# **HEC MONTRÉAL**

# Political Donations Networks in Canada: A Structural and Evolutionary Analysis from a Complex Network Perspective

By

Abdoulaye Diop abdoulaye.2.diop@hec.ca

#### **Thesis Supervisor**

Gilles Caporossi

gilles.caporossi@hec.ca

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This thesis is submitted as part of my Msc program requirement at HEC Montreal.

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#### Abstract

This paper introduces a network-based approach to study the impact of Canada's 2006 campaign financing reforms banning corporate donations on political donations networks in Canada. The goal of the 2006 reform has been to root out the influence of money in politics and make the donation landscape a much fairer environment. The paper investigates the structure and evolution of donations networks of all 13 provinces and territories and the power dynamics among political parties using complex network methodologies. Each region's donation networks were constructed from corporate and individual donations public data provided by Elections Canada. The results show that the 2006 reforms did have some impact on the structure of donations networks and the power dynamics among political parties and the power dynamics among political parties networks and the power dynamics among political parties and the power dynamics among political parties canada.

Keywords:Complex Networks; Political Networks; Donations Networks; Campaign FinanceNetworks, Contributions Networks, Power and Influence, Canada Politics.

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And to my readers, I would like to thank you for taking the time to read my thesis. I hope this thesis would be an inspiration for you in your field of work.

I would like to end this chapter with a quote of mine:

"A true measure of a person should not be evaluated based on his or her IQ or intellect, but rather should be evaluated based on his or her willingness to venture into the unexplored."

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# List of Acronyms

APPC	Animal Protection Party of Canada
BQ	Bloc Quebecois
CAP	Canadian Action Party
СНРС	Christian Heritage Party of Canada
COPC	Communist Party of Canada
СР	Canada Party
CPC	Conservative Party of Canada
CRCA	Canadian Reform Conservative Alliance
FD	Forces et Démocratie
FPNPC	First Peoples National Party of Canada
GPC	Green Party of Canada
IND	Independent
LIPC	Libertarian Party of Canada
LPC	Liberal Party of Canada
MLPC	Marxist-Leninist Party of Canada
MP	Marijuana Party
NAF	No Affiliation
NAPC	National Advancement Party of Canada
NDP	New Democratic Party
NLFP	Newfoundland and Labrador First Party
NLPC	Natural Law Party of Canada
РАСТ	Party for Accountability, Competency and Transparency
РСР	Progressive Canadian Party
PCPC	Progressive Conservative Party of Canada
PIPC	Pirate Party of Canada
PPC	People's Party of Canada
PPPPC	People's Political Power Party of Canada
PRP	Parti Rhinocéros Party
SPC	Seniors Party of Canada
UPC	United Party of Canada
WBP	Western Block Party

# List of Acronyms

AB	Alberta
BC	British Columbia
MB	Manitoba
NB	New Brunswick
NL	Newfoundland and Labrador
NS	Nova Scotia
NT	Northwest Territories
NU	Nunavut
ON	Ontario
PEI	Prince Edward Island
QC	Quebec
SK	Saskatchewan
YT	Yukon Territories

### Preface

This research undertaking is the result of months of hard work and dedication. It has been written for several reasons. First and foremost, it has been written to fulfill the graduation requirements of HEC Montreal. Second, it has been written to expand my knowledge of data science and political science. Third, it has been written to appreciate a challenge and venture into the unexplored. Lastly, it has been written to find new opportunities and open new doors.

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# Chapter 1.

# Introduction

In today's age of digital transformation and Big Data revolution, the political sphere has been undergoing tremendous changes and transformations. Recent years have seen many efforts made by political scientists and practitioners in bolstering political transparency to improve political governance, root out public corruption, and restore public trust. (Cucciniello, Porumbescu, & Grimmelikhuijsen, 2016) [1].

At the heart of this effort is campaign money, which plays a quintessential role in politics as it can be seen as a means to influence the political decision-making process. Research has shown that loose campaign regulations drive parties to be more beholden to the interests of the elites upon which political parties are dependent on for funding at the expense of citizens who are less endowed in resources (Potter and Tavits, 2015) [2].

From a market standpoint, the U.S. bolsters the world's most substantial political contributions than any other country. According to Open Secrets.org, the U.S. political contribution market is currently estimated at over USD 5.5 Billion [47]. Most of them stem from corporations and trade unions that tend to form special interest groups working to serve their interests and exert the will of the elites. This political campaign financing environment has had nefarious political implications in terms of corruption resulting in public cynicism and low voter turnout ratio (Persily & Lammie2004) [3]. Low voter participation stems from the common non-voters' belief that their votes and contributions do not matter in a world where the elites are believed to exert a strong influence in the political process (Bowler & Donovan 2015) [4].

In contrast to its neighbor Canada, corporate donations to political parties have been banned at the federal level since 2006 to remove corporate money from and influence Canadian politics. Through a series of tax credits and reimbursement incentives, the government has tried to boost individual political donations and increase voter electoral participation. While this legislative initiative was followed through and welcomed by political parties to regain public trust, the policy has not yielded to the desired results since statistics have shown that voter participation continues to decline. The reasons for low voter turnout have been attributed to negative attitudes toward politics and the public's lack of interest in elections, especially among young voters (Elections Canada) [5]. This worrisome trend seems to suggest a deepening disconnect between politicians and voters.

The current literature on political donations contains a vast amount of research focusing mainly on U.S. corporate political contributions. However, very little attention has been paid to individual contributions, which deserves some attention since it concerns voters directly. Moreover, there seems to be a literature gap in understanding political donations networks' formation, structure, and evolution, which are elements that give the bigger picture of the story.

Big data and new advancements in computing technology have brought increasing changes to the political science sphere as a range of data science methods are gradually replacing traditional methods such as surveys. The current inability of conventional approaches to have reliable predicting capacity has been shown by the election's polls predicting Clinton's win in the U.S. 2016 presidential elections and the polls predicting a non-Brexit success in U.K. Brexit 2016 referendum (Helen Margetts, 2017) [<u>6</u>].

New developments in data science methods present a challenge for many political scientists who lack the data science skills and expertise needed to leverage the vast amount of data available for their studies (Benderly, 2014) [7]. Data on political donations are widely available, and studying their networks is now possible through methodologies used in the field of complex networks.

Campaign finance law can have an impact on political competition and the quality of political representation. Under the Liberal Party government leadership of Jean Chretien, in 2003 Canada enacted Bill C-24 reforming its campaign finance laws significantly by increasing public funding, extending further disclosures requirements, placing a yearly \$1,500 limit on individual monetary donations to political parties and contestants, and placing an annual \$5,000 limit on corporate financial contributions to political parties and contestants. Furthermore, non-citizens and permanent residents were banned from making contributions to political parties and contestants. It was not until 2006 under the Conservative Party minority government leadership of Stephen Harper that businesses, corporations, labor unions, foreign corporate and political entities were banned from making contributions to political parties and contestants (Alexander 2019) [8].

According to Alexander (2019), the level of resource parity between parties when it comes to campaign financing dictates the polarization level among political parties within the political system. The author argues that Canada's party funding reforms shifted the balance of power among political parties in a way that allowed all parties regardless of their sizes to have relatively the same equal access to campaign resources. The author further concludes that these reforms created a fair environment in which parties, regardless of their size, have access to campaign resources, which allows them to compete on equal footing against each other.

According to Leslie Seidle, a research director at the Montreal-based Canada's Changing Federal Community at the Institute for Research on Public Policy (IRPP), the 2006 campaign finance reforms had put the Liberal Party (LPC)'s campaign funding system at a disadvantage. The liberals (LPC) had been heavily reliant on corporate donations. In contrast, the Conservative Party (CPC) has been more efficient in collecting individual donations giving the party the edge over its liberal counterparts in receiving campaign donations (Geddes, 2016) [9].

Given these findings, the overall objective of this thesis can be divided threefold:

- The first objective would be to evaluate the impact of Canada's 2006 campaign financing reform on the competition among political parties. Fundamentally, we want to investigate whether the latest campaign reforms have created a fairer and equitable campaign financing environment across the country.
- The second objective would be to investigate the impact of the reforms on LPC's position within the donations network and check whether its heavy reliance on corporate donations has rendered the party less efficient than CPC in collecting individual contributions post 2006.
- And finally, the third objective would be to utilize complex network methodologies in analyzing further the structure and evolution of political donations networks in Canada with the hope of inspiring more future political scientists to use complex networks in their field of study.

Therefore, this thesis will be structured as follow:

- The first part would be a literature review providing a background of political donations and the current studies on political donations networks using complex networks.
- The second part would be an overall analysis of Canada's political donations (corporate and individual) and a Gini-Index analysis to analyze Canada's distribution of contributions. This section will investigate the performance of the political parties in each province and territory in collecting donations and analyze the donation dispersion among parties before and after the 2006 Campaign Financing Reform.
- The third part would consist of presenting properties of political donations networks. Fundamentally, this section will analyze the characteristics of donations networks in each province and territories and how they evolved.
- The fourth part will address distances and centrality measures to understand the similarities between political parties and the power dynamics among parties. This section seeks to understand the degree of rivalry among political parties, the balance in power over time in terms of importance, control, and influence, and the shift in power dynamics post-2006 reform. The Jaccard Similarity and the different centrality measures will help in this quest.
- The fifth part will address community detection in which we will assess the different communities across Canada. This section will attempt to assess the number of communities within each network and analyze the connections between political parties and different communities.
- And finally, the thesis will end with a conclusion providing key insights, limitations, and possible extensions. This section will conclude on the impact of Canada's reforms on the structure of political donations networks in Canada.

# Chapter 2.

## **Literature Review**

#### 2.1. Literature Survey on Complex Networks

Given this thesis is about the study of political donations networks in Canada using complex network analysis, it is crucial to define the meaning of complex networks. The terminology "complex networks" is often used interchangeably with "complex systems." However, there is a slight difference between the two terminologies. Complex systems are interconnected elements interacting with one another. They can be of natural origin or human-made. In contrast, complex networks can be regarded as the framework that models complex systems. Gaining insights on complex systems require mathematical and computational approaches that can translate these systems into visualizable, analyzable, and interpretable networks (Zinoviev and Tulton, 2018) [<u>30</u>], (Estrada, 2011) [<u>55</u>].

Complex networks permeate all aspects of our society. There are numerous kinds of networks such as:

- *Social networks*: friendships, professional circles, social circles, academic circles, etc.
- *Economic networks*: financial transactions, business partnerships, trade networks, etc.
- *Cultural networks*: religious networks, cultural value system, language system, etc.
- *Environmental networks*: sustainable energy networks, ecological networks, etc.
- *Biological networks*: food chain, epidemic system, digestive system, neural system etc.
- *Technological networks*: Internet, innovation system, artificial intelligence system, etc.

These networks are said to be 'complex' because their intricate structure makes it difficult to understand their collective behavior without visualizing individual components' interactions (Mata, 2020) [54].

Mathematical graph theory is used to treat this complexity by translating networks into graphs. Graphs are abstract objects used to represent networks. This branch of discrete mathematics offers a high level of abstraction that can prove practical in solving complex network problems. The representation of networks in graph form using discretized data can capture the essence of real networks.

All networks (also known as graphs) are composed of two objects: entities that are represented as nodes (also known as vertices) and connections between entities, which are represented as edges (also known as links or arcs). The mathematical representation of graphs is G = (N, E). Edges can be directed or undirected. They can also be weighted or unweighted. A weight (also known as an edge attribute) is a numerical value that quantifies the strength of the connection between two given nodes.

While graphs provide great intuitions about networks, they are not enough to fully understand networks. The increasing complexity of networks and the growing availability of massive data make it impossible for practitioners to draw and analyze networks by hand. Hence, they need to construct and analyze networks using powerful computing technology to understand complex networks better. It begs the question of how to construct networks (graphs) from large datasets. It requires a deeper understanding of graph data structures.

Networks can be generated from several data structures, including adjacency matrix, incidence matrix, edge list, and adjacency list (Zinoviev and Tulton, 2018) [<u>30</u>]. Their characteristics are described below:

• *Adjacency matrix*: An adjacency matrix is an N x N square matrix (N being the size of the matrix) whereby the rows represent the source nodes, and the columns represent the destination nodes. If the graph is unweighted, the matrix will contain 0s and 1s. An entry equals 1 indicates the existence of a link between the source node and the destination node; otherwise, it indicates no relationship. In the case of a weighted graph, the entry is a random number highlighting the edge weight connecting two given nodes. If a graph is undirected, the matrix will always be symmetric. It is not the case of a directed graph (also known as digraph). In an undirected graph, the diagonal of an adjacency matrix is always equal to 0 since a node cannot be linked to itself. It is not the case of a directed graph. The adjacency matrix representation is best used for dense graphs. From an adjacency matrix, it is possible to identify to see the existence of a link between two given nodes. The downside of an adjacency matrix is the data structure is not suited for sparse graphs (graphs in which most of the entries is 0) because it can consume much memory.

- *Incidence matrix*: An incidence matrix is a N x M rectangular matrix, in which the rows N represent the number of nodes, and the columns M represent the number of links. In an undirected graph, the matrix entries will either be 0 or 1. If an entry is equal to 1, it means that a node has an edge linked to it. In this case, we say that a node is an incident with an edge. If an entry is equal to zero, it means no linkage exist. In the case of a directed graph, outbound links have entries equal to 1, inbound links have entries equal to -1, and no links have entries equal to 0. The downside of an incidence matrix is that weight cannot be represented.
- *Edge list*: An edge list is a variation of the adjacency matrix whereby the data structure consists of an array of 3 objects: a start node, a destination node, and the edge attribute (weight). Each line represents an arc. The advantage of edge lists is that the nodes and edges can be sorted in an unsorted fashion. Furthermore, it saves on storage by taking only into account nodes with edges. Unlike the adjacency matrix, isolated nodes are not considered. Such an advantage allows for better storage of complex data. An edge list is best used to represent sparse graphs. The downside is that using this form of data structure requires scanning the whole list to determine whether two given nodes are adjacent.
- *Adjacency list*: An adjacency list is a hybrid between an adjacency matrix and an edge list. Each line in the data structure is associated with a given node and its array list of adjacent nodes. The main advantages of this data structure are efficient storage of information and efficient information retrieval of all adjacent nodes. The main caveat is to figure out whether there exists an edge between two given nodes.

These four graph data structures are illustrated in the two examples below (undirected graph and directed graph) [61]. The shaded grey boxes are given indexes.



When constructing a network, an essential factor that needs to be considered is the time complexity of graph construction operations. Time complexity is the total running time required by an algorithm until its completion at its worst case. Big O is the asymptotic notation used to represent the time complexity.

Goodrich and Tamassia (2014) [56] pointed out that the complexity of graph data structure operations depends on several factors:

- *the memory* (space complexity)
- *the insertion or removal time of a node* (time complexity)

• *the insertion or removal time of a given edge* (time complexity)

#### • *the query time for checking adjacency nodes* (time complexity)

Based on these four criteria, the worst-case time complexity of an edge list, an adjacency list, and an incidence matrix is linear (O(n)). In contrast, the worst-case time complexity of an adjacency matrix is quadratic (O(n<sup>2</sup>) [57].

Overall, complex network analysis is a powerful tool used in the study of real-world systems (complex systems). The application of this historically rich discipline is rapidly becoming a key topic of interdisciplinary research. The methodologies used in complex network analysis include a wide range of statistical properties, connectivity, distance metrics, centrality, clustering, community structure, and others. These methodologies allow us to gain insights into the structure, properties, and dynamics of various complex networks.

#### 2.2. Literature Survey on Political Donations

The present literature on political donations is rich. The vast body of research provides great insights into the political donations' environment in Western democracies. In the world of politics, common belief dictates that politicians strive for mainly two things: votes and money. To ensure the effectiveness of democracies, democratic systems such as political parties are highly dependent on voluntary participation relying on both intrinsic incentives (prestige) and extrinsic incentives (money) (Alexander, 2019) [8]. As a result, a series of policies for political funding coupled with various incentives and subsidies (tax-addons, checkoffs, tax deductions, tax credits, matching funds, or potential reimbursement of campaign expenses) are designed to stimulate political participation. These policies strengthen the financial link between private and public entities working together to reduce the risk of funds insufficiency that governments alone would not be able cover.

Historically, the debate over campaign regulation in Western Democracies can be been framed as a debate between liberty and equality. The contrasts between the two sociopolitical philosophies are reflected in North America between the United States and Canada. Alexander (2019) has contributed to the literature of political donations in North America by providing a comprehensive and detailed comparative analysis between the United States and Canada. According to Alexander, the United States and Canada are two similar federal systems with different campaign financing schemes. The United States is a presidential-congressional system with fifty-five states and four territories with each having their own laws and regulations. In contrast, Canada is a parliamentary system with ten provinces and three Territories and similarly to the U.S., each of them has its own laws and regulations as well.

As Alexander points out, the two countries although similar in political system, differ greatly in political finance system. The author argues that the political finance system in the U.S. is more of a libertarian (a free speech approach) in which the system relies heavily on private financing with relaxed contribution limits for both individuals and organizations. The goal of the system is to raise an abundant amount of money to fund political campaigns which are increasingly becoming costly and difficult to fund. As a result, spending limits in the U.S. are not only imposed in presidential campaigns but also when a political candidate voluntary agrees to the limits. In contrast, the Canadian system is more egalitarian in its approach in a way that the system funds two-thirds of candidates and party costs. The goal of the system is to ensure equal opportunity by enforcing expenditure ceilings on candidates, parties, and interest groups spending.

Another key difference pointed out by Alexander is the orientation of the funding system. The American presidential-congressional system is a candidate-oriented system in which the focus is on party candidates to whom funding goes directly to or their personal campaign committees. As a result, political parties are driven to compete with candidates for funding. Unlike the American system, the Canadian parliamentary system is a party-oriented system based on the building of strong parties backed by public financing to parties. Public financing to parties is not only provided for election years but also non-election years as well. These differences also highlight the differences in both countries' social value system. The U.S. has its political roots in a social value system that places a great emphasis on individualism. Whereas, Canada has its political roots in a value system that is more collectivist (Peoples and Gortari, 2008) [10].

From a historical standpoint, the evolution of campaign financing laws between the United States and Canada mirrors one another.

