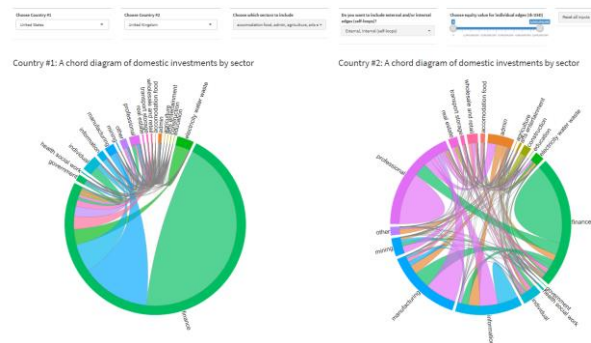


Fig. 20. Comparing domestic investments of two countries

Visualization #9: FDI investments: ego network + table

The ninth visualization provides an FDI ego-network for a selected country showing all the incoming and outgoing foreign direct investments (FDI). This visualization allows one to examine the largest incoming and outgoing investments for a given country. The user has an option to select any country they want, to filter countries the main country is connected to based on their weighed degree (i.e. how much capital they own), to choose whether to include incoming or outgoing investments (or both), and to filter edges based on their weight (the monetary value of the

ownership tie in \$). The outgoing investments are shown in blue, while the incoming investments are shown in red. The colours of nodes correspond to different continents, while the size of nodes corresponds to how much capital each country owns internationally. The user can access numerical information on incoming and outgoing investments using the table on the right. The network was produced using *visNetwork* package while the table was produced using *DT* package.

Figure 21 showing an FDI ego-network for the United States highlights how the United States is an exporter of capital with many more outgoing than incoming investments. The network shows that the US has significant presence both in Europe (shown in yellow) and Asia (shown in red). There are also significant investments coming from an unknown location.

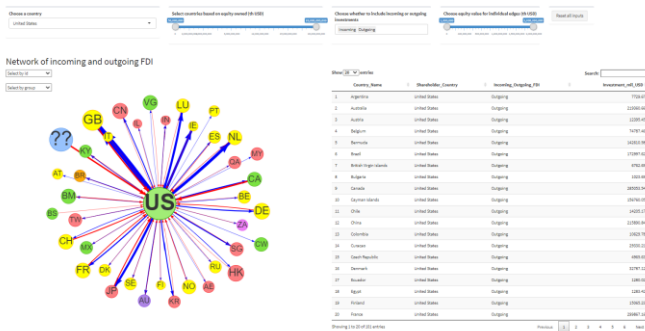


Fig. 21. Network of incoming and outgoing FDI

Visualization #10: Comparing countries' FDI investments

The tenth visualization provides FDI ego-networks for two selected countries, allowing to easily compare the incoming and outgoing investments for any two countries. As previously, the user has an option to select two countries, to filter countries the main countries are connected to based on their weighed degree, to choose whether to include incoming or outgoing investments (or both), and to filter edges based on their weight. The networks were produced using *visNetwork* package. Figure 22 shows FDI networks for the United States (on the left) and the United Kingdom (on the right), highlighting that the UK is an importer of capital, receiving significant investments from the US and, in comparison with the US, having fewer outgoing investments.

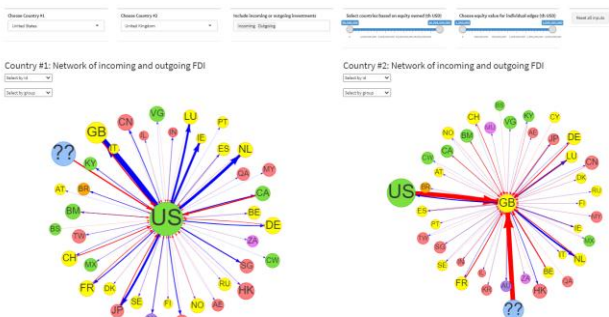


Fig. 22. Comparing FDI of two countries

Visualization #11: Global corporate ownership network (two views)

The final visualization shows global ownership ties between countries. The information on global investment flows are represented into views: a chord diagram shown on the left and a network shown on the right (see Figure 23). This visualization allows one to examine the largest investors in the global corporate ownership network and explore the ownership ties between various countries. The user has an option to include/exclude any countries they want (by selecting the countries or continents they are interested in or by filtering countries based on how much capital they own), to choose whether to include self-loops (i.e. domestic investments), and to filter edges based on their weight (the monetary value of the ownership tie in \$). The chord diagram provides numerical information on total foreign investments when you move a mouse cursor over a country, as well as information on investments between two countries when one moves a mouse cursor over an edge. The network view has an option to highlight all the edges connected to a selected node, as well as to highlight all the nodes belonging to a particular group (in this case, a continent). The chord diagram was produced using *chorddiag* package while the network was produced using *visNetwork* package. Overall, Figure 23 reveals the ongoing dominance of the United States in the global corporate ownership network, confirming the position of the US as a heart of the global empire.