Earliest major campaign finance law reforms in North America can be traced back in the 1970s. At that time, campaign finance laws in the U.S. and Canada underwent major legislation reforms. In 1971, the U.S. enacted the Federal Election Campaign Act (FECA). It was the first U.S. legislation on campaign funds disclosure. The rules were later reinforced in 1974 placing limits on contributions and creating the Federal Election Commission (FEC) to monitor campaign funding activities. Parallelly within the same year, Canada followed suit by passing the Election Expenses Act which places limits on campaign contributions. It was the first Canadian attempt to regulate party finances in the country. These laws would remain unchanged for three decades until the early 2000. (Peoples and Gortari, 2008) [<u>10</u>].

Following decades of loose campaign funding laws causing a series of scandals, the United States and Canada entered into a series of reforms. These reforms were not driven by politicians or party self-interests but by the growing public distrust of the system and the concerns of ameliorating the quality of government (Potter & Travits, 2015) [11].

In 2002, the U.S. enacted the Bipartisan Campaign Reform Act (BCRA) increasing the overall limits of individuals monetary contributions from \$2,000 per year to \$95,000 in a twoyear election cycle but also placing limits on soft money donations to political parties. Parallelly, in 2003 Canada under the Liberal Party leadership of Jean Chretien enacted Bill C-24 making significant changes to its campaign finance laws by increasing public funding, extending further disclosures requirements, placing limits on hard money with a yearly \$1,500 limit on individual monetary donations and \$5,000 limit on corporate monetary donations to political parties and contestants, and banning non-citizens, permanent residents from making contributions to political parties and contestants. It was not until 2006 under the Conservative Party minority government leadership of Stephen Harper that businesses, corporations, labor unions, foreign corporate and political entities were banned to make contributions to political parties and contestants (Alexander 2019) [8].

These strong similarities between the U.S. and Canada can be explained by their similar past and history, their geographical proximity, their federal system for electing legislators, the strong presence of information sharing across both borders, and finally the presence of a strong economic and political integration between the two countries (Boatright 2009) [12].

While both the U.S. and Canada share strong parallel similarities when it comes to their campaign financing law history, however there are significant differences in terms of regulations. First, the language used in these new reforms differ between the U.S. and Canada. The terminology used in the U.S. is "campaign finance reform" whereas the terminology used in Canada is "party finance reform" (Boatright 2009) [12]. However, for the simplicity of our analysis, these terminologies along with "campaign financing", "contributions", "donations" would be used interchangeably. Second, the United States has tougher regulations than Canada when it comes to soft (non-monetary) money contributions whereas Canada has stricter regulations than the U.S when it comes to hard money contributions (Peoples and Gortari 2008) [10]. Third, political parties in the U.S. are bipartisan where the parties often clash with one another when it comes to reforms. Democrats are known to be pro-reform whereas Republicans are against reforms (Alexander 2019) [8]. In the Canadian case, its multiparty parliamentary structure focuses the importance of parties and party discipline and coalitions ensure that policymakers vote within the party line (Peoples and Gortari 2008) [10]. Lastly, U.S. limited role of political parties and strong independence of legislators in policymaking has allowed major contributors and large interest groups to easily influence lawmakers. In contrast, Canada's strong party discipline make it difficult to easily and directly influence policymaking (Boatright 2009) [12].

According to Flavin (2015) [13], laws which regulate the financing of political campaign have the goal of reducing the influence of money and promoting citizens' opinions and interests in the political making process. The author found that states with stricter campaign financing laws tend to spend huge portion of their budget spending into public welfare and tend to have a smaller proportion of campaign contributions originating from business interests. This particularly falls into the case of Canada rather than U.S.

From a policymaking standpoint, the U.S. and Canada have institutional differences. Peoples & Gortari (2008) [10] highlight that they are three broad theories in policymaking. The first is the "State-centered" theory which theorizes that state actors rather than outside interests influence more policymaking. The second is the "Pluralist theory" which argues that plurality of interests expressed by many classes rather than one class influence more policymaking. The last one is the "Elite-power and class-based" theories which posit that businesses, because of its resources, drive and influence policymaking at the expense of other classes. According to the authors' findings, they found that the elite-power and class-based theories tend to conform to the U.S. case as there is strong evidence of parties receiving contributions from business donors. While the Canadian case tend to conform to the statecentered theory as the evidence did not show a relationship between shared contributors and vote similarity among parliamentarians. This explains the difference between Canada and the United states whose campaign financing laws are more laxed compared to Canada's campaign financing laws fostering a more polarized political environment.

Upon looking at the strong similarities between the U.S. and Canada, one cannot help to wonder about the role of geographical proximity in political donations. Research has found that geography plays a vital role in political donations. In his studies of contagion effect and ethnic contributions networks, Cho (2003) [17] found through spatial analysis that patterns of campaign contributions are geographically clustered, meaning that there is a spatial dependence (environmental effect).

According to Gimpel, Lee, and Kaminski (2006) [18], geography has a strong influence on the motives of donations. The authors point out that spatial proximity reduces organizational barriers by lowering the cost of communication and increases the likelihood of these motives to form political organizations and social ties based on common interests. Moreover, they found that networks of donors are geographically tied together, from which parties try to capitalize. They also mentioned that the political geography of fundraising campaigns is usually not a zero-sum game whereby political parties will not directly skip areas just because those areas are more welcoming to the opposing party. In a nutshell, donation networks will likely form when the distance barriers are low, making it much easier for politicians to build stronger social ties from which they collect campaign contributions.

In another study related to geography and campaign financing, Fontana (2016) found that people in very few places in the U.S. have control over politics in the rest of the country. According to the author, such control shows a concentration of power, which translates to campaign concentration power. This campaign contribution power is geographically concentrated that the performance of a Democratic or Republican candidate, in general, depends on their performance in a few cities [<u>19</u>].

Lin, Kennedy, and Lazer (2017) found studies that have demonstrated that political contributions are geographically correlated. Using an aggregated ten-year U.S. campaign contribution data from the Federal Election Commission, Lin, Kennedy, and Lazer (2017) conducted a study on the role of population density in influencing political donations per capita in the U.S. [20].

All these findings seem to indicate a strong correlation between geography and political financing. However, one might also be interested in the motivations behind political donations. In a study conducted on corporate and individual donations to political parties in Germany to see whether corporations and individuals are more of an investing nature striving for special interests via quid pro quo relationships or they are more consuming in nature being a more legitimate form of donation supporting specific policies in favor of the public interest and ideologies. Fink (2017) found that both individuals and corporations may be investing or consuming when they make political donations, but corporations tend to be more investing in nature than individuals, while individuals tend to be consuming. This finding is evidenced by the fact that corporations tend to increase their donations more heavily than individuals from non-election years to election years to incumbent parties [22]. In a similar study, McMenamin (2012) found that businesses do influence politics. According to the author, business donations in Canada are the foundations of personal and organizational relationships through which special consideration is delivered to businesses by political parties. This statement suggests that there exists a systematic integration of political finance and party-firm relations in Canada, where firms making donations to political parties are individualistic and strategically competitive in pursuing their business interests, especially with pro-business political parties [23]. Relating individual donations and corporate donations to political geography, Gimpel, Lee, and Kaminski (2006) pointed out that the motives of individuals and businesses' donations derive from their pursuit of selfinterests in terms of material interests, ideological interests, or policy interests as they seek to engage with like-minded collectivity in the pursuit of these goals.

Furthermore, research has shown that donations are successful through social gatherings as these gatherings are organized so that they build social pressure onto donors. From a geographic context, proximity plays a crucial role in building strong social ties and affect the motives to drive people to engage in politics and make contributions to political campaigns (Gimpel, Lee, and Kaminski, 2006) [18]. Antia, Kim, and Pantzalis (2013) [24] studied the relationship between political geography and corporate political strategy using lobbying expenditures. They found that companies increase their lobbying efforts when local politicians cannot give direct access to the governing elite. Firms lobby as a means to build political capital exerting influence on politicians who use enormous political power for their short-term goals and interests. Firms reduce their lobbying expenditures when there is an alignment of power. Firms' engagement in lobbying activities is seen more as a way for the

firm to pursue its self-interest rather than to be politically loyal. Regarding individuals' motivations to donate, Francia et al., (2003) identified three motives that explain individuals' decision to donate. The first one is 'Material' (investors) motives for spatial clustering, which suggests that individuals that are geographically in proximity to one another are more likely to have common interests when it comes to government policy. The second motive is 'Purposive' (ideologues) motive, which suggests that interactions with family members, friends, and colleagues influence an individual's ideology, which in turn has a bearing on an individual's decision to donate. The last one, 'Solidary' (intimates) motive, is expressed by the person's desire to impress and support its social ties to gain distinguished recognition [25].

All these findings show that the motivations behind political donations can differ between a business organization and an individual.

#### 2.3. Literature Survey on Political Donation Networks

When it comes to political campaign financing networks, the current research is sparse and is mostly focused on the U.S. political campaign financing networks. Campaign financing networks play a crucial role in politics where political parties and organizations trade with one another and share intelligence (Herrnson and Kirkland, 2016) [14]. According to Herrnson and Kirkland (2016), the current literature on campaign finance networks is primarily based on the theory of 'extended party network,' positing that U.S. political parties are networks of interest groups collaborating to support favored political candidates. As a result, a system with party organizations has a considerable impact on the flow of campaign donations.

The authors pointed out that an actor's position within the network is determined by an actor's strategic objectives, resources, and sponsorship. These factors also determine the depth of connections (direct and indirect) to other actors and the structure of the campaign finance network.

While the current advanced methodologies of complex networks existed decades ago, however, it was not until recent years that complex network methodologies are starting to be used in the studies of political donation networks. This possibility is due to the advancements in fast computing technologies and the abundant availability of large and open datasets for processing.

Herrnson and Kirkland (2016) [14] used social network analysis centrality measures on transaction data among connected party committee, PAC, and formal political parties. They were able to find that formal political parties' organizations to be the most influential across the full finance network and the extended party network. This finding was surprising given that formal political parties' organizations had fewer direct connections to other actors than party-connected committees, which have the most direct links in full finance and extended party networks. They also found that allied party PACs have the fewest direct and indirect connections to other actors and the least influence within the extended party network and full campaign finance network. The construction of graphs was done in a way to take into account the presence of nodes based on financial transactions. From their network analysis, they were able to find the existence of a multi-layered and hierarchical party coalition which show the central role of party organizations in campaign finance activities as they determine the network coalitions of actors and control the financial exchanges within the network. The authors were able to see the existence of distinctive partisan ties of Democratic and Republican party campaign finance networks defined by hierarchies among different types of actors from community detection algorithms. This detection of unique communities demonstrates the importance and influence of partisan ties campaign finance.

While individuals represent the largest source of donations accounting between 50 percent and 70 percent of funds collected by national party organizations and PACs, few analyses have been made to include individual donors. The authors advocate for more research when it comes to individual donations network to include information such as the directionality and amounts of transaction data exchanges.

Another political donation study using complex network methodologies that deserves attention is the analysis of contagion of campaign donations. Traag (2016) [15] was among the few researchers to use social network analysis to study contagion of campaign donations. Traag studied the diffusion of campaign donations on a network of over 50000 elites in the U.S., analyzing how the connections between donors strengthen contagion. A network of elites was constructed using a social tracking data of the elites' circles gathered by LittleSis. The question that Traag was trying to find is the likelihood of someone adopting a particular behavior given the neighbor's adoption within his or her network. The author introduced two different modes of contagion, which are cohesive reinforcement and independent reinforcement. Under these different modes, the structure may affect contagion.

The goal was to check whether contagion is driven by independent reinforcement or by cohesive reinforcement. The results show that donations diffusion (contagion) in the U.S. is mainly made by independent reinforcement contagion. This finding means that the probability of people making donations is higher when most people within their network, making donations are from different social groups or do not know each other well. This statement is opposite to the cohesive reinforcement principle whereby the contagion would derive from people from the same group or knows each other well. In a cohesive reinforcement contagion setting, people are willing to make risky decisions as they are likely to be supportive of friends and family. Such a setting describes a normative environment where social pressure exists on each individual. Failing to adhere to the group's norm is likely to lead to ostracization.

In contrast, in the setting of independent reinforcement, social contagion is not reinforced by adopters of the same group but rather by adopters from different groups. In some way, signals from the same group are redundant, meaning that the ties are weak. In answering whether contagion is driven by cohesive reinforcement or independent reinforcement, the author first analyzed the effect of donor degree to see whether the donation is likely to occur when exposed to donors. This effect (same community of donors) is compared to the impact of the number of independent donors (diverse community of donors). The analysis showed that campaign donations are socially contagious.

While these examples illustrate interesting findings on U.S. political donations networks using complex network analysis, there has been a growing application of complex network methodologies in the study of other countries' political donation networks in recent years. Bursztyn, Victor, et al. (2019) [16] used complex network methods to study the network of congress members by their co-partisanship and co-regional gains. Their goal was to understand the homophily of co-partisanship and co-regional within donation and voting networks. Homophily is the tendency of social entities to build ties and bond with other similar social entities similar to them. Through their analysis of networks, the authors were able to find strong evidence of homophily within donation and voting networks. Using Jaccard similarity, cosine similarity, and Louvain community detection algorithms, the authors, found homophily in both donation and voting networks. In Brazil's donation network, they found strong homophily of donors for regions as opposed to political parties, meaning that donors prefer to donate to regions rather than to political parties. Whereas in Brazil's voting

network, they found strong homophily of voters for political parties as opposed to regions, meaning that voters had a more definite preference to align their votes with political parties than regions. Using complex networks analysis, they were able to capture the dynamics between donations and votes, revealing the Brazilian federal system's fragility and weakness in which party interests tend to supersede regional interests. A situation that renders the system vulnerable to corruption.

# **Chapter 3.**

# **Methodology and Project Design**

#### 3.1. Research Motivation

The literature survey in political donations and political donations networks has provided us with insights into the similarities and differences between the U.S. and Canada's political system and campaign financing laws. It has also provided us with tremendous knowledge into the current state of political donations networks studies using complex network analysis. The research in political donations networks through the lens of complex networks is still at its infancy and growing. However, much of the studies have been focused on U.S. campaign contributions. This circumstance seems reasonable given that much of the sociological studies and body of work with regards to political donations have been focused primarily in the U.S. This gives us opportunities to explore other political contributions environments that have not yet been fully explored. Hence, the chance of this thesis to examine the Canadian case. As explained in the introduction, the Canadian experience presents an interesting case study. Unlike its U.S. counterparts, Canada is one of the few democracies to ban corporate donations. Hence, the motivation behind this research undertaking. Furthermore, most of the research in political contributions networks has been mainly focused on corporate donations over individual donations, which, contrary to common belief, represents the largest source of donations. This fact presents a new avenue of research to be explored.

#### 3.2. Data Collection

Given the objective of this thesis is to investigate the impact of the 2006 Party funding reforms on the power dynamics of political parties within the political donations across Canada's 13 provinces and territories, this thesis will analyze corporate and individual contributions made across the different geographical regions in Canada. The reason for this geographical approach is that research has found that geography plays a vital role in political donations. Therefore, this thesis project uses the public data of campaign contributions in Canada made available by Elections Canada [43].

The data consists of historical and current data on all campaign contributions made from 2003 to 2018. The reason for choosing this timeframe is to analyze and compare campaign contributions made pre-2006 Campaign Financing Reforms and campaign contributions made after the 2006 reforms. For the simplicity of the analysis, the timeframe will be divided into four periods: 2003-2006, 2007-2010, 2011-2014, and 2015-2018. The reason for this approach is to fall in line with the timeline of Canada's election. Based on the calculations, historically Canada's leadership specifically Prime Ministers (PM) tend to change on average every four years (PM. Jean Chrétien in the year 2000, PM. Paul Martin in the year 2004, PM. Stephen Harper in years 2006, 2008, and 2011, PM Justin Trudeau in years 2015 and 2018) [21].

Since the analysis will look at political donations from two dimensions (individual and corporate), individual campaign contributions data, business campaign contributions data, and corporate campaign contributions data were collected. The data of individual donations spanned from 2003 to 2018, while the business donations data and corporation donations data spanned from 2003 to 2006. No data was available after 2006 for corporation donations, and business donations since corporations and businesses campaign financing were banned. For simplicity, data on corporation donations and business donations were combined to form corporate donations data. Individual donations and corporate donations should be viewed distinctively in our analysis since research has shown that both sides' motivations differ.

#### 3.3. Data Transformation

The dimension for the raw data collected for individual donations of all provinces and territories from 2003 to 2018 was 1,083,790 x 26, while the dimension for the raw data collected for corporate donations of all provinces and territories from 2003 to 2006 was 32,365 x 26. These two datasets had to go through a series of transformations and data cleaning to ensure their relevancy and quality in the analysis. First, the dimensions of the datasets were reduced from 26 variables to 5 variables, including 'Year', 'Province', 'Political Party' (Party), 'Forward Sortation Area' (FSA), and 'Amount' (CAD). The first two variables would serve as filters, while the last three variables would be used for network construction. Contributions at all levels to a Political Party recipient was considered. Given that the Election Canada identifies the postal code of each donor, the postal code had to be modified in order

to only take into consideration the first three alphanumerical letters also known as the Forward Sortation Area (FSA) which represents the postal district (the geographical area that we intend to use when drawing the network).

Upon observation of the FSA information, mistakes were found in the inputting of the postal code. Some postal codes were not correctly inputted given that FSA follows a strict alphanumerical code pattern with the first entry being a letter, followed by a number, then another letter. These tiny mistakes had to be rectified. Furthermore, mistakes were made regarding the FSA code in which the code did not match the province and city. These errors had to be rectified by cross-referencing the FSA code with the contributor city and Canada Post FSA code database. There were missing or partly missing postal codes information which had to be cross-referenced with the contributor's city and treated by assigning the exact or similar FSA code based on Canada Post FSA code database. Datapoints with missing dates and contributions from overseas had to be removed, given that they could not be rendered useful in the analysis.

In the end, the data was aggregated by FSA since postal codes reveal micro-societies and are often considered to be socio-demographically homogeneous. Overall, the quality of the datasets was high, with a missing value rate of 6% for individual donations and 7% for corporate donations. In the end, the final cleaned data for individual donations has a dimension of 1,019,986 x 5, while the final cleaned data for corporate donations has a dimension of 30,197 x 5.

#### 3.4. Network Construction

The network construction requires to draw graphs of both individual donations from 2003-2018 and corporate donations from 2003-2006 of all 13 provinces and territories. This undertaking makes it at least a construction of 195 networks for individual donations and 52 networks for corporate donations. Before the construction of the networks, a formulation step is required to define the nodes, edges, and attributes. As explained in the previous section, from the extracted datasets, we will use the variables 'Party', 'FSA', and 'CAD' to be represented in a weighted edge list which is a list of 3 tuples that has a beginning node, an ending node, and an edge attribute (weight). Since we will be drawing the graphs of different provinces and territories across several years, we will have multiple different edge lists to construct the networks. From an algorithmic perspective, 'FSA' and 'Party' represent nodes

(the former being the start node while the latter being the end node). Edges represent the links between FSA and Party. CAD (the total contributions from FSA to Party) represents the edge attribute. Since the edges are weighted, all the networks will be undirected and weighted.

There are several basic steps in network construction described as follow:

#### • Step 1: Create a network from a specific data structure (for instance an edge list)

The edge list must be preferably in a CSV format to ensure that the programming language can read the data. The CSV file must describe the relationships among entities. It entails the following:

- Creating a node J for each political party and a node I for each district (FSA)

- When there is a donor from district I who donates an amount m to party J, if there is no arc between I and J, connect district I to party J by an arc of weight m. If there is an arc between I and J, add m to its weight.

#### • Step 2: Read the edge list and convert it into a network using Python (codes in blue)

df=pd.read\_csv (edgelist.csv) # Read the edge list under the new name 'df.'

g=nx.from\_pandas\_edgelist(df, 'source node', 'target node', 'weight') # Convert 'df' into a network

#### • Step 3: Draw the network (codes in blue)

nx.draw (g) # Draw the network

In the end, the conversion from an edge list to a network graph would resemble as follow, except the weight will not be shown on the graph.



#### 3.5. Software Used for Network Construction

The programming language module that was used to construct and visualize the networks was Python NetworkX. The four reasons for this choice of programming language, namely: no compilation required, active community and rich online documentation, good network analysis structure and commands, acceptable performance up to 100,000 nodes. The only caveats are lack of some community detection features and advanced visualization features (Zinoviev and Tulton, 2018) [30]. For data storage, Microsoft Excel was mainly used to store edge lists in CSV (comma-separated value) format to be read by Python for network construction. Excel was also used to treat the missing and erroneous values during the data treatment phase. Furthermore, the software pivot table function was used to summarize the data and aggregate donation amounts into a single FSA and Party. Statistical analysis was used with excel as well.

## Chapter 4.

# **Global Analysis of Canada's Political Donations**

#### 4.1. Canada Political Donations Statistics & Trends

#### 4.1.1. Canada's Individual Donations Statistics:

The estimates obtained from the new dataset reveal that from 2003 to 2018, individual donations to political parties totaled \$281,944,584.33. Among the 30 political parties, the data shows that 40.5% of individual donations went to the Liberal Party of Canada (LPC), 38.6% to the Conservative Party of Canada (CPC), 13.3% to the New Democratic Party (NDP), 2.20% to the Green Party of Canada (GPC), and 2.10% to Bloc Quebecois (BQ). The remaining 3.20% of individual donations were distributed among 25 other political parties. These percentages show that over the period, the most significant proportion of individual donations have been concentrated mainly in five main parties out of 30 political parties with the dominance of LPC and CPC.

The trend patterns of individual donations to political parties over the fifteen years show a relatively similar pattern for each province. Noticeable spikes in individual donations were found in 2008 (representing 12.3% of total individual donations), in 2011 (representing 7.40% of total individual donations), and in 2015 (representing 14.3% of total individual donations). These spikes in individual donations can be explained by the fact that donations tend to spike during Federal elections (the 40th Federal elections in 2008, the 41st Federal elections in 2011, and the 42nd Federal elections in 2015) [21]. In 2008, the Conservatives led by Prime Minister Harper won a second minority. In 2011, the Conservatives under Prime Minister Harper won a majority. Moreover, finally, in 2015, the Liberals under the leadership of Justin Trudeau won a majority government. (Elections Canada)

In terms of geographical areas, individual donations to political parties are highly concentrated in 3 provinces: Ontario (46.20%), British Columbia (15.3%), and Quebec (14.9%). Together, all three provinces represent 76.4% of total individual donations. From a regional point of view, individual donations from Eastern Canada, which consists of Newfoundland and Labrador, New Brunswick, Nova Scotia, Ontario, Prince Edward Island, and Quebec, totaled around \$189,552,543.47 representing 67.20% of total individual

donations during the fifteen years. Western Canada, which consists of British Columbia, Alberta, Saskatchewan, and Manitoba, totaled around \$90,762,876.88, representing 32.2% of total individual political donations. While, Northern Canada, which consists of Yukon, Northwest Territories, and Nunavut, totaled around \$1,511,598.01, just representing a mere 0.60%. These statistics show that much of individual donations have been concentrated in Eastern Canada. Individual donations from the three Territories have been hardly existent.

In Eastern Canada, individual donations were primarily contributed to the Liberal Party of Canada, having almost a triple percentage lead over the Conservative Party of Canada, their main opposition. Individual political donations in Ontario totaled \$130,198,472, most of which were gone to the Liberal Party of Canada (43.30%), the Conservative Party of Canada (38.5%), and the New Democratic Party (12.7%). In Quebec, individual donations amounted to \$42,109,540.31, among which 51.7% went to the Liberal Party of Canada, 25% to the Conservative Party of Canada, 14.0% to the Bloc Quebecois, and 7.4% to New Democratic Party. In Nova Scotia, individual donations totaled \$6,961,003.34, among which 46% went to the Liberal Party of Canada, 27.5% to the Conservative Party of Canada, and 20.3% to the New Democratic Party. Individual political donations in New Brunswick totaled \$5,452,260.26, most of which were given to the Liberal Party of Canada (53.2%), the Conservative Party of Canada (35.7%), and the New Democratic Party (7.80%). In Newfoundland and Labrador, individual donations amounted to \$2,823,277.69, among which 63.2% went to the Liberal Party of Canada, 24% to the Conservative Party of Canada, and 10.70% to New Democratic Party. Individual political donations in Prince Edward Island totaled \$2,007,989.87, most of which were given to the Liberal Party of Canada (44.10%), the Conservative Party of Canada (41.30%), and New Democratic Party (9.30%). These statistics indicate that the Liberal Party of Canada has had an absolute global advantage over parties in all the Eastern Canadian provinces.

In Western Canada, individual donations were primarily contributed to the Conservative Party of Canada, having a strong lead over the Liberal Party of Canada, their main opposition. Individual political donations in British Columbia totaled \$ 43,230,625.18, most of which were given to the Conservative Party of Canada (40.1%), the Liberal Party of Canada (31.70%), and New Democratic Party (20.00%). In Alberta, individual donations amounted to \$27,556,011.80, among which 57.00% went to the Conservative Party of Canada, 26.40% to the Liberal Party of Canada, and 8.40% to New Democratic Party.
Individual political donations in Manitoba totaled \$10,680,186.99, most of which were given to the Conservative Party of Canada (44.0%), Liberal Party of Canada (34.00%), New Democratic Party (16.00%). Saskatchewan individual donations totaled \$9,296,052.91, most of which were given to the Conservative Party of Canada (45.20%), New Democratic Party (25.80%), and Liberal Party of Canada (24.90%). These statistics indicate that the Conservative Party of Canada has had an absolute global advantage over parties in all the Western Canadian provinces.

In Northern Canada, individual donations were primarily contributed to the Conservative Party of Canada. Individual political donations in Yukon totaled \$742,657.75, most of which were given to the Conservative Party of Canada (50.60%), Liberal Party of Canada (21.50%), New Democratic Party (16.20%), Green Party of Canada (9.70%). Northwest Territories individual donations totaled \$562,687.40, among which 47.10% to the Conservative Party of Canada, 26.70% went to the Liberal Party of Canada, and 22.30% to New Democratic Party. In Nunavut, individual donations amounted to \$206,252.86. Conservative Party of Canada represented 36.90%, Liberal Party of Canada 32.60%, and the New Democratic Party 26.40%. These statistics indicate that the Conservative Party of Canada has had an absolute global advantage over parties in all the Territories.

**Insights:** All these statistics seem to show that CPC has had an advantage over LPC and other parties in collecting individual donations in Western and Northern Canada, while LPC has had an advantage over CPC and other parties in collecting individual donations in Eastern Canada.

#### 4.1.2. Canada's Corporate Donations Statistics:

From 2003 to 2006, corporate donations to political parties totaled \$31,914,561.15 compared to individual donations of \$63,232,414.54 within the same period. Among the 15 political parties, the data shows that the Liberal Party of Canada benefited the most from corporate donations accounting 63.80%, more than doubled the Conservative Party of Canada of 24.90% in second place. Over the four years, corporate donations showed a sharp decline.

Geographical analysis shows that much of corporate donations to political parties took place in Ontario (48.0%), Quebec (18.7%), Alberta (11.4%), and British Columbia (8.0%). Together all four provinces accounted for 86.1% of total corporate donations. From

a regional point of view, corporate donations from Eastern Canada, which consist of Newfoundland and Labrador, New Brunswick, Nova Scotia, Ontario, Prince Edward Island, and Quebec, totaled around \$24,029,787.53 representing 77.1% of total corporate donations in the region. Western Canada, which consists of British Columbia, Alberta, Saskatchewan, and Manitoba, totaled around \$7,726,654.83, representing 25% of total corporate political donations. Northern Canada, which consists of Yukon, Northwest Territories, and Nunavut, totaled around \$1,184,009.19, representing a mere 0.40%. Just like individual donations, these statistics show that corporate donations between 2003 and 2006 have been mainly concentrated in Eastern Canada and are hardly existent in the Territories.

In Eastern Canada, corporates largely contributed to the Liberal Party of Canada's disproportionally massive lead over their main opposition, the Conservative Party of Canada. Corporate political donations in Ontario totaled \$ 15,330,307.01, most of which were given to the Liberal Party of Canada (61.80%) and the Conservative Party of Canada (26.9%). In Quebec, corporate donations amounted to \$ 5,974,827.78, among which 81.3% went to the Liberal Party of Canada and 9.5% to the Conservative Party of Canada. In Nova Scotia, individual donations totaled \$1,066,830.97, among which 67.60% went to the Liberal Party of Canada, 20.10% to the Conservative Party of Canada, and 10.0% to the Progressive Conservative Party of Canada. The Progressive Conservative Party would merge with the Conservative Party in 2004. Corporate political donations in New Brunswick totaled \$813,728.86, most of which were given to the Liberal Party of Canada (52.80%) and the Conservative Party of Canada (43.50%). In Newfoundland and Labrador, corporate donations amounted to \$577,959.78, among which 63.2% went to the Liberal Party of Canada and 24.20% to the Conservative Party of Canada. Corporate political donations in Prince Edward Island totaled \$266,133.13, most of which were given to the Liberal Party of Canada (78.50%) and the Conservative Party of Canada (21.0%). These statistics indicate that the Liberal Party of Canada has had an advantage over parties in all Eastern Canadian provinces.

In Western Canada, much of the corporate contributions mostly went to the Liberal Party of Canada. Corporate political donations in British Columbia totaled \$2,542,761.15, most of which were given to the Liberal Party of Canada (61.80%) and the Conservative Party of Canada (24.50%). In Alberta, corporate donations amounted to \$3,632,463.12, among which 47.30% went to the Liberal Party of Canada and 36.50% to the Conservative Party of Canada. Corporate political donations in Manitoba totaled \$980,961.00, most of which were

given to the Liberal Party of Canada (62.10%) and the Conservative Party of Canada (30.70%). Saskatchewan's corporate political donations totaled \$570,469.56, most of which were given to the Liberal Party of Canada (45.20%), the Conservative Party of Canada (35.00%), and the New Democratic Party (10.90%). These statistics also reveal that the Liberal Party of Canada has had an advantage over parties in all Western Canadian provinces.

In the Territories, corporate donations were primarily contributed to the Liberal Party of Canada. Corporate political donations in Yukon totaled \$21,940.45, most of which were given to the Liberal Party of Canada (71.30%), New Democratic Party (15.00%), and the Conservative Party of Canada (13.70%). Northern Territories' corporate political donations totaled \$95,237.77, among which 73.70% went to the Liberal Party of Canada and 22.20% to the Conservative Party of Canada. In Nunavut, individual donations amounted to \$9,220 Liberal Party of Canada represented 49.10%, Conservative Party of Canada (27.10%), and Independent (15.10%). These statistics indicate that the Liberal Party of Canada has had a definite advantage over parties in all Northern Canadian Territories.

**Insights:** All these statistics support the claim that LPC has had a tremendous advantage over CPC and other parties in collecting corporate donations. LPC dominated in first place in all 13 provinces and territories.

### 4.1.3. Corporate and Individual Donations Pre- and Post-Reforms:

Another insight that we can derive from the data is the comparison between political parties' shares for corporate and individual donations before and after the 2006 reforms. It entails comparing the total amount of corporate donations by party between 2003 and 2006 to the total amount of individual donations by party between 2003 and 2006. It also entails analyzing the trend from 2003-2006 to 2015-2018. The total corporate donations and individual donations between 2003 and 2006, were \$31,851,261.15 and \$63,169,558.00, respectively. The total individual donations of 2007-2010, 2011-2014, and 2015-2018 were \$88,420,840.30, \$58,372,212.39, \$71,862,527.67, respectively.

As shown in Fig 1, LPC had the largest share of corporate donations and individual donations between 2003 and 2006. Corporate donations given to LPC was more than double the donations given to CPC. Similarly, individual donations to LPC were almost double of donations to CPC within the period 2003 and 2006. Furthermore, the results show that the

structure of corporate donations was duopolistic with LPC and CPC monopolizing most of the shares.

However, the structure began to change after 2006. The change after the 2006 reforms shows individual donations increasingly becoming triopolistic with LPC, CPC, and NDP occupying most of the shares and leading over other 27 parties. Between 2007 and 2010, LPC shares in individual donations declined, coming second to CPC. At the same time, many parties' donations increased. It was the case of CPC, NDP, GPC, BQ, and many others. However, their percentage shares either declined or remained the same. It was the case of NDP, LPC, BQ, GPC, and others. Some parties like CRCA and PCPC merged with the CPC. CPC became the biggest winner, whose donations skyrocketed by 150% from CAD 16 million (2003-2006) to CAD 40 million (2007-2010). The 2011-2014 era would see another shift with NDP rising in donations while CPC and LPC declined. Between 2015 and 2018, the donation structure would start to see a triopolistic structure with CPC, LPC, and NDP.



Fig. 1 Corporate and Individual Donations Comparison Pre-2006 and Post-2006

**Insights:** These trends tell us that the reforms had some impact on the structure of donations post-2006 reform. The reforms shifted the donations structure in favor of the CPC and disadvantaging LPC losing a big chunk of the donation shares it used to enjoy in the prereform era. The donation structure after 2006 moved from a duopolistic structure to a triopolistic structure due to the reforms.

## 4.2. Canada Political Donations Equity Analysis

Given the statistical results in the previous section, it seems fair to understand why reforms were needed in 2006, especially in the near-monopoly of a single party over the country's corporate donations suggesting a substantial degree of corporate-party embeddedness. The question that one might need to appreciate now is whether the 2006 reforms have had an impact in creating a fair competing battlefield for all political parties. To answer this question, we need to measure the inequality of donations among political parties across Canada's regions. One metric that is often used as the benchmark for measuring income inequality is the Gini Index (Gini, 1921) [26]. It is a measure of statistical dispersion that ranks income distribution from the Lorenz Curve on a 0 to 1 scale, with 0 being perfect equality and 1 being perfect inequality. The Lorenz curve is a statistical graph that shows the concentration of wealth in a population. The tracing of the graph is done by sorting incomes of a population in ascending order, then plotting the percentages of the population against the cumulative percentages of wealth on an x-y axis. It was developed by Max Lorenz (1905) [41]. The straight line on the curve corresponding to x=y represents the perfect equality line. The Gini index measures the deviation of a population from the perfect equality line. In our study, the higher the Gini index approaches 1, the higher the inequality among parties when it comes to donations, with those parties receiving much of the total donations' shares.

#### 4.2.1. Canada's Individual Donations Gini Analysis:

Between 2003 and 2018, the Gini index of individual donations in Canada averaged 0.725, meaning individual donations to political parties have been unequal. ON, AB, QC, BC, NL, MB, NS, NB in their decreasing order have Gini indexes above the national average while PEI, SK, NT, YT NU in their decreasing order have Gini indexes below the national average. Northern Territories has the lowest inequality compared to the other regions (Figure 1).



Figure 1: Individual Donations Average Gini Indexes and Trends

From 2003 to 2014, the average individual donations Gini index saw a sharp decrease from 0.765 to 0.692. From 2015 to 2018, the average individual donations Gini index saw a slight increase from 0.695 to 0.70. The results indicate that although the distribution of individual donations among political parties in Canada remains unequal, there are signs that this inequality is reducing (Figure 1).

### 4.2.2. Canada's Individual Donations Gini Analysis by Region:

In Eastern Canada, the Gini index has generally remained high. Among all the Eastern provinces, PEI had the lowest average inequality, followed by NB, NS, NL, QC, and ON (Figure 1). The data shows reduced inequality in 4 provinces (QC, NB, NS, and PEI) except in ON and NL. The trends are as followed (Figure 2):

- In ON, the average Gini index followed an upward trend. It rose from 0.875 (2003-2006 average) to 0.885 (2015-2018 average). This rise signifies that donations inequality among political parties has gradually increased in ON.
- In QC, the average Gini index followed a downward trend from 0.882 (2003-2006 average) to 0.845 (2015-2018 average). This decline signifies that donations inequality among political parties has gradually decreased in QC.
- In NB, the average Gini index followed a downward trend from 0.765 (2003-2006 average) to 0.485 (2015-2018 average). This decline signifies that donations inequality among political parties has gradually decreased in NB.
- In NS, the average Gini index had a downward trend from 0.818 (2003-2006 average) to 0.744 (2015-2018 average). This decline signifies that donations inequality among political parties has gradually decreased in NS.
- In PEI, the average Gini index followed a downward trend from 0.744 (2003-2006 average) to 0.627 (2015-2018 average). This decline signifies that donations inequality among political parties has gradually decreased in PEI.
- In NL, the average Gini index followed an upward trend from 0.824 (2003-2006 average) to 0.882 (2015-2018 average). This decline signifies that donations inequality among political parties has gradually increased in NL.