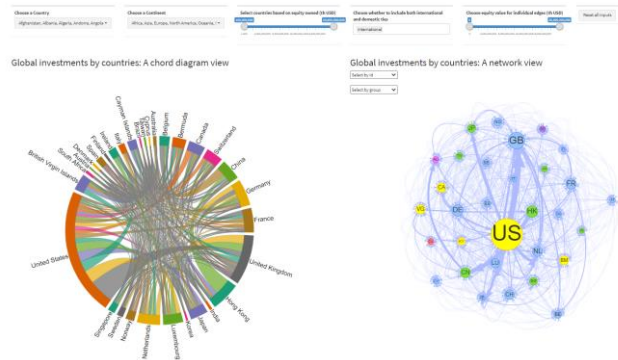


Fig. 23. Global investments between countries

6 DISCUSSION AND FUTURE WORK

While I originally planned to use this term project to produce a series of static visualizations for an academic paper, developing a shiny app made me realize that the potential uses of these visualizations are much broader than I initially planned for. Even though I was particularly interested in estimating the rates of financialization of capital ownership across different industries and different countries, the final visualizations, while addressing my original research questions, appear to have much broader use. For instance, one could use these visualizations to examine foreign direct investments between countries (e.g. China has very significant investments in Australia) or identify tax havens. A wide geographical coverage and an in-depth analysis of domestic investment patterns make this shiny app relevant to

researchers, policymakers, and journalists from a wide range of backgrounds. As corporate ownership data is often proprietary and challenging to examine at an aggregate scale, this project makes an important contribution to the literatures on financialization and corporate networks by analysing the largest dataset of corporate ownership ties available to date.

In terms of the main research findings, I confirmed that financialization as a new regime of property relations has been a US-only phenomenon with very few countries having similar rates of financialization (exceptions are mainly tax havens). Contrary to what the literature on financialization claims, capital ownership in the United Kingdom does not appear to be highly financialized. American finance, in addition to owning over half of capital in the US non-financial sectors, appears to be heavily invested in itself, raising questions about the prevalence of speculation in financial markets. Globally, the United States remains to be extremely powerful, occupying a central position in the global corporate ownership network. My data does not show the decline of the “US empire” as some researchers have suggested.

The developed visualizations allowed me to develop a series of stylized facts about the global economy and the power of finance in it. At this point, it is important to acknowledge some of the limitations to my analysis. First of all, it has been noted that the data provided by Orbis has very uneven geographical coverage, impacting countries in the Global South and offshore tax and regulatory havens. To understand the extent to which my analysis has been impacted by this uneven coverage, it would be important, at the very least, to examine how much information is available for each country. Secondly, I was not able to develop network visualization at the level of sectors between various countries. It would be important to develop such visualizations to highlight the power held by the US financial sector in the global economy. Lastly, it would be important to develop additional network visualizations for the US specifically at the level of individual firms to examine the influence exerted by US index funds.

My next steps and future work are listed below:

1. Create an interactive page for data description, showing information on geographical data coverage and missing ownership data; provide an estimate of missing data for each country and industry.
2. Develop an interactive network visualization combining circle packing and hierarchical edge bundling to show connections between industries of different countries (example of this visualization is shown in Figure 25). For now, I have developed a chord diagram showing investments between industries of specific countries (see Figure 24).
3. Develop US-centric visualizations at the scale of individual firms; examine the power of index funds.
4. Make interactive tables reflect values highlighted in a map and in a network for visualizations #6 and #9.
5. Figure out how to better identify ownership ties between firms belonging to the same company.
6. Upload the code and aggregated datasets to a public data repository (e.g. figshare)