Figure 2: Eastern Canada Provinces Individual Donations Average Gini Index

In Western Canada, the Gini index has generally remained high. Among all the Western provinces, SK had the lowest inequality, followed by MB, BC, then AB. (Figure 1). The data shows reduced inequality in 3 provinces (BC, SK, and MB) except AB. The trends are as followed (Figure 3):

- In AB, the average Gini index followed an upward trend from 0.806 (2003-2006 average) to 0.913 (2007-2010 average). This index would then follow a decline to 0.861 (2011-2014 average) only to later rise to 0.873 (2015-2018 average). This rise signifies that donations inequality among political parties has increased in AB.
- In BC, the average Gini index followed an upward trend from 0.837 (2003-2006 average) to 0.887 (2007-2010 average). This index would then follow a downward trend to 0.801 (2015-2018 average). This decline signifies that donations inequality among political parties has gradually decreased in BC.
- In MB, the average Gini index followed an upward trend from 0.808 (2003-2006 average) to 0.844 (2007-2010 average). This index would then follow a downward trend to 0.716

(2015-2018 average). This decline signifies that donations inequality among political parties has gradually decreased in MB.

• In SK, the average Gini index followed a rise from 0.723 (2003-2006 average) to 0.872 (2007-2010 average). This trend would then be followed by a decline in Gini index to 0.507 (2011-2014 average). The index would rise to 0.618 (2015-2018 average). This latest rise signifies that donations inequality among political parties has increased in SK.



Figure 3 Western Canada Provinces Individual Donations Average Gini Index

In Northern Canada, the territories have had the lowest Gini indexes. Among all the Northern territories, NU had the lowest inequality, followed by NT and YT. (Figure 1). The data shows reduced inequality in 2 territories (NU and NT) except YT. The trends are as followed (Figure 4):

- In NU, the average Gini index followed a downward trend from 0.626 (average 2003-2006) to 0.428 (average 2015-2018). This decline signifies that donations inequality among political parties has decreased in NU.
- In NT, the average Gini index followed an upward trend from 0.647 (average 2003-2006) to 0.757 (average 2011-2014). The upward trend would be followed by a decline to 0.520

(average 2015-2018). This decline signifies that donations inequality among political parties has decreased in NT.

In YT, the average Gini index declined from 0.592 (average 2003-2006) to 0.129 (average 2007-2010). This trend would be followed by a sharp rise in Gini index to 0.617 (average 2015-2018). This rise in Gini index signifies that donations inequality among political parties has increased in YT.



Figure 4 Northern Canada Territories Individual Donations Average Gini Index

From the results of the Gini Index analysis, we can deduce that although the inequality among political parties when it comes to individual donations remains high in most of the provinces in Eastern Canada and Western Canada, there are signs that over the years inequality has been on the decline in most provinces and territories except for ON, NL, AB, and YT. Nevertheless, the signs are promising, which indicates that the 2006 Reforms have made an impact on slowing inequality. To put it into perspective, from 2003 to 2006, corporate political donations had higher average Gini indexes than individual political donations. The average Gini index of corporate donations in Canada was 0.799 versus 0.725 for individual donations within the same period. Across regions, eight provinces and two territories had higher average Gini indexes for corporate donations than for individual donations. This was the case of QC (0.921 vs 0.882), NL (0.888 vs 0.824), BC (0.871 vs 0.837), MB (0.868 vs 0.807), NS (0.863 vs 0.818), NB (0.863 vs 0.765), PEI (0.851 vs 0.744), NT (0.844 vs 0.647), SK (0.742 vs 0.723), and NU (0.584 vs 0.428). The only exceptions were AB (0.802 vs 0.806), ON (0.717 vs 0.875), and YT (0.576 vs 0.592). Interestingly, the latter are the ones that have been witnessing rising inequalities among parties in individual donations. The results show the strong inequalities that had plagued parties when it came to corporate donations.



Figure 5 Corporate Donations Average Gini Indexes

**Insights**: The decline in the Gini index between 2007 and 2014, coincides with the arrival of the Conservative Party under the leadership of Prime Minister Stephen Harper. PM Harper led two minority governments (one in 2006 and the other in 2008) and a majority government in 2008 that would last until 2014. The Conservative Party during the Harper era was able to constitute a strong and active coalition of political parties and politicians that was able to take advantage of the anger of voters expressed towards the Liberals in their favor. Furthermore, two minority governments created a climate in which the coalition of political parties and Conservatives had to collaborate on policies that would benefit their interests. As a result, the 2006 ban on corporate donations has put the Liberal Party in disarray as the Liberal Party funding system was more efficient in corporate donations. These factors explain the reason why the Gini Index declined. Smaller parties saw their donations increased. The Conservative Party was able to capitalize on the Liberal Party's weaknesses to triple its donations and reduce LPC dominance. Overall, the 2006 reforms had an effect in reducing the inequalities among political parties.

Given these findings, there is a need to see how these inequalities manifest in network structures and the power dynamics among political parties within the network.

# Chapter 5.

# **Donation Networks Global Measures of Connectivity**

As we move forward into exploring the structure and evolution of Canada's political donation networks, there is a need to understand the global connectivity of Canada's political donation networks. Such an approach will allow us to appreciate the relational properties between donors and political parties in Canada. It is a crucial step in understanding later the power distribution and dynamics within Canada's political network. This section will analyze four basic connectivity properties, namely: number of nodes, number of edges. In this section, we will focus mainly on individual donations.

## 5.1. Connectivity Properties of Donation Networks

### 5.1.1. Donation Networks Connectivity in Eastern Canada

In Eastern Canada, the connectivity properties differ from province to province and have evolved over the years. Their properties by province and trends are described below:

NB individual donations from 2003 to 2018, shows a decrease in the number of party nodes, a tiny increase in the number of FSA nodes, a tiny increase in the number of nodes, and an increase in the number of edges. The story behind these properties tells us that competition among political parties for donations has decreased, the geographical pool of donors has slightly increased, the connections between political parties and donors have increased. The verdict is an increasing level of connectivity between political parties and donors in the region.

NB	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	5.25	6.75	5.50	4.00	5.38	-4.3%	decreased
# of FSA	76.50	94.75	81.00	74.75	81.75	0.4%	increased
Total Nodes	81.75	101.50	86.50	78.75	87.13	0.1%	increased
# of Edges	132.50	190.50	143.50	142.00	152.13	4.5%	increased

Table 1: NB Individu	al Donations	Connectivity	Properties
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NL individual donations networks from 2003 to 2018, shows a decrease in the number of party nodes, a decrease in the number of FSA nodes, a decrease in the number of nodes, and a decrease in the number of edges. The story behind these properties tells us that competition among political parties for donations has decreased, the geographical pool of donors has decreased, and the number of connections between political parties and donors has decreased. The verdict is a decreasing level of connectivity between political parties and donors in the region.

NL	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	4.00	4.75	3.50	3.75	4.00	-0.1%	decreased
# of FSA	28.25	30.00	30.25	24.25	28.19	-3.2%	decreased
Total Nodes	32.25	34.75	33.75	28.00	32.19	-3.0%	decreased
# of Edges	56.00	62.50	52.00	52.75	55.81	-0.9%	decreased

Table 2: NL Individual Donations Connectivity Properties

NS individual donations networks from 2003 to 2018, shows a decrease in the number of party nodes, a decrease in the number of FSA nodes, a decrease in the number of nodes, and an increase in the number of edges. The story behind these properties tells us that competition among political parties for donations has decreased, the geographical pool of donors has decreased, and the number of connections between political parties and donors has decreased. The verdict is a decreasing level of connectivity between political parties and donors in the region.

T	abl	e 3:	NS	Indi	ividu	al L	Donati	ons	Connect	tivity I	Properties	
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NS	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	7.25	9.50	4.50	4.00	6.31	-8.2%	decreased
# of FSA	63.00	69.00	66.50	55.25	63.44	-2.8%	decreased
Total Nodes	70.25	78.50	71.00	59.25	69.75	-3.6%	decreased
# of Edges	164.25	209.50	148.75	122.75	161.31	-4.7%	decreased

ON individual donations networks from 2003 to 2018, shows a decrease in the number of party nodes, a decrease in the number of FSA nodes, a decrease in the number of nodes, and an increase in the number of edges. The story behind these properties tells us that competition among political parties for donations has decreased, the geographical pool of donors has decreased, the number of connections between political parties and donors has

decreased. The verdict is a decreasing level of connectivity between political parties and donors in the region.

ON	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	12.00	13.25	11.50	9.25	11.50	-5.6%	decreased
# of FSA	500.25	512.50	505.50	471.75	497.50	-1.4%	decreased
Total Nodes	512.25	525.75	517.00	481.00	509.00	-1.5%	decreased
# of Edges	1709.75	1965.25	1440.75	1214.00	1582.44	-6.9%	decreased

Table 4: ON Individual Donations Connectivity Properties

PEI individual donations networks from 2003 to 2018, shows a decrease in the number of party nodes, a decrease in the number of FSA nodes, a decrease in the number of nodes, and a decrease in the number of edges. The story behind these properties tells us that competition among political parties for donations has decreased, the geographical pool of donors has decreased, the number of connections between political parties and donors has decreased. The verdict is a decreasing level of connectivity between political parties and donors in the region.

Table 5: PEI Individual Donations Connectivity Properties

PEI	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	5.50	5.75	3.75	3.75	4.69	-7.6%	decreased
# of FSA	6.75	6.75	6.50	6.00	6.50	-2.8%	decreased
Total Nodes	12.25	12.50	10.25	9.75	11.19	-5.2%	decreased
# of Edges	22.00	22.75	19.75	16.75	20.31	-6.2%	decreased

QC individual donations networks from 2003 to 2018, shows an increase in the number of party nodes, a decrease in the number of FSA nodes, a decrease in the number of nodes, and a decrease in the number of edges. The story behind these properties tells us that competition among political parties for donations has decreased, the geographical pool of donors has decreased, and the number of connections between political parties and donors has decreased. The verdict is a decreasing level of connectivity between political parties and donors in the region.

QC	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	8.50	10.75	9.25	8.25	9.19	0.4%	increased
# of FSA	372.75	395.00	368.75	325.75	365.56	-3.1%	decreased
Total Nodes	381.25	405.75	378.00	334.00	374.75	-3.0%	decreased
# of Edges	906.50	1152.50	884.50	743.75	921.81	-3.0%	decreased

#### Table 6: QC Individual Donations Connectivity Properties

From this analysis, we found that in Eastern Canada, connectivity between parties and donors has generally declined. The provinces with decreasing connectivity, were NL, NS, PEI, and QC. The only province in the region with increasing connectivity was NB.

### 5.1.2. Donation Network Connectivity in Western Canada

In Western Canada, the connectivity properties differ from province to province and have evolved over the years. Their properties by province and trends are described below:

AB individual donations networks from 2003 to 2018, shows a decrease in the number of party nodes, an increase in the number of FSA nodes, an increase in the number of edges. The story behind these properties tells us that competition among political parties for donations has decreased, the geographical pool of donors has increased, and the number of connections between political parties and donors has decreased. The verdict is a decreasing level of connectivity with weaker ties between political parties and donors in the region.

AB	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	8.00	11.25	7.75	7.00	8.50	-0.04%	decreased
# of FSA	138.75	146.00	139.50	142.00	141.56	0.6%	increased
Total Nodes	146.75	157.25	147.25	149.00	150.06	0.5%	increased
# of Edges	404.50	516.00	339.25	336.00	398.94	-1.9%	decreased

Table 7 AB Individual Dor	ations Conne	ectivity Pr	operties
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BC individual donations networks from 2003 to 2018, shows a decrease in the number of party nodes, a decrease in the number of FSA nodes, a decrease in the number of nodes, and a decrease in the number of edges. The story behind these properties tells us that competition among political parties for donations has decreased, the geographical pool of

donors has decreased, and the number of connections between political parties and donors has decreased. The verdict is a decreasing level of connectivity with weaker ties between political parties and donors in the region.

BC	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	10.50	12.50	8.75	7.00	9.69	-7.7%	decreased
# of FSA	184.75	188.50	186.25	175.00	183.63	-1.3%	decreased
Total Nodes	195.25	201.00	195.00	182.00	193.31	-1.7%	decreased
# of Edges	646.75	716.75	543.50	477.75	596.19	-6.4%	decreased

Table 8: BC Individual Donations Connectivity Properties

MB individual donations networks from 2003 to 2018, shows a decrease in the number of party nodes, a decrease in the number of FSA nodes, a decrease in the number of nodes, and a decrease in the number of edges. The story behind these properties tells us that competition among political parties for donations has decreased, the geographical pool of donors has decreased, and the number of connections between political parties and donors has decreased. The verdict is a decreasing level of connectivity between political parties and donors in the region.

Table 9: MB Individual Donations Connectivity Properties

MB	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	7.75	8.75	6.00	5.75	7.06	-5.7%	decreased
# of FSA	61.00	62.25	61.00	56.75	60.25	-1.7%	decreased
Total Nodes	68.75	71.00	67.00	62.50	67.31	-2.3%	decreased
# of Edges	190.00	205.25	155.50	137.00	171.94	-7.0%	decreased

SK individual donations networks from 2003 to 2018, shows a decrease in the number of party nodes, an increase in the number of FSA nodes, a decrease in the number of nodes, and a decrease in the number of edges. The story behind these properties tells us that competition among political parties for donations has decreased, the geographical pool of donors has decreased, and the number of connections between political parties and donors has decreased. The verdict is a decreasing level of connectivity between political parties and donors in the region.

SK	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	7.25	7.25	4.25	5.25	6.00	-4.5%	decreased
# of FSA	41.00	43.00	41.25	42.25	41.88	0.8%	increased
Total Nodes	48.25	50.25	45.50	47.50	47.88	-0.2%	decreased
# of Edges	125.75	125.00	105.25	101.75	114.44	-4.9%	decreased

#### Table 10: SK Individual Donations Connectivity Properties

From this analysis, we found that in Western Canada, connectivity between parties and donors have been on the decline. All 4 provinces (AB, BC, MB, SK) have decreasing connectivity. This indicates that there is a growing disconnect between political parties and donor in Western Canada.

#### 5.1.3. Donation Network Connectivity in Northern Canada

NT individual donations networks from 2003 to 2018, shows a decrease in the number of party nodes, an increase in the number of FSA nodes, a decrease in the number of nodes, and a decrease in the number of edges. The story behind these properties tells us that competition among political parties for donations has decreased, the geographical pool of donors has increased, and the number of connections between political parties and donors has decreased. The verdict is a decreasing level of connectivity between political parties and donors in the region.

NT	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	4.75	4.25	3.75	2.75	3.88	-12.24%	decreased
# of FSA	2.00	2.00	2.25	2.00	2.06	0.3%	increased
Total Nodes	6.75	6.25	6.00	4.75	5.94	-8.1%	decreased
# of Edges	8.00	7.25	6.50	5.00	6.69	-10.7%	decreased

Table 11: NT Individual Donat	ions Connectivity Properties
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NU individual donations networks in from 2003 to 2018, shows a decrease in the number of party nodes, a decrease in the number of FSA nodes, a decrease in the number of nodes, and an increase in the number of edges. The story behind these properties tell us that competition among political parties for donations have decreased, the geographical pool of donors has decreased, and the number of connections between political parties and donors

has increased. The verdict is an increasing level of connectivity between political parties and donors in the region.

NU	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	6.00	4.75	3.75	3.00	4.38	-15.5%	decreased
# of FSA	5.75	3.75	2.75	2.00	3.56	-22.2%	decreased
Total Nodes	1.88	1.58	1.46	1.29	1.55	-8.8%	decreased
# of Edges	0.37	0.43	0.54	0.71	0.51	18.3%	increased

Table 12: NU Individual Donations Connectivity Properties

YT individual donations networks from 2003 to 2018, shows an increase in the number of party nodes, an increase in the number of FSA nodes, an increase in the number of edges. The story behind these properties tells us that competition among political parties for donations have decreased, the geographical pool of donors has increased, and the number of connections between political parties and donors has increased. The verdict is an increasing level of connectivity between political parties and donors in the region.

Table 13: YT Individual Donations Connectivity Properties

ΥТ	2003-2006	2007-2010	2011-2014	2015-2018	AVG 2003-2018	AVG Annual Growth Rate 2003-2018	Connectivity
# of Parties	3.75	5.00	4.00	3.50	4.06	0.21%	increased
# of FSA	2.00	3.00	2.75	2.75	2.63	10.4%	increased
Total Nodes	5.75	8.00	6.75	6.25	6.69	4.0%	increased
# of Edges	6.25	9.50	7.75	7.25	7.69	6.8%	increased

From this analysis, we found that Northern Territories' connectivity between parties and donors have been on the rise. All three territories (NT, NU, and YT) have increased connectivity suggesting an increase in political activity.

## 5.2. Visualization of Donation Networks in Canada

The visualization of donation networks was generated by using Python NetworkX. As shown, the political parties are represented in light blue and are sized according to their connections. The nodes in grey represent FSA, which are the least connected, and nodes in orange represent FSA, which are highly connected. The networks for each province are grouped by four within year periods: 2003-2006, 2007-2010, 2011-2014, and 2015-2018. From the graphs, it is possible to visualize four things: which party has the most connections, which FSA is highly connected, which FSA are battle terrains for political parties, and how the networks evolve. Given the sheer volume of graphs, they can be found in <u>Appendix A</u>.

From these visualizations, we generally see a duopolistic or triopolistic network structure rather than an oligopolistic structure in connection terms centered around LPC, CPC, and NDP. Historically, CPC has been first place, followed by LPC and NDP when it comes to individual donations. Just looking at the first position in terms of node degree, we can find that CPC has usually taken first place in ON, PEI, AB, BC, MB, SK, and YT. Whereas, LPC would usually take most of the first-place rank in NB, NL, NS, QC, NT, and NU. NDP would mostly grab third places across Canada except for BC, MB, SK, and YT, taking most of the second places. GPC would mostly be successful in YT taking most of the third places. The rankings provided by the graph representations in <u>Appendix A</u> are summarized in the table below.

		2003 - 2006			2007 - 2010			2011 - 2014				2015 - 2018						
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	MODE
	1st	LPC	LPC	LPC	CPC	CPC	CPC	CPC	CPC	CPC	LPC	LPC	LPC	LPC	LPC	CPC	CPC	LPC
NB	2nd	PCPC	CPC	CPC	LPC	LPC	LPC	LPC	LPC	LPC	CPC	CPC	CPC	CPC	CPC	LPC	LPC	LPC
	3rd	NDP	NDP	NDP	NDP	NDP	NDP	NDP	GPC	NDP	NDP	NDP	NDP	NDP	NDP	NDP	NDP	NDP
	1st	LPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	CPC	CPC	LPC
NL	2nd	PCPC	NDP	CPC	CPC	CPC	CPC	CPC	CPC	CPC	NDP	CPC	NDP	CPC	CPC	LPC	NDP	CPC
	3rd	NDP	CPC	NDP	NDP	NDP	NDP	NDP	NDP	NDP	CPC	NDP	CPC	NDP	NDP	NDP	0	NDP
	1st	PCPC	LPC	LPC	LPC	CPC	LPC	LPC	CPC	LPC	NDP	LPC	LPC	LPC	LPC	CPC	CPC	LPC
NS	2nd	LPC	NDP	NDP	CPC	LPC	CPC	CPC	LPC	CPC	LPC	CPC	CPC	CPC	CPC	NDP	NDP	CPC
	3rd	NDP	CPC	CPC	NDP	NDP	NDP	NDP	NDP	NDP	CPC	NDP	NDP	NDP	NDP	LPC	0	NDP
	1st	LPC	CPC	LPC	LPC	CPC	CPC	CPC	CPC	CPC	LPC	LPC	LPC	CPC	CPC	CPC	CPC	CPC
ON	2nd	PCPC	LPC	CPC	CPC	LPC	LPC	LPC	LPC	LPC	NDP	CPC	CPC	LPC	LPC	LPC	NDP	LPC
	3rd	NDP	NDP	NDP	NDP	NDP	NDP	NDP	GPC	NDP	CPC	NDP	NDP	NDP	NDP	NDP	LPC	NDP
-	1st	LPC	CPC	CPC	CPC	CPC	CPC	CPC	CPC	CPC	LPC	LPC	CPC	CPC	CPC	LPC	CPC	CPC
PEI	2nd	PCPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	CPC	CPC	LPC	LPC	LPC	CPC	GPC	LPC
	3rd	NDP	GPC	NDP	NDP	NDP	NDP	NDP	GPC	NDP	NDP	NDP	NDP	NDP	GPC	NDP	CHPC	NDP
	1st	LPC	LPC	LPC	LPC	CPC	CPC	LPC	BQ	CPC	NDP	LPC	LPC	LPC	CPC	CPC	CPC	LPC
QC	2nd	BQ	RØ	BQ	CPC	BQ	LPC	CPC	CPC	LPC	LPC	NDP	NUP	NDP	LPC	LPC	LPC	LPC
_	3rd	PCPC	CPC	CPC	BQ	LPC	BQ	BQ	LPC	BQ	CPC	CPC	BQ	CPC	NDP	NDP	NDP	CPC
<u> </u>																		
	1st	CRCA	CPC	CPC	CPC	CPC	CPC	CPC	CPC	CPC	LPC	LPC	CPC	CPC	CPC	CPC	CPC	CPC
AB	2nd	LPC	LPC	LPC	LPC	NDP	NDP	LPC	LPC	LPC	CPC	CPC	LPC	LPC	LPC	NDP	NDP	LPC
	3rd	PCPC	NDP	NDP	NDP	LPC	LPC	NDP	GPC	NDP	NDP	NDP	NDP	NDP	NDP	LPC	LPC	NDP
	1st	CRCA	CPC	CPC	CPC	CPC	CPC	CPC	CPC	CPC	NDP	LPC	LPC	CPC	CPC	CPC	CPC	CPC
BC	2nd	NDP	LPC	NDP	LPC	NDP	NDP	NDP	LPC	NDP	LPC	CPC	CPC	NDP	LPC	NDP	NDP	NDP
	3rd	LPC	NDP	LPC	NDP	LPC	LPC	LPC	NDP	LPC	CPC	NDP	NDP	LPC	NDP	LPC	GPC	LPC
	1st	CRCA	CPC	CPC	CPC	CPC	CPC	CPC	CPC	CPC	NDP	LPC	LPC	CPC	CPC	CPC	CPC	CPC
MB	2nd	NDP	LPC	NDP	LPC	NDP			LPC	NDP	LPC	CPC	CPC	NDP	LPC	NDP	NDP	NDP
1	3rd	LPC	NDP	LPC	NDP	LPC	LPC	LPC	NDP	LPC	CPC	NDP		LPC	NDP	LPC	GPC	LPC
	1st	NDP	CPC	CPC	CPC	CPC	CPC	CPC	CPC	CPC	NDP	LPC	CPC	CPC	CPC	CPC	CPC	CPC
SK	2nd	CRCA	LPC	LPC	LPC	NDP	NDP	NDP	NDP	NDP	CPC	CPC	LPC	NDP	LPC	NDP	NDP	NDP
	3rd	LPC	NDP	NDP	NDP	LPC	LPC	LPC	LPC	LPC	LPC	NDP	NDP	LPC	NDP	LPC	IND	LPC

Table 14: Individual Donations Ranking Position by Province

	1st	CRCA	LPC	NDP	CPC	CPC	CPC	LPC	LPC	CPC	LPC	LPC	CPC	LPC	LPC	LPC	CPC	LPC
NT	2nd	PCPC	CPC	LPC	LPC	LPC	LPC	CPC	CPC	LPC	CPC	CPC	LPC	CPC	CPC	CPC	0	CPC
1	3rd	LPC	NDP	CPC	NDP	NDP	NDP	NDP	NDP	NDP	NDP	NDP	NDP	NDP	NDP	NDP	0	NDP
	1st	NDP	LPC	CPC	CPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	LPC	CPC	LPC
NU	2nd	LPC	CPC	LPC	LPC	CPC	CPC	CPC	CPC	CPC	CPC	CPC	CPC	CPC	CPC	CPC	0	CPC
1	3rd	CRCA	GPC			NDP				NDP	NDP	NDP	0	0	0	NDP	0	GPC
	1st	CRCA	LPC	LPC	LPC	CPC	CPC	NDP	CPC	CPC	CPC	CPC	LPC	CPC	CPC	CPC	CPC	CPC
YT	2nd	NDP	NDP	CPC	CPC	NDP	NDP			LPC	GPC	LPC	CPC	LPC	LPC	NDP	NDP	NDP
1	3rd	LPC	GPC	NDP	NDP	APPC	LPC	CPC	LPC	GPC	LPC	GPC	GPC	GPC	GPC	GPC	0	GPC

The visualization of the networks seems to support the claim that when it comes to individual donations, CPC has been more efficient in collecting donations than LPC. While the network graph representations give us insights on the position of political parties within the donation network in terms of connectivity, it only captures one aspect of power and influence. To address this, the next chapter will cover the topics of centrality measures.

# Chapter 6.

# **Centrality Measures**

## 6.1. Jaccard Similarity Matrix

Political donations can usually be thought of as the expression of a donor's political will for which political parties would compete to influence. In that regard, the question one might ask is the level of competition among political parties. Fundamentally, we want to explore how similar political parties are concerning their geographical donors. One metric to measure similarity is the Jaccard similarity coefficient also known as the Jaccard Index. It is defined as the ratio between the intersection size of two sets and the union size of two sets, and it is often used as a metric of similarity (Hancock, 2004) [40]. The metric ranges between 0% (no similarity) and 100% (perfect similarity). In simple terms, the Jaccard Distance is the number of common elements divided by the number of unique elements. The metric indicates the similarity between two vertices. The formula is as shown below:

Jaccard Index = 
$$\frac{A \cap B}{A \cup B}$$

To illustrate this measure, we can take the example of two universities A and B. Suppose University A has students from Canada, the U.S., Senegal, Philippines, and Japan, and University B has students from Canada, the U.S., Japan, Senegal and Spain. How similar are universities A and B in terms of student country diversity? We then have the following:

A = {Canada, U.S., Senegal, Philippines, Japan} |A| = 5

$$B = \{Canada, U.S., Senegal, Spain, Japan\} \qquad |B| = 5$$

$$A \cap B = \{Canada, U.S., Japan, Senegal\}$$
  $|A \cap B| = 4$ 

$$A \cup B = \{Canada, U.S., Senegal, Japan, Philippines, Spain\}$$
  $|A \cup B| = 6$ 

Jaccard Index=  $\frac{|A \cap B|}{|A \cup B|} = \frac{4}{6} = 66.7\%$ 

From this result, A and B have a 66.7% similarity in terms of student diversity.

In their study of Brazil's donations and voting networks, Bursztyn, Victor, et al. (2019) calculated the similarity between congress members in both networks using the Jaccard coefficient similarity [16]. In our study, this metric has been used to analyze the similarity level among political parties concerning their donations network. The analysis shows dissimilarity and similarity between political parties. Similar political parties tend to compete in the same geographical locations and vice versa.

#### 6.1.1. Jaccard Similarity Analysis in Eastern Canada

In NB, the Jaccard similarity matrix for both corporate and individual donations reveals the following trends:

- NB Corporate Donations:
  - Corporate donations landscape shows an increasing level of geographical cohesiveness among some political parties, notably between LPC and CPC, which suggests that these parties compete in the same sphere for political donations.
  - 2003-2006: The corporate donation landscape in 2003 showed substantial dissimilarity among political parties. The highest degree of similarity was at a 16% similarity between LPC and PCPC, followed by a 12 % similarity between CPC and PCPC. The similarity level between political parties would start to increase in 2004, notably between LPC and CPC, with a 32% similarity, followed by a 14% similarity between GPC and NDP. The percentages would increase further in 2005 with a 41% similarity between LPC and CPC, 19% similarity between LPC and NDP, and 18% similarity between CPC and NDP. In 2006, this similarity would further increase with a 58% similarity between LPC and CPC, a 25% similarity between NDP and GPC. These results suggest that there was a growing direct competition between LPC and CPC and NDP in the corporate donations landscape sphere.
- NB Individual Donations:
  - The similarity level among political parties shows an increasing level of geographical cohesiveness notably among LPC, CPC, and NDP, suggesting that these parties are increasingly competing in the same sphere for political donations.

- 2003-2006: The results show a high level of dissimilarity among parties in 2003. The most substantial similarity in 2003 was between LPC and PCPC, with a 45% similarity, followed by a 30% similarity between LPC and NDP. The similarity would later increase from 2004 to 2006 between LPC and CPC, starting from 39% similarity in 2004 to 45% similarity in 2006. LPC and NDP would also see an increase in similarity from 30% in 2003 to 34% in 2006. Within the same period, the similarity between CPC and NDP would reach 27% in 2006.
- 2007-2010: Similarity between LPC and CPC would continue to rise at around 47%. The highest was in 2008, with a similarity of 67%. LPC and NDP would continue to decline from 48% in 2007 to 19% in 2010. This trend would indicate a decrease in competition between the two parties. Similarly, CPC and NDP would also see a decline from 29% in 2007 to less than 20% similarity in 2010 (the highest being 44% in 2008). GPC, which was also in the game, would have a higher similarity with NDP than with LPC, hovering between 25% to 36%.
- 2011-2014: Similarity between LPC and CPC would reach its peak in 2011 with 64% of similarity, only to reach 42% in 2014. Nevertheless, the similarity between the two parties remained the strongest. The similarity between LPC and NDP would continue to decline from 39% in 2011 to 21% in 2014. This decline in similarity would also be seen between CPC and NDP from 37% in 2011 to 27% in 2014.
- 2015-2018: the similarity between LPC and CPC would reach its peak in 2015, with 74% of similarity marking a fierce competition, only to reach 58% in 2017. The similarity between the two parties remained the strongest. The similarity between LPC and NDP would continue to decline from 51% in 2011 to 25% in 2017. The similarity between the two parties also indicated a fierce competition between the two parties. This decline in similarity would also be seen between CPC and NDP from 49% in 2015 to 37% in 2017. The similarity between CPC and NDP in 2017 was higher than the similarity between LPC and NDP in 2017.

In NL, the Jaccard similarity matrix for both corporate and individual donations reveals the following trends:

• NL Corporate Donations:

- 2003-2006: The results show an increasing level of similarity among political parties notably between LPC and CPC suggesting that these parties were directly competing in much of the same locations for political donations. The corporate donation landscape in 2003 showed strong dissimilarity between political parties. The highest degree of similarity was at a 18% similarity between LPC and PCPC. The similarity level among political parties would start to increase in 2004 notably between LPC and CPC with a 63% similarity followed by a 18% similarity between CPC and NDP. While the similarity between LPC and CPC would remain the strongest (62% in 2005 and 48% in 2006), the similarities between GPC and NDP and IND would increase in 2005 with both set of parties reaching 25%. These results seem to suggest a fierce competition between LPC and CPC in the corporate donations landscape sphere.
- NL Individual Donations:
  - The results show a high level of similarities among political parties, notably between LPC and CPC.
  - The similarity level among political parties shows a healthy level of dissimilarity among parties. The highest similarity in 2003 was between LPC and PCPC, with a 52% similarity. This percentage was followed by a 33% similarity between LPC and COPC, and a 30% similarity between LPC and NDP. Competition would later increase from 2004 to 2006 between LPC and CPC, starting from 52% similarity in 2004 to 57% similarity in 2006. LPC and NDP would also see a decrease in similarity from 52% in 2004 to 29% in 2006. Within the same period, the similarity between CPC and NDP would decline from 39% in 2004 to 29% in 2006.
  - 2007-2010: The similarity between LPC and CPC would continue to rise to around 50%. The highest being in 2008, with a similarity of 78%. LPC and NDP would continue to see a decline from 39% in 2007 to 29% in 2010 (the highest being 50% in 2008). These percentages would indicate a decrease in competition between the two parties. Similarly, CPC and NDP would also see a decline from 42% in 2007 to less than 30% similarity in 2010 (the highest being 43% in 2008). GPC was also in the game but having a low similarity with other parties (the highest being 25% similarity with COPC).

- 2011-2014: The similarity between LPC and CPC would reach its peak in 2011 with 71% of similarity, only to reach 10% in 2014. The similarity between LPC and NDP would continue to decline from 39% in 2011 to 23% in 2014. This decline in similarity would also be seen between CPC and NDP from 46% in 2011 to 38% in 2014.
- 2015-2018: The similarity between LPC and CPC would reach its peak in 2015, with 82% of similarity indicating a fierce rivalry, only to reach 65% in 2017. The similarity between the two parties remained the strongest. The similarity between LPC and NDP would continue to decline from 62% in 2011 to 39% in 2017. The similarity between the two parties still indicates a fierce competition between the two parties. This decline in similarity would also be seen between CPC and NDP from 55% in 2015 to 11% in 2018. The similarity between LPC and NDP was higher than the similarity between CPC and NDP.

In NS, the Jaccard similarity matrix for both corporate and individual revealed the following trends:

- NS Corporate Donations:
  - 2003-2006: NS corporate donations landscape shows an increasing level of similarity between political parties, notably between LPC and CPC, suggesting that these parties were directly competing in much of the same locations for political donations. The corporate donation landscape in 2003 showed substantial dissimilarity between political parties. The highest degree of similarity was at a 40% similarity between LPC and PCPC. The similarity level between political parties would start to increase in 2004, notably between LPC and CPC, with a 63% similarity followed by a 27% similarity between CPC and NDP. The similarity between LPC and CPC would remain the highest at 37% in 2005 and 54% in 2006), the similarity between LPC and NDP would increase from 23% to 25%. The similarity between NDP and CPC would increase from 27% in 2003 to 29% in 2006. These results seem to suggest a fierce competition between LPC and CPC in the corporate donations landscape sphere and moderate competition between CPC and NDP and LPC and NDP.
- NS Individual Donations:

- The results show a high level of similarities among political parties, notably between LPC and CPC.
- 2003-2006: The similarity level between political parties shows a healthy level of similarity among many political parties. The highest similarity in 2003 was between LPC and NDP, with a 69% similarity. This percentage was followed by a 68% similarity between PCPC and NDP, and a 60% similarity between LPC and CPC. Similarities between CRCA and parties like PCPC, LPC, and NDP would range between 46% and 59%. From 2004 to 2006, similarities between LPC and CPC would increase from 68% in 2004 to 76% in 2006. Similarities between LPC and NDP and CPC and NDP would maintain similarities above 50%, reaching the highest level in 2005 with a 70% similarity between LPC and NDP and 60% similarity between CPC and NDP. These numbers show a more substantial similarity between NDP and LPC than between NDP and CPC.
- 2007-2010: Similarity between LPC and CPC would continue to rise at around 68%. The highest being in 2008, with a similarity of 81%. LPC and NDP would see a decline from its highest at 71% in 2007 to 44% in 2010 (the highest being 78% in 2008). These numbers would indicate a decrease in competition between the two parties. Similarly, CPC and NDP would also see a decline from 77% in 2007 to 43% similarity in 2010 (the highest being 78% in 2008). GPC, which was also in the game but having a low similarity with LPC, CPC, and NDP averaging above 35% (the highest being 49% similarity with NDP).
- 2011-2014: The similarity between LPC and CPC would reach its peak in 2011 with 81% of similarity, only to reach 46% in 2014. The similarity between LPC and NDP would continue to decline from 68% in 2011 to 51% in 2014. This decline in similarity would also be seen between CPC and NDP from 74% in 2011 to 57% in 2014.
- 2015-2018: The similarity between LPC and CPC in 2015 was 82% marking a fierce competition, only to reach 65% in 2017. The similarity between the two parties remained the strongest. The similarity between LPC and NDP would continue to decline from 69% in 2015 to 62% in 2017. The similarity between the two parties still indicates a fierce competition between the two parties. This decline in similarity would also be seen between CPC and NDP from 66% in 2015 to 70% in 2017. The

similarity between LPC and NDP is much more substantial than the similarity between CPC and NDP.

In ON, the Jaccard similarity matrix for both corporate and individual revealed the following trends:

- ON Corporate Donations:
  - 2003-2006: ON corporate donations landscape shows an increasing level of similarity between political parties notably between LPC and CPC suggesting that these parties were directly competing in much of the same locations for political donations. The corporate donation landscape in 2003 showed strong dissimilarity among political parties averaging around 20%. The highest degree of similarity was at a 28% similarity between LPC and PCPC. CPC and PCPC would come second with a 27% similarity along with PCPC and CRCA with the same similarity percentage. The similarity level between political parties would start to increase in 2004 notably between LPC and CPC with a 64% similarity followed by a 14% similarity between CPC and NDP. While the similarity between LPC and CPC would remain the strongest (63% in 2005 and 59% in 2006), the similarities between LPC and NDP and NDP and CPC would hover around 15%. These results seem to suggest a fierce competition between LPC and CPC in the corporate donations landscape sphere.
- ON Individual Donations:
  - The results show a high level of similarities among political parties, notably between LPC and CPC.
  - 2003-2006: The similarity level among political parties shows a high level of similarity among many political parties. The highest similarity in 2003 was between LPC and PCPC, with a 79% similarity. This percentage was followed by a 75% similarity between LPC and NDP, a 74% similarity between LPC and CRCA, and a 71% similarity between PCPC and NDP. Similarities between LPC and CPC and CPC and NDP would be 38% and 39%. From 2004 to 2006, similarities between LPC and CPC would range from 84% to 87%. Similarities between LPC and NDP and CPC and NDP would maintain similarities above 50%, reaching the highest level in 2005 with 76%. Similarities between GPC and other significant parties would hover around 30%.