7. Finish a draft of the paper using these visualizations.

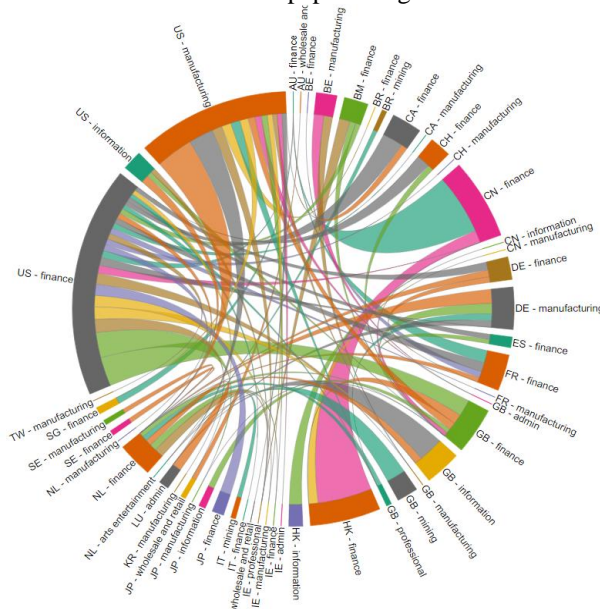


Fig. 24. Global investments between industries of countries

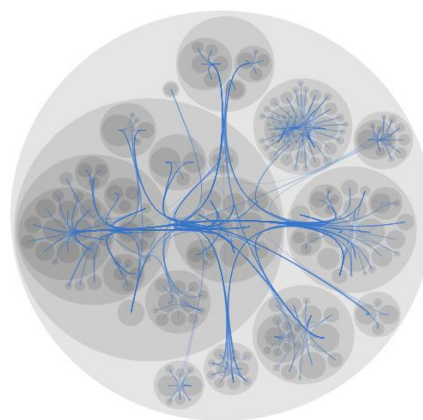


Fig. 25. A visualization example combining circle packing and hierarchical edge bundling⁵

7 CONCLUSION

In this project, I explored who owns the means of production in various countries through the analysis of a novel corporate ownership dataset, featuring shareholders of 2.9 million firms whose ownership claims accounted for \$114 trillion. I developed a series of interactive visualizations (including bar charts, scatterplots, maps, networks, chord diagrams, and tables) using various data visualization and data analysis packages in R and published my analysis using a *shiny dashboard*. These visualizations have highlighted that the US economy has become highly financialized and that overall the US remains incredibly powerful in the global economy.

⁵ Source: <https://bl.ocks.org/nitaku/972a1a1ca93bb3da54505f3b0f3bb335>

8 MILESTONES

Project milestones, their description, expected time to complete the milestone, and their respective deadlines can be seen in Table 4.

Table 4. Milestones schedule

Milestone	Time (hrs)	Deadline	Description	Part of CPS C 547
Data collection	20	March 15, 2020	Querying data from Orbis based on the selected criteria	No
Data cleaning	20	March 30, 2020	Combining downloaded data files into one file, formatting data values to ensure consistency, identifying data entry errors	No
Pitch	3	October 1, 2020	Preparing presentation slides, developing a summary of the project, recording presentation	Yes
Pre-proposal meeting	2	October 15, 2020	Preparing presentation slides in preparation for the proposal	Yes
Proposal	10	October 23, 2020	Reviewing existing work, summarizing data, writing proposal	Yes
Conduct a literature review	15	November 10, 2020	Completing a literature review on financialization, corporate networks, and methodological papers using Orbis database	Yes
Review data visualization packages in R	15	November 10, 2020	Examining existing packages in R and their functions, including igrph, ggraph, ggplot2, visNetwork, shiny	Yes
Review possible visualization options	10	November 15, 2020	Considering different visualization options, including necklace maps, flow maps, bow-tie network visualizations, small multiples, semi-geographical networks	Yes
Measure the national rates of financialization	15	November 15, 2020	Develop a measurement for the rate of financialized corporate ownership and control for each nation	Yes
Peer Review	2	November 17, 2020	Preparing presentation slides for peer-review	Yes
Update	8	November 18, 2020	Update the proposal	Yes
Visualization #1	7	November 23, 2020	Making an interactive bar chart showing domestic shareholders	Yes
Visualization #2	5	November 24, 2020	Making an interactive bar chart for domestic finance	Yes
Visualization #3	4	November 25, 2020	Making an interactive stacked bar chart	Yes
Visualization #4	5	November 26, 2020	Making an interactive bar chart for foreign shareholders	Yes
Visualization #5	10	November 27, 2020	Making an interactive scatterplot using plotly	Yes
Visualization #6a	8	November 28, 2020	Making an interactive map	Yes
Visualization #6b	4	November 29, 2020	Making an interactive table	Yes
Visualization #7a	7	November 30, 2020	Making an interactive chord diagram	Yes
Visualization #7b	6	November 31, 2020	Making an interactive network	Yes
Visualization #8	3	December 1, 2020	Making an interactive chord diagram	Yes
Visualization #9a	9	December 2, 2020	Making an interactive ego-network	Yes
Visualization #9b	2	December 2, 2020	Making an interactive table	Yes
Visualization #10	3	December 2, 2020	Making an interactive ego-network	Yes
Visualization #11a	3	December 3, 2020	Making an interactive chord diagram	Yes
Visualization #11b	6	December 4, 2020	Making an interactive network	Yes
Project overview	8	December 5, 2020	Make a project overview and description page	Yes
Make app publicly accessible	4	December 6, 2020	Use shinyapps.io to make app accessible	Yes
Reset all inputs button	8	December 7, 2020	Make a button to reset inputs for all the visualizations	Yes
Final Presentation	10	December 10, 2020	Preparing presentation slides, recording the presentation	Yes
Final Report	20	December 15, 2020	Finishing writing final report	Yes
Term paper for GEOG 547	80	January 1, 2021	Use developed visualizations and analysis for sections 4, 5 in a term paper for GEOG 547	No

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