- 2007-2010: Similarity between LPC and CPC would rise at around 95%, with the highest being in 2008 with a similarity of 97%. LPC and NDP would continue to see a decline from its highest at 77% in 2007 to 53% in 2010 (the highest being 90% in 2008). These percentages would indicate a decrease in competition between the two parties. Similarly, CPC and NDP would also see a decline from 79% in 2007 to 53% similarity in 2010 (the highest being 90% in 2008). GPC, which was also in the game but having a low similarity with other parties with an average similarity with LPC, CPC, and NDP of above 50% (the highest being 68% similarity with NDP).
- 2011-2014: The similarity between LPC and CPC would reach its peak in 2011 with 91% of similarity, only to reach 83% in 2014. The similarity between LPC and NDP would continue to decline from 81% in 2011 to 51% in 2014. This decline in similarity would also be seen between CPC and NDP from 81% in 2011 to 51% in 2014. GPC would have its most substantial similarity with NDP of 43%.
- 2015-2018: The similarity between LPC and CPC in 2015 was 94% marking a fierce competition between the two parties, only to reach 89% in 2017. The similarity between the two parties remained the strongest. The similarity between LPC and NDP would continue to decline from 87% in 2015 to 82% in 2017. The similarity between the two parties still indicates a fierce competition between the two parties. This decline in similarity would also be seen between CPC and NDP from 87% in 2015 to 13% in 2018.

In PEI, the Jaccard similarity matrix for both corporate and individual donations reveals the following trends:

- PEI Corporate Donations
  - 2003-2006: The results show an increasing level of similarity among political parties, notably between LPC and CPC, suggesting that these parties were directly competing in much of the same locations for political donations. The corporate donation landscape in 2003 showed strong dissimilarity among political parties averaging around 20%. The only highest degree of similarity was at 20% between LPC and PCPC. The similarity level between political parties would start to increase in 2004 notably between LPC and CPC, reaching with a 100% similarity followed by a 33%

similarity between CPC and NDP and 33% similarity between LPC and NDP. The similarity between LPC and CPC would remain the strongest (40% in 2005 and 43% in 2006). These results seem to suggest intense competition between LPC and CPC in the corporate donations landscape sphere.

- PEI Individual Donations
  - Regarding PEI individual donations, the results show a higher level of similarities among political parties, notably between LPC and CPC.
  - 2003-2006: The similarity levels between political parties show a substantial similarity among many political parties. The strongest similarity in 2003 was between LPC and PCPC, with an 86% similarity. This percentage was followed by a 71% similarity between LPC and NDP, an 83% similarity between PCPC and NDP, and a 60% similarity between CRCA and NDP. Similarities between CPC and NDP would be 14%. From 2004 to 2006, similarities between LPC and CPC would reach the highest similarity of 100%. Similarities between LPC and NDP and CPC and NDP would maintain similarities ranging from 67% to 83%. Similarities between GPC and other significant parties would remain low.
  - 2007-2010: Similarity between LPC and CPC would average 86%. LPC and NDP would continue to see a decline from its highest at 83% in 2007 to 86% in 2010. Similarly, CPC and NDP would also see a decline from 83% in 2007 to 43% similarity in 2010 (the highest being 86%). The similarity between GPC and other significant parties would be between 17% and 67%. The highest would be with LPC, followed by NDP with 60% and CPC with 57%.
  - 2011-2014: The similarity between LPC and CPC would reach its peak in 2011 with 100% of similarity, only to reach 86% in 2014. Similarity between LPC and NDP would increase from 83% in 2011 to 100% in 2014. This increase in similarity would also be seen between CPC and NDP from 83% in 2011 to 86% in 2014 (the highest being 100% in 2012). GPC similarity with LPC, NDP, CPC of 83%, 71%, and 57% respectively.
  - 2015-2018: The similarity between LPC and CPC in 2015 was 100%, indicating a fierce competition between the two parties and will remain the same in 2017. The

similarity between the two parties remained the strongest. The similarity between LPC and NDP would continue to decline from 100% in 2015 to 57% in 2017. The similarity between the two parties still indicates a fierce competition between the two parties. This decline in similarity would also be seen between CPC and NDP from 43% in 2015 to 57% in 2017. In 2015, GPC had a substantial similarity with LPC, CPC, and NDP of 71%.

In QC, the Jaccard similarity matrix for both corporate and individual donations reveals the following trends:

- QC Corporate Donations
  - 2003-2006: The results show a more robust increasing level of similarity between LPC and BQ instead of LPC and CPC, suggesting a stronger rivalry between LPC and BQ rather than the traditional rivalry across Canada between LPC and CPC when it comes to competing in the same locations for political donations. The corporate donation landscape in 2003 showed a stronger dissimilarity among political parties. The highest degree of similarity was at 21% between CPC and CRCA. The similarity between CRCA and PCPC was at 20%. While the similarity between BQ and LPC remained at 18%, the similarity between LPC and CPC was at close to 0%. The similarity between LPC and BQ would continue to increase from 21% in 2004 to 30% in 2006(the highest being 35% in 2005). In parallel, the similarity in 2006. CPC and BQ would also see an increase from 10% in 2004 to 22% in 2006. These results seem to suggest stiffer competition between LPC and BQ and between CPC and BQ in the corporate donations landscape sphere.
- QC Individual Donations
  - The results show a high level of similarities among political parties, notably between LPC and BQ, CPC and BQ, LPC and CPC.
  - 2003-2006: The similarity levels between political parties show a high level of similarity among many political parties. In 2003, the highest similarity was between LPC and BQ, with a 51% similarity, followed by a 47% similarity between LPC and PCPC. From 2004 to 2006, similarities between LPC and BQ would decline from 69%

in 2004 to 58% in 2006. On the other hand, the similarities between CPC and BQ would increase from 48% in 2004 to 53% in 2006. At the same time, the similarity between LPC and CPC would also increase from 48% in 2004 to 70% in 2006 (the highest similarity within the period).

- 2007- 2010: Similarity between LPC and BQ would average 68%. The similarity between CPC and BQ would average 67%. While the similarity between LPC and CPC would average 71%. The results show that a stronger rivalry to emerge between LPC and CPC. Similarities between NDP and these major rival parties would hover around 20%, while similarities between GPC and these significant parties would be below 20%
- 2011-2014: The similarities between LPC and BQ would decline from 65% in 2011 to 44% in 2014. A similar decline in similarity would be seen between CPC and BQ from 62% in 2011 to 21% in 2014. The similarity between LPC and CPC would also decline from 69% in 2011 to 34% in 2014. However, the similarity between NDP and LPC would increase from 49% in 2011 to 50% in 2014. These figures suggest an increasing rivalry between LPC and NDP.
- 2015-2018: While the similarity between LPC and NDP would reach its peak with a 73% similarity in 2015, the similarity between LPC and CPC would continue to maintain a level of similarity of over 60%. NDP would maintain a similarity level with LPC and CPC of 50% and 48%, respectively, in 2017.

### 6.1.2. Jaccard Similarity Analysis in Western Canada

In AB, the Jaccard similarity matrix for both corporate and individual donations reveals the following trends:

- AB Corporate Donations
  - 2003-2006: The results show an increasing similarity between LPC and CPC from 25% in 2003 to 37% in 2006. In 2003, the highest degree of similarity was between LPC and CRCA at 43%. This percentage was followed by a 35% similarity between LPC and PCPC. The similarity between LPC and CPC would reach 25% in 2003. From

2004, the similarity between LPC and CPC would decline from 60% to 37% in 2006. The similarity between other political parties would be small.

- AB Individual Donations
  - The results show strong similarities among political parties, notably between LPC and CPC, and to a certain extent LPC and NDP, and CPC and NDP.
  - 2003-2006: The similarity levels between political parties show a substantial level of similarity among many political parties. In 2003, the most substantial similarity was between PCPC and CRCA, with a 73% similarity, followed by a 72% similarity between LPC and CRCA. In that same year, the similarity between LPC and CPC was at 57%. The similarities between LPC and NDP and between CPC and NDP were estimated at 65% and 51%, respectively. From 2004 to 2006, similarities between LPC and CPC would increase from 69% in 2004 to 75% in 2006. On the other hand, similarities between CPC and NDP and similarities between LPC and NDP would maintain a level within 40% and 54% range. On the other hand, similarities between GPC and major parties (LPC, CPC, and NDP) would remain between 17% and 25%.
  - 2007-2010: Similarity between LPC and CPC would increase from 68% in 2007 to 72% in 2010 (the highest being 86%). The similarity between LPC and NDP would decrease from 79% in 2007 to 33% in 2010. Whereas the similarity between CPC and NDP would decline from 79% in 2007 to 29% in 2010. The results show that a stronger rivalry would emerge between LPC and CPC. Similarities between GPC and other parties (LPC, CPC, and NDP) would average 50.75%, 41.75%, and 40.75%, respectively.
  - 2011-2014: The similarities between LPC and CPC would decline from 71% in 2011 to 66% in 2014. A similar decline in similarity would be seen between LPC and NDP from 56% in 2011 to 30% in 2014. The similarity between CPC and NDP would also see a decline from 61% in 2011 to 13% in 2014. Similarities between GPC and other parties (LPC, CPC, and NDP) would average 22%, 18%, and 19%, respectively.
  - 2015-2018: The similarity between LPC and CPC would decrease from an 86% similarity in 2015 to a 61% similarity in 2017. The similarity between LPC and NDP would continue to decrease from 81% in 2015 to 63% in 2017. The similarity

between CPC and NDP would increase from 78% similarity to 80%, respectively, in 2017.

In BC, the Jaccard similarity matrix for both corporate and individual donations reveals the following trends:

- BC Corporate Donations
  - 2003-2006: BC corporate donations landscape showed an increasing similarity between LPC and CPC. The similarity between LPC and CPC would be nonexistent in 2003. The similarity between CPC and LPC would decrease from 60% in 2004 to 45% in 2006.
- BC Individual Donations
  - The results show strong similarities among political parties.
  - 2003-2006: The similarity levels between political parties show very high levels of similarity among many political parties. In 2003, the highest similarities were between CRCA and NDP (91% similarity), CRCA and LPC (82% similarity), LPC and NDP (79% similarity), PCPC and NDP (75% similarity), CRCA and PCPC (73% similarity), PCPC and LPC (72% similarity), CRCA and CPC (56% similarity), CPC and NDP (56% similarity), LPC and CPC (55% similarity), CPC and LPC (55% similarity), and PCPC and CPC (53% similarity). From 2004 to 2006, similarities between LPC and CPC would increase from 69% in 2004 to 75% in 2006. On the other hand, similarities between CPC and NDP and similarities between LPC and NDP would maintain a level within 40% and 54% range. On the other hand, similarities between GPC and major parties (LPC, CPC, and NDP) would remain at 17% and 25%. From 2004 to 2006, the similarity between LPC and CPC would increase from 85% in 2004 to 89% in 2006. Similarities between LPC and NDP would maintain 82% similarities between GPC and other parties (LPC, CPC, and NDP) would hover around 30%.
  - 2007-2010: The similarity between LPC and CPC would range between 80% and 94%. The similarity between LPC and NDP would range between 61% and 91%. Whereas the similarity between CPC and NDP would range between 72% and 92%.

The results show that a stronger rivalry would emerge between LPC, CPC, and NDP. Similarities between GPC and other parties (LPC, CPC, and NDP) would average 53%, 58.75%, and 58% respectively.

- 2011-2014: The similarities between LPC and CPC would decline from 86% in 2011 to 82% in 2014. A similar decline in similarity would be seen between LPC and NDP from 83% in 2011 to 57% in 2014. The similarity between CPC and NDP would also see a decline from 88% in 2011 to 65% in 2014. Similarities between GPC and other parties (LPC, CPC, and NDP) would average 31%, 32%, and 33% respectively.
- 2015-2018: The similarity between LPC and CPC would decrease from a 97% similarity in 2015 to an 85% similarity in 2017. The similarity between LPC and NDP would continue to decrease from 95% in 2015 to 84% in 2017. The similarity between CPC and NDP would decline from a 96% similarity to 13%, respectively, in 2018. Similarities between GPC and other parties (LPC, CPC, and NDP) would average 35%, 35%, and 34% respectively.

In MB, the Jaccard similarity matrix for both corporate and individual donations reveal the following trends:

- MB Corporate Donations
  - 2003-2006: MB corporate donations landscape showed an increasing similarity between LPC and CPC. The similarity between LPC and CPC would jump from 17% in 2003 to 51% in 2006. The similarity between LPC and NDP and between CPC and NDP would be below 20%.
- MB Individual Donations
  - $\circ$   $\;$  The results show strong similarities among political parties
  - 2003-2006: The similarity between LPC and CPC would see an increase from 54% in 2003 to 66% in 2006 (the highest being 80% in 2005). The similarity between LPC and NDP would see a decrease from 78% in 2003 to 60% in 2006. While the similarity between CPC and NDP would reach 55% in 2006.

- 2007-2010: Similarity between LPC and CPC would range between 70% and 85%. The similarity between LPC and NDP would range between 67% and 83%. Whereas the similarity between CPC and NDP would range between 70% and 84%. The results show that a stronger rivalry would emerge between LPC, CPC, and NDP. Similarities between GPC and other parties (LPC, CPC, and NDP) would range between 29% and 48%.
- 2011-2014: The similarities between LPC and CPC would decline from 79% in 2011 to 71% in 2014. A similar decline in similarity would be seen between LPC and NDP from 64% in 2011 to 46% in 2014. The similarity between CPC and NDP would also see a decline from 65% in 2011 to 38% in 2014. Similarities between GPC and other parties (LPC, CPC, and NDP) would hover around 20%.
- 2015-2018: The similarity between LPC and CPC would decrease from an 82% similarity in 2015 to a 70% similarity in 2017. The similarity between LPC and NDP would continue to decrease from 83% in 2015 to 79% in 2017. The similarity between CPC and NDP would rise from a 68% similarity to 82%, respectively, in 2017. Similarities between GPC and other parties (LPC, CPC, and NDP) would hover around 20% on average.

In SK, the Jaccard similarity matrix for both corporate and individual donations reveals the following trends:

- SK Corporate Donations
  - 2003-2006: SK corporate donations landscape showed an increasing similarity between LPC and CPC. The similarity between LPC and CPC would jump from 14% in 2003 to 50% in 2006. The similarity between LPC and NDP would decrease from 38% in 2003 to 18% in 2006. Furthermore, the similarity between CPC and NDP would decrease from 33% similarity in 2003 to 10% similarity in 2006.
- SK Individual Donations
  - The results show strong similarities among political parties:79% similarity between PCPC and LPC, 77% similarity between PCPC and CRCA, 86% similarity between LPC and CRCA, 69% similarity between PCPC and NDP, 52% similarity between PCPC and

CPC, 86% similarity between LPC and CRCA, and 50% similarity between COPC and GPC.

- 2003-2006: The similarity between LPC and CPC would see an increase from 53% in 2003 to 78% in 2006 (the highest being 75% in 2005). Similarity between LPC and NDP would see a decrease from 82% in 2003 to 69% in 2006. While similarity between CPC and NDP would increase from 44% in 2003 to 65% in 2006.
- 2007-2010: Similarity between LPC and CPC would increase from 59% in 2007 to 62% in 2010. The similarity between LPC and NDP would increase from 60% in 2007 to 65% in 2010. Whereas the similarity between CPC and NDP would decrease from 88% in 2007 and 67% in 2010. The results show that a stronger rivalry would emerge between LPC, CPC, and NDP. Similarities between GPC and other parties (LPC, CPC, and NDP) would range between 17% and 47%
- 2011-2014: The similarity between LPC and CPC would rise from 74% in 2011 to 75% in 2014 (the highest being 82%). A similar decline in similarity would be seen between LPC and NDP from 68% in 2011 to 59% in 2014. The similarity between CPC and NDP would also see a decline from 80% in 2011 to 71% in 2014. Similarities between GPC and other parties (LPC, CPC, and NDP) would range between 10% and 15%.
- 2015-2018: The similarity between LPC and CPC would decrease from an 80% similarity in 2015 to a 61% similarity in 2017. The similarity between LPC and NDP would continue to decrease from 80% in 2015 to 66% in 2017. The similarity between CPC and NDP would decrease from a 91% similarity to 13%, respectively, in 2018. Similarities between GPC and other parties (LPC, CPC, and NDP) would hover around an average of 19%.

### 6.1.3. Jaccard Similarity Analysis in Northern Canada

In NT, the Jaccard similarity matrix for both corporate and individual donations reveals the following trends:

• NT Corporate Donations

- 2003-2006: NT corporate donations landscape showed an increasing similarity between LPC and CPC. The similarity between LPC and CPC would jump from 50% in 2003 to 100% in 2006. The similarity between LPC and NDP would maintain a similarity level of 100% between 2003 and 2006. Furthermore, the similarity between CPC and NDP would increase from 50% similarity in 2003 to 100% similarity in 2006. In 2004, IND and GPC would have a 100% similarity with CPC.
- NT Individual Donations
  - The results show strong similarities among political parties ranging from 50% similarity to 100% similarity.
  - 2003-2006: The similarity between LPC and CPC would see an increase from 50% in 2003 to 100% in 2006. The same trend would follow between LPC and NDP from 50% in 2003 to 100% in 2006. The similarity between CPC and NDP would increase from 50% in 2003 to 100% in 2006. GPC would also see a 100% similarity with LPC, CPC, and NDP.
  - 007-2018: Similarities between LPC and CPC, LPC and NDP, and CPC and NDP would maintain 100%. The results show that a stronger rivalry would emerge between LPC, CPC, and NDP. In contrast, GPC would see a 50% similarity with LPC, CPC, and NDP.

In NU, the Jaccard similarity matrix for both corporate and individual donations reveals the following trends:

- NU Corporate Donations
  - 2003-2006: NU corporate donations landscape showed a 50% similarity between LPC and CPC. LPC will have a 100% similarity with IND in 2004. The similarity between MP and CPC would maintain a similarity level of 100%.
- NU Individual Donations
  - 2003-2018: The results show 100% similarities among political parties (LPC, CPC, NDP, GPC) from 2003 to 2018.
In YT, the Jaccard similarity matrix for both corporate and individual donations reveal the following trends:

- YT Corporate Donations
  - 2003-2006: YT corporate donations landscape showed a 50% similarity between LPC and CPC and between LPC and NDP. The similarity between CPC and NDP had a 100% similarity.
- YT Individual Donations
  - The results show strong similarities among political parties.
  - 2003-2018: The similarity between LPC and CPC would range from 33% in 2003 to 67% in 2018. Similarities between LPC and NDP and between CPC and NDP would range from 33% to 100%. Similarities between GPC and other parties (LPC, CPC, and NDP) would range between 50% and 100%.

The key takeaway from the analysis is that we have witnessed stronger and more cohesive similarities among political parties in individual donations than in corporate donations. Many of the Jaccard similarities among parties in individual donations were above 50% similarities across the regions. This situation was the case for LPC, CPC, NDP, and many others. On the other hand, the Jaccard similarities in corporate donations were, for the most part, way below 50% similarities. The highest similarity in corporate donations was usually a similarity between LPC and CPC. The conclusion that can be made is that there has been more competition among parties in individual donations networks than corporate donation networks.

While many political parties compete on similar terrain for political donations, there is still the question of which political parties hold power, prestige, and influence of political donations. Fundamentally, what we are trying to understand is how central a political party is within its network and what degree of influence, power, and control a political party has vis a vis its network. In this regard, the literature on network centrality has been well documented to answer these questions. It has been argued that the application of centrality measures in political network analysis can give "political advantages of access, brokerage, and efficiency, all of which can translate into political power" (Hafner-Burton & Montgomery, 2010) [27]. The most prominent centrality measures are divided into degree centrality, betweenness centrality, and closeness centrality. (Rusinowska, Berghammer, Swart, & Grabisch, 2011) [28]. These measures were developed by Freeman (1979) [29]. Centrality is vital to our study because it indicates which political parties occupy critical positions in the donation network. The next sections will analyze the power dynamics among political parties using degree, betweenness, and closeness centrality measures.

#### 6.2. Degree Centrality Analysis

Degree centrality is a measure of popularity (Freeman, 1979) [29]. To be more specific, it is a measure of direct influence. It is simply defined as the number of connecting links that a node has. The formula is shown below (Zhang and Luo, 2017) [59]:

$$C_{D=} \frac{\sum_{j=1}^{n} X_{ij}}{(n-1)(n-2)} i \neq j$$

where  $\sum X_{ij}$  is the number of edges directly connected with a given node N (node degree); n is the total number of nodes.

The higher the node degree, the higher the connections, the higher the importance. The degree centrality is illustrated in the following example:



From this example, node B has the highest node degree. It means that node B has the highest number of connections, and consequently, it is the most important node.

The metric can be weighted by computing the number of edges and the sum of the weight of the edges. In the context of political donations, the metric can help identify the most popular political parties within the network in terms of connections and donations. Political parties with the most connections with donors are the ones with the highest degree centrality. The size of their connections represents the size of their power base within the

donation network from which they can rally the most donors and donations. The bigger their size, the more likely they will increase their chances of collecting more political donations.

#### 6.2.1. Degree Centrality Analysis in Eastern Canada

- NB Corporate Donations
  - 2003-2006: The degree centralities of NB corporate donations show that the most popular party was an alternation between LPC and CPC. The results show that both parties have similar node degrees. Nevertheless, LPC was the clear victor when it comes to the weighted node degree.
- NB Individual Donations
  - 2003-2006: The results show that the most central node by node degree was LPC.
     CPC would take second place except for 2006. However, LPC would be the most popular in terms of donations received. CPC comes second, followed by NDP.
  - 2007-2010: The results show that CPC would largely dominate LPC in terms of the number of connections. However, LPC would lead in terms of the number of donations.
  - 2011-2014: LPC would lead CPC in terms of node degree and maintain the lead in weighted node degree.
  - 2015-2018: 2015-2018: LPC leadership trend in both the number of connections and donations value ((weighted degree) would continue until 2016 only to come second to CPC.

From this analysis, we can conclude that the winner in terms of node degree would be LPC, and the winner in terms of weighted node degree would be LPC for both corporate and individual donations.

- NL Corporate Donations
  - 2003-2006: Degree centrality analysis shows that LPC is the most central node with the highest node degree centrality and weighted degree centrality.
- NL Individual Donations

- 2003-2010: Degree centrality analysis shows LPC to be the most popular node having the highest node degree centrality and weighted degree centrality. CPC would come second, followed by NDP.
- 2011-2014: LPC would continue to maintain its dominance in both the number of connections and donations amount except for 2011 when CPC would surpass LPC in terms of donations connections. The second most popular node in terms of the number of connections would alternate yearly between CPC and NDP.
- 2015-2018: LPC would continue to be the most popular node in terms of the number of connections and donations value until 2016 when CPC would take the lead in terms of node degree and weighted degree.

From this analysis, we can conclude that the winner in terms of node degree would be LPC, and the winner in terms of weighted node degree would be LPC for both corporate and individual donations.

- NS Corporate Donations
  - 2003-2006: LPC led over other parties in node degree and weighted degree. CPC would take second place, followed by NDP.
- NS Individual Donations
  - 2003-2006: LPC would be the most popular node in terms of node degree and weighted degree. NDP generally comes in second place, followed by CPC.
  - 2007-2010: The most popular node in terms of node degree would alternate between CPC and LPC. However, LPC would continue to be the most popular in terms of amount donations connections except for 2010 when CPC would surpass LPC.
  - 2011-2017: LPC would remain the most popular node. However, LPC would be surpassed by CPC in 2017.

From this analysis, we can conclude that the winner in node degree and weighted degree would be LPC for both corporate and individual donations.

• ON Corporate Donations

- 2003-2006: Degree centrality for corporate donations reveals that LPC was the most popular node when it comes to the number of connections and donations value. CPC would come second, followed by NDP.
- ON Individual Donations
  - 2003-2006: Degree centrality for individual donations would show CPC to be the most central node in terms of the number of connections followed by LPC, NDP, and GPC. However, LPC would continue to be the most central node in terms of donations value. CPC will come in second place, followed by NDP.
  - 2007-2010: Degree centrality analysis reveals that CPC to be the most central node in terms of the number of connections and donations value to a certain extent. LPC would remain second, followed by NDP then GPC.
  - 2011-2014: The trend would reverse in favor of LPC in terms of the number of connections and donations value.
  - 2015-2018: CPC would reclaim its leadership position over LPC in terms of the number of connections and donations value. NDP would usually remain in third place.

From this analysis, we can conclude that LPC would be the winner in node degree and weighted degree for corporate donations. However, CPC would be the winner in node degree and weighted degree for individual donations.

- PEI Corporate Donations
  - 2003-2006: The most popular node in terms of the number of connections alternate between LPC and CPC. However, LPC would continue to lead in terms of donations value.
- PEI Individual Donations
  - 2003-2006: CPC would be the most central node in terms of the number of connections. However, LPC would lead in terms of donations value.

- 2007-2010: the trend would continue with CPC being the most central node in terms of the number of connections and donations value. LPC will come in second place, followed by NDP and GPC.
- 2011-2014: CPC would be the most popular node in terms of the number of connections. However, LPC would lead in terms of donations value, while NDP will continue to take third place.
- 2015-2018: CPC would maintain its leadership position in terms of number of connections and reclaim its leadership position in terms of donations value.

From this analysis, we can conclude that LPC would be the winner in node degree and weighted degree for corporate donations. However, CPC would be the winner in node degree and weighted degree for individual donations.

- QC Corporate Donations
  - 2003-2006: Degree centrality analysis shows that LPC to be the most popular node within the network both in terms of the number of connections and donations value. Interestingly, BQ would take second place over CPC in terms of the number of connections. However, CPC would surpass BQ in terms of donations value.
- QC Individual Donations
  - 2003-2006: Degree centrality analysis shows LPC to be the most popular node within the network in terms of network connections and donations value. BQ would come in second place, followed by CPC and NDP.
  - 2007-2010: CPC would take the lead in terms of the number of connections followed by LPC, BQ, and NDP. However, LPC would lead in donations value followed by CPC, BQ, and NDP.
  - 2011-2014: CPC would lead in terms of the number of connections in 2011. It would be overtaken by NDP in 2012, and by LPC in 2013. LPC would continue to maintain its leadership position in donations value.

 2015-2018: CPC would take over the leadership position of LPC in terms of number of connections and donations value making LPC fall into second place followed by NDP and BQ.

From this analysis, we can conclude that LPC would be the winner in node degree and weighted degree for corporate donations. On the other, for individual donations, CPC would be the winner in node degree. However, LPC would be the winner in weighted degree.

#### 6.2.2. Degree Centrality Analysis in Western Canada

- AB Corporate Donations
  - 2003-2006: The degree centrality analysis shows that CPC was the most popular political party in terms of the number of connections and donations value. LPC would claim second place in both the number of connections and donations value. NDP would come in third place in terms of number of connections only.
- AB Individual Donations
  - 2003-2006: CPC would continue to lead in both number of connections and donations value. LPC would take second place in both the number of connections and donations value. NDP would take third place.
  - 2007-2010: CPC would continue to lead in both number of connections and value. On the other hand, LPC and NDP would compete for second place in the number of connections. However, LPC would claim second place in terms of donations value.
  - 011-2014: CPC and LPC would continue to compete for first place in terms of the number of connections. However, CPC would claim victory over LPC in terms of donations value.
  - 2015-2018: CPC lead over LPC in the number of connections and donations value.

From this analysis, we can conclude that CPC would be the winner in node degree and weighted degree for corporate donations and individual donations.

• BC Corporate Donations

- 2003-2006: Degree centrality analysis shows that LPC would be the most popular node when it comes to the number of connections and donations value. The party would dominate over CPC, which comes to sit in second place and NDP, which comes in third place.
- BC Individual Donations
  - 2003-2006: Degree centrality analysis for individual donations shows that CPC is the most popular node in terms of the number of connections, while LPC would claim the most popular in terms of donations value. When it came to the number of connections, LPC and NDP would battle for second place. On the other hand, when it comes to donations value, CPC would claim second place over NDP.
  - 2007 to 2010: CPC would claim victory as the most popular node in terms of the number of connections and donations value. NDP would claim second place in terms of the number of connections, while LPC will claim second place in terms of donations value.
  - 2011-2014: LPC would be, to a certain extent, the most popular in terms of the number of connections and donations value except for 2011 and 2012 when the title would go to NDP and CPC, respectively.
  - 2015-2018: CPC would claim victory in both the number of connections and donations value. NDP and LPC would alternate for second place in terms of the number of connections, while LPC would generally claim second place in terms of donations value.

From this analysis, we can conclude that CPC would be the winner in node degree and weighted degree for both corporate donations and individual donations.

- MB Corporate Donations
  - 2003-2006: The degree centrality analysis reveals that CPC was the most popular node in terms of the number of connections; however, LPC claimed first popularity in terms of donations value.
- MB Individual Donations

- 2003-2006: LPC would lead as being the most popular node in terms of the number of connections and donations value except for 2005, of which CPC would claim victory.
- 2007-2010: CPC would claim victory over LPC as being the most popular node when it comes to the number of connections and donations value. LPC would claim second place while NDP would claim third place.
- 2011-2014: CPC would be the most popular node in terms of number of connections except in 2012 and 2013, where that popularity would go to LPC and NDP, respectively. CPC would claim dominance in terms of donations value except for 2012, when NDP will claim victory. LPC however, would generally take second place, followed by NDP.
- 2015-2018: CPC would continue to be the most popular node in terms of the number of connections and donations value except for 2015 when the victory would go to LPC.
   LPC will generally take second place while in NDP would generally claim third place.

From this analysis, we can conclude that LPC would be the winner in node degree and weighted degree for corporate donations. On the other, CPC would be the winner in node degree and weighted degree for individual donations.

- SK Corporate Donations
  - 2003-2006: Degree centrality analysis would show that CPC would dominate LPC as the most popular note in terms of the number of connections and donations value. LPC would mostly come in second place well NDP generally would claim third place.
- SK Individual Donations
  - 2003-2006: Degree centrality analysis of individual donations would show a CPC dominance in terms of the number of connections and donations value except for 2003 and 2004 when the first-place position would go to NDP and LPC, respectively.
  - 2007-2010: CPC would claim victory in terms of the number of connections and donations value. NDP would come in second place, followed by LPC. GPC would claim in fourth place.

- 2011-2014: CPC would continue to claim a leadership position in terms of popularity of the number of connections and amount donation connections with except for 2012 and 2013 when NDP and LPC would claim first place, respectively.
- 2015-2018: CPC would be the most popular node in terms of the number of connections and donations value. NDP would generally claim second place, and LPC would claim third place.

From this analysis, we can conclude that CPC would be the winner in node degree and weighted degree for both corporate donations and individual donations.

#### 6.2.3. Degree Centrality Analysis in Northern Canada

- NT Corporate Donations
  - 2003-2006: LPC, NDP, and CPC were equal in terms of the number of connections.
     However, LPC would generally be the most popular node in terms of donations value.
     CPC would come in second place while NDP would come in third place.
- NT Individual Donations
  - 2003-2018: CPC, NDP, and LPC were equal in terms of the number of connections; however, from 2003 to 2006, NDP would be the most popular in terms of donations value. From 2011 to 2014, CPC would be the most popular in terms of donations value while LPC would come in second place, followed by NDP. This same trend as in 2011-2014 would persist from 2015 to 2018.

From this analysis, we can conclude that CPC would be the winner in node degree and weighted degree for individual donations. However, LPC would be the winner in weighted degree for corporate donations.

- NU Corporate Donations
  - 2003-2006: LPC would generally be the most popular node in terms of the number of connections. however, CPC would generally be the most popular in terms of donations value.

- NU Individual Donations
  - 2003-2006: LPC CPC, NDP, GPC, and other parties would generally be equal in terms of the number of connections. However, in terms of donations value, LPC would generally be the most popular except for 2004 and 2005 when that popularity would go to CPC and NDP, respectively. NDP would generally claim second place.
  - 2007-2010: CPC would generally be the most popular node when it comes to donations value except for 2007 and 2008, with LPC and NDP being the most popular.
  - 2011-2018: CPC would continue to be the most popular in terms of donations value. However, its popularity in terms of donations value would be challenged by LPC becoming the most popular in 2016 and 2017.

From this analysis, we can conclude that CPC would be the winner in node degree and weighted degree for individual donations. However, for corporate donations, LPC would be the winner in node degree and weighted degree.

- YT Corporate Donations
  - 2003-2006: LPC would dominate in terms of number of connections and donations value. CPC will come in second place and NDP in third place.
- YT Individual Donations
  - 2003-2006: LPC would dominate in terms of the number of connections and donations value. CBC will come in second place and NDP in third place. From 2003 to 2018, all parties would generally have the same popularity in terms of the number of connections. However, from 2003 to 2006, NDP would claim victory in terms of donations value. LPC would take second place while CPC would take third place.
  - 2007-2010: CPC would be the most popular in terms of donations value. LPC would generally take second place except for 2010 when GPC would claim second place. NDP would continue to claim third place.
  - 2011-2014: CPC would continue to lead in terms of donations value. LPC would generally come second while GPC would generally come third.

 2015-2018: CPC would claim victory in terms of donations value while NDP would take second place, followed by LPC and GPC in third place.

From this analysis, we can conclude that CPC would be the winner in node degree and weighted degree individual donations except for corporate donations in which LPC would be the winner in node degree and weighted degree.

**Insights:** We can learn from this degree centrality analysis that LPC, CPC, and NDP are the most popular nodes. From 2003 to 2006, LPC would generally be the party with the most connections in terms of donors and direct monetary importance in the corporate sphere. It was also the case in the public sphere (individual). However, its leadership position in donations would start to wane after the 2006 reforms in favor of other parties but particularly to CPC. It seems to indicate that the 2006 Reforms has some impact on the distribution of power when it comes to direct influence on donors and their donations.

### 6.3. Betweenness Centrality Analysis

Betweenness centrality is a measure of accessibility influence; more specifically, it is a measure of centrality (Freeman, 1977 & 1979) [45] [29]. It measures the nodes that act as bridges to other nodes by calculating the shortest paths between all pairing nodes and counting the number of times each node lies on these shortest paths. Essentially, the goal of the measure is to find the most central node in the network. The measure is based on the shortest path and is calculated as follow (Zhang and Luo, 2017) [59]:

$$C_{b}(N_{i}) = \frac{\sum_{j < k} \frac{G_{jk}(N_{i})}{G_{jk}}}{\frac{(n-1)(n-2)}{2}}$$





From this example, node C has the highest betweenness centrality. It means that node C is the most central node.

The higher the betweenness centrality, the higher the control within the network. Political parties with high betweenness centralities tend to have tremendous influence within the donations network in the context of political donations. It also indicates that these parties are more "in the center" in the sense that they have could have donors from various backgrounds. They are very influential in communicating between nodes and can control the flow of political donations between nodes. It can prevent other political parties from effectively forming a coalition with their donors. Parties with the lowest betweenness centralities tend to be at the extreme and tend to have their donors and neutral donors. In this case, donors are not expected to give much to these parties.

#### 6.3.1. Betweenness Centrality Analysis in Eastern Canada

- NB Corporate Donations
  - 2003-2006: Betweenness centrality analysis reveals that the most central node when it comes to connectivity influence (unweighted betweenness) would be an alternation between LPC and CPC. NDP would likely remain the third most central. However, the most central node when it comes to exerting influence on donation flows (weighted betweenness), CPC would lead except for 2003 and 2006 in which CRCA and BQ would claim the first position while the LPC will generally claim the second position.
- NB Individual Donations
  - 2003-2006: Betweenness centrality analysis reveals that the most central node within the network would generally be LPC in terms of connectivity influence followed by CPC then NDP. However, weighted betweenness centrality would reveal CPC to be the most central node when it comes to their capacity to influence donation flows, followed by LPC and GPC then NDP.
  - 2007-2010: CPC would be the most central node in terms of connectivity influence and capacity to influence donation flows. LPC would come second where is NDP would come third.

- 2011-2014: LPC would become the most central node in terms of connectivity influence, however CPC would remain the most central node when it comes to capacity to influence donation flows.
- 2015-2018: The most central node in terms of connectivity influence would alternate between LPC and CPC, however CPC would remain the most central node when it comes to capacity to influence donation flows.
- NL Corporate Donations
  - 2003-2006: Betweenness centrality analysis would reveal that the most central node when it comes to connectivity influence within the network would be LPC. CPC would take second place. However, CPC would be the most central node when it comes to their capacity to influence donation flows.
- NL Individual Donations
  - 2003-2006: Betweenness centrality analysis reveals that the most central node within the network would generally be LPC in terms of connectivity influence followed by CPC then NDP. However, weighted betweenness centrality would reveal that CPC would be the most central node when it comes to their capacity to influence donation flows, followed by LPC and NDP.
  - 2007-2010: When it comes to connectivity influence, the most central node would be LPC. CPC would come second. However, weighted betweenness centrality would reveal CPC as the most central node when it comes to their capacity to influence donation flows, followed by LPC and NDP.
  - 2011-2014: When it comes to connectivity influence, the most central node would be LPC. CPC would come second. However, weighted betweenness centrality would reveal that both CPC and LPC would alternate with one another to be the most central node when it comes to their capacity to influence donation flows.
  - 2015-2018: The most central node when it comes to connectivity influence would alternate between LPC and CPC. However, CPC would remain the most central node when it comes to influencing donation flows while LPC would come second.

- NS Corporate Donations
  - 2003-2006: Betweenness centrality analysis would reveal that the most central node when it comes to connectivity influence within the network would be LPC. CPC would take second place. LPC would also be the most central node when it comes to their capacity to influence donation flows, except for 2003 and 2004 in which CRCA and CPC would claim the first position while the LPC would claim the second position when it comes to their capacity to influence donation flows.
- NS Individual Donations
  - 2003-2006: Betweenness centrality analysis revealed that the most central node within the network would generally be LPC in terms of connectivity influence followed by NDP then CPC. However, weighted betweenness centrality would reveal that LPC would generally be the most central node when it comes to their capacity to influence donation flows, followed by CPC and NDP.
  - 2007-2010: When it comes to connectivity influence, the most central node alternated between LPC and CPC. However, weighted betweenness centrality would reveal that LPC would generally be the most central node when it comes to their capacity to influence donation flows except in 2008 (GPC) and 2010 (CPC).
  - 2011-2014: When it comes to connectivity influence, the most central node would be LPC. CPC would come second. However, weighted betweenness centrality would reveal that LPC would be the most central node when it comes to their capacity to influence donation flows followed by CPC.
  - 2015-2018: The most central node when it comes to connectivity influence would alternate between LPC and CPC. Nevertheless, CPC would remain the most central node when it comes to their capacity to influence donation flows while LPC would come second.
- ON Corporate Donations
  - 2003-2006: Betweenness centrality analysis would reveal that the most Central node when it comes to connectivity influence within the network would be LPC. CPC would take second place. However, BQ would be the most central node when it comes to

their capacity to influence donation flows, while CPC would claim the second position, and LPC would claim third place.

- ON Individual Donations
  - 2003-2006: Betweenness centrality analysis revealed that the most central node within the network would generally alternate between LPC and CPC in terms of connectivity influence, followed by NDP in third place. However, weighted betweenness centrality would reveal that BQ would generally be the most central node when it comes to their capacity to influence donation flows, followed by CPC and GPC.
  - 2007-2010: when it comes to connectivity influence, the most central node alternated between CPC and BQ. However, weighted betweenness centrality would reveal that BQ to be the most central node when it comes to their capacity to influence donation flows.
  - 2011-2014: When it comes to connectivity influence, the most central node would be LPC. CPC would come second. However, weighted betweenness centrality would reveal that BQ would be the most central node when it comes to their capacity to influence donation flows, followed by CPC. GPC and LPC would claim third place
  - 2015-2018: The most central node when it comes to connectivity influence would be CPC. LPC would come second, followed by NDP. However, CPC would remain the most central node when it comes to their capacity to influence donation flows while LPC would come second.
- PEI Individual Donations
  - 2003-2006: Betweenness centrality analysis reveals that the most central node when it comes to connectivity influence within the network would alternate between LPC and CPC. However, CPC would be the most central node when it comes to their capacity to influence donation flows, while LPC would claim the second position.
  - 2007-2010: When it comes to connectivity influence, the most central node would be CPC, while LPC would come second. NDP would come third. However, weighted

betweenness centrality would reveal that APPC would be the most central node when it comes to their capacity to influence donation flows while CPC would come second.

- 2011-2014: When it comes to connectivity influence, the most central node would be CPC. LPC would come second. However, weighted betweenness centrality would reveal that CPC would be the most central node when it comes to their capacity to influence donation flows, followed by LPC and GPC.
- 2015-2018: The most central node when it comes to connectivity influence would be CPC. LPC would come second, followed by NDP. However, CPC would remain the most central node when it comes to their capacity to influence donation flows while LPC would come second.
- QC Corporate Donations
  - 2003-2006: Betweenness centrality analysis would reveal that the most central node when it comes to connectivity influence within the network would alternate between LPC and BQ. However, BQ would be the most central node when it comes to their capacity to influence donation flows, while CPC would claim the second position.
- QC Individual Donations
  - 2003-2006: Betweenness centrality analysis revealed that the most Central node in terms of connectivity influence within the network would be LPC, followed by BQ. However, weighted betweenness centrality would reveal that BQ would generally be the most central node when it comes to their capacity to influence donation flows, followed by CPC.
  - 2007-2010: When it comes to connectivity influence, the most central node would be CPC, while LPC would come second. NDP would come third. However, weighted betweenness centrality would reveal that PRP would be the most central node when it comes to their capacity to influence donation flows while BQ would come second followed CPC then LPC.
  - 2011-2014: When it comes to connectivity influence, the most central node would generally be LPC. However, weighted betweenness centrality would reveal that BQ

would be the most central node when it comes to their capacity to influence donation flows, followed by CPC and LPC.

 2015-2018: The most central node for connectivity influence would be CPC, followed by LPC. However, BQ would remain the most central node when it comes to their capacity to influence donation flows, followed by CPC and LPC.

#### 6.3.2. Betweenness Centrality Analysis in Western Canada

- AB Corporate Donations
  - 2003-2006: Betweenness centrality analysis reveal that the most central node when it comes to connectivity influence within the network would be CPC followed by LPC. However, CPC would be the most central node when it comes to their capacity to influence donation flows, while LPC would claim second place.
- AB Individual Donations
  - 2003-2006: betweenness centrality analysis revealed that the most Central node in terms of connectivity influence within the network would be CPC followed by LPC. However, weighted betweenness centrality would reveal that CPC would generally be the most central node when it comes to their capacity to influence donation flows, followed by GPC.
  - 2007-2010: When it comes to connectivity influence, the most central node would be CPC, followed by an alternation between LPC and NDP for second place. However, weighted betweenness centrality would reveal that the most central node when it comes to their capacity to influence donation flows would alternate between APPC and GPC while CPC and LPC would alternate for second place.
  - 2011-2014: When it comes to connectivity influence, the most central node would be an alternation between LPC and NDP. However, weighted betweenness centrality would reveal that the most central node when it comes to their capacity to influence donation flows would alternate between CPC and LPC while NDP takes third place.
  - 2015-2018: The most central node when it comes to connectivity influence would be CPC, followed by an alternation between LPC and NDP. However, the most central

node when it comes to influencing donation flows would be an alternation between GPC and CPC, followed by LPC.

- BC Corporate Donations
  - 2003-2006: Betweenness centrality analysis reveals that the most central node when it comes to connectivity influence within the network would generally be CPC followed by LPC for second place. However, CPC would generally be the most central node when it comes to their capacity to influence donation flows, while LPC would claim second place.
- BC Individual Donations
  - 2003-2006: Betweenness centrality analysis revealed that the most central node in terms of connectivity influence within the network would be CPC, followed by an alternation between LPC and CPC. However, weighted betweenness centrality would reveal that CPC would generally be the most central node when it comes to their capacity to influence donation flows, followed by GPC.
  - 2007-2010: When it comes to connectivity influence, the most central node would be CPC, followed by an alternation between LPC and NDP for second place. However, weighted betweenness centrality would reveal that the most central node when it comes to their capacity to influence donation flows would be BQ while CPC would take second place.
  - 2011-2014: When it comes to connectivity influence, the most central node would generally be LPC, followed by CPC for second place. Weighted betweenness centrality would reveal that the most central node when it comes to their capacity to influence donation flows would be LPC, followed by CPC.
  - 2015-2018: The most central node when it comes to connectivity influence would be CPC, followed by NDP. However, the most central node when it comes to their capacity to influence donation flows would be an alternation between GPC and LPC.
- MB Corporate Donations

- 2003-2006: Betweenness centrality analysis would reveal that the most central node when it comes to connectivity influence within the network would generally be CPC followed by LPC for second place. CPC would generally be the most central node when it comes to their capacity to influence donation flows, while LPC comes second.
- MB Individual Donations
  - 2003-2006: Betweenness centrality analysis revealed that the most central node in terms of connectivity influence within the network would be LPC followed by CPC. However, weighted betweenness centrality would reveal that CPC would generally be the most central node when it comes to their capacity to influence donation flows, followed by LPC.
  - 2007-2010: When it comes to connectivity influence, the most central node would be CPC, followed by LPC. However, weighted betweenness centrality would reveal that the most central node when it comes to their capacity to influence donation flows would be an alternation between CPC and APPC, followed by an alternation between LPC and CPC.
  - 2011-2014: When it comes to connectivity influence, the most central node would generally be CPC. However, weighted betweenness centrality would reveal that the most central node when it comes to their capacity to influence donation flows would be CPC, followed by LPC.
  - 2015-2018: The most central node when it comes to connectivity influence would be CPC, followed by NDP. However, the most central node when it comes to their capacity to influence donation flows would be CPC, followed by an alternation between GPC and LPC.
- SK Corporate Donations
  - 2003-2006: Betweenness centrality analysis reveals that the most central node when it comes to connectivity influence within the network would generally be CPC followed by LPC for second place. However, CPC would generally be the most central node when it comes to their capacity to influence donation flows, while LPC would claim second place.

- SK Individual Donations
  - 2003-2006: Betweenness centrality analysis reveals that the most central node in terms of connectivity influence within the network would be CPC, followed by LPC. However, weighted betweenness centrality would reveal that CPC would generally be the most central node when it comes to their capacity to influence donation flows, followed by LPC.
  - 2007-2010: When it comes to connectivity influence, the most central node would be CPC, followed by NDP. However, weighted betweenness centrality would reveal that the most central node when it comes to their capacity to influence donation flows would be between CPC followed by LPC
  - 2011-2014: When it comes to connectivity influence, the most central node would generally be CPC followed by NDP. However, weighted betweenness centrality would reveal that the most central node when it comes to their capacity to influence donation flows would be CPC, followed by LPC.
  - 2015-2018: The most central node when it comes to connectivity influence would be CPC, followed by NDP. However, the most central node when it comes to their capacity to influence donation flows would be CPC, followed by LPC.

#### 6.3.3. Betweenness Centrality Analysis in Northern Canada

- NT Corporate Donations
  - 2003-2006: Betweenness centrality analysis reveals that the most central node when it comes to connectivity influence within the network would generally be LPC. However, LPC would generally be the most central node when it comes to their capacity to influence donation flows, while CPC would claim second place.
- NT Individual Donations
  - 2003-2006: Betweenness centrality analysis revealed that the most central node in terms of connectivity influence within the network would be CPC followed by LPC. However, weighted betweenness centrality would reveal that CPC would generally be

the most central node when it comes to their capacity to influence donation flows, followed by LPC.

- 2007-2010: When it comes to connectivity influence, the most central node would be CPC, followed by LPC. However, weighted betweenness centrality would reveal that the most central node when it comes to their capacity to influence donation flows would be between CPC followed by LPC
- 2011-2014: When it comes to connectivity influence, the most central node would generally be CPC, followed by NDP. However, weighted betweenness centrality would reveal that the most central node when it comes to their capacity to influence donation flows would be CPC, followed by LPC.
- 2015-2018: The most central node when it comes to connectivity influence would be CPC, followed by LPC. However, the most central node when it comes to their capacity of influencing donation flows would be CPC followed by LPC
- NU Corporate Donations
  - 2003-2006: Betweenness centrality analysis reveal LPC to be the only most central node when it comes to connectivity influence and capacity of influencing donation flows in 2004 and 2006. There were no central nodes in 2003 and 2005.
- NU Individual Donations
  - 2003-2018: betweenness centrality analysis would reveal no central political party nodes within its network.
- YT Corporate Donations
  - 2003-2006: Betweenness centrality analysis reveals that the most central node when it comes to connectivity influence within the network would generally be LPC. However, LPC would generally be the most central node when it comes to their capacity to influence donation flows.
- YT Individual Donations

- 2003-2006: Betweenness centrality analysis reveals that the most central node in terms of connectivity influence within the network would be CPC, followed by NDP. However, weighted betweenness centrality reveals that CPC would generally be the most central node when it comes to their capacity to influence donation flows, followed by GPC.
- 2007-2010: When it comes to connectivity influence, the most central node would be CPC, followed by NDP. However, weighted betweenness centrality would reveal that the most central node when it comes to their capacity to influence donation flows would be CPC followed by GPC
- 2011-2014: When it comes to connectivity influence, the most central node would generally be CPC, followed by GPC. However, weighted betweenness centrality would reveal that the most central node when it comes to their capacity to influence donation flows would be CPC, followed by LPC.
- 2015-2018: The most central node when it comes to connectivity influence would be CPC, followed by an alternation between NDP and GPC. However, the most central node when it comes to their capacity to influence donation flows would be CPC, followed by GPC.

**Insights:** The main takeaway from this analysis is that when it comes to corporate donations, LPC had more accessibility than other parties to influence and leverage donors' connections except in Western Canada, where the central position would go to CPC. However, CPC generally had more ability than other parties to influence donation flows except in QC, where the central position would go to BQ. When it comes to individual donations, CPC had more accessibility than other parties to influence and leverage donors' connections, and influence donation flows in general. It indicates that the 2006 reforms gave more power and leverage to CPC to influence donation networks across Canada.

#### 6.4. Closeness Centrality Analysis

Closeness centrality (Freeman, 1979) [29] is a measure of influence spread. It measures how quickly a node can, directly and indirectly, spread its influence on other nodes in the network. It is based on the concept of efficiency. The metric is done by computing the

inverse of the sum of all the shortest paths to other nodes. Unlike the degree centrality, the closeness centrality is not looking at the most connected nodes, but the nodes with the fastest spread of influence. It is calculated by taking the inverse of the average distance to all other nodes. The formula of the closeness centrality is as follow (Zhang and Luo, 2017) [59]:



where d (Ni, Nj) is the distance between node i and node j

1	<b>A</b> -	- <b>B</b> -	C	_D_	E
$\left[\sum_{j=1}^{n} d\left(N_{i}, N_{j}\right)\right]^{1}$	0.1	0.143	0.167	0.143	0.1
$C_{C}$	0.4	0.57	0.67	0.57	0.4

From this example, it can be observed that node C has the highest closeness centrality.

Unlike betweenness centrality, closeness centrality is more concerned with extending influence across the network rather than maintaining control over it. In the context of political donations, closeness centrality can help identify the political parties which are best positioned to efficiently spread its influence on the entire network for political donations. Political parties with high closeness centrality can efficiently connect with donors and collect donations. Parties with high closeness can build a coalition of donors much faster.

#### 6.4.1. Closeness Centrality Analysis in Eastern Canada

- NB Corporate Donations
  - 2003-2006: The party with the highest closeness centrality had been an alternation between LPC and CPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- NB Individual Donations
  - 2003-2006: The parties with the highest closeness centrality were LPC and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.

- 2007-2010: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- 2011-2014: The parties with the highest closeness centrality were LPC and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- 2015-2018: The parties with the highest closeness centrality were an alternation between LPC and CPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- NL Corporate Donations
  - 2003-2006: The parties with the highest closeness centrality were LPC and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- NL Individual Donations
  - 2003-2006: The parties with the highest closeness centrality were LPC and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2007-2010: The parties with the highest closeness centrality were LPC, CPC, and NDP, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2011-2014: the parties with the highest closeness centrality were LPC and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2015-2018: The party with the highest closeness centrality was an alternation between LPC and CPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- NS Corporate Donations

- 2003-2006: The parties with the highest closeness centrality were LPC and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- NS Individual Donations
  - 2003-2006: The parties with the highest closeness centrality were LPC and NDP, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2007-2010: The parties with the highest closeness centrality were an alternation between LPC and CPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2011-2014: The parties with the highest closeness centrality were LPC and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2015-2018: The party with the highest closeness centrality was an alternation between LPC and CPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- ON Corporate Donations
  - 2003-2006: The parties with the highest closeness centrality were LPC and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- ON Individual Donations
  - 2003-2006: The parties with the highest closeness centrality were an alternation between LPC and CPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2007-2010: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.

- 2011-2014: The parties with the highest closeness centrality were LPC, CPC, and NDP, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- 2015-2018: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- PEI Corporate Donations
  - 2003-2006: The parties with the highest closeness centrality were an alternation between LPC and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- PEI Individual Donations
  - 2003-2006: The parties with the highest closeness centrality CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2007-2010: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2011-2014: The parties with the highest closeness centrality were CPC, LPC, and NDP, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2015-2018: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- QC Corporate Donations
  - 2003-2006: The parties with the highest closeness centrality were LPC, BQ, and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.

- QC Individual Donations
  - 2003-2006: The parties with the highest closeness centrality LPC and BQ, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2007-2010: the parties with the highest closeness centrality were CPC, LPC, and BQ, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2011-2014: The parties with the highest closeness centrality were an alternation between LPC and CPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2015-2018: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.

From this analysis, we can see that in Eastern Canada, LPC was the party with the highest efficiency in spreading its influence on the entire corporate donations network. It would have a lead in individual donations in most of the provinces in the region. However, its dominant position began to wane after 2006 as CPC would take the lead, being more efficient than LPC in building a coalition of donors for donations, particularly in ON, PEI, and QC to a certain extent.

#### 6.4.2. Closeness Centrality Analysis in Western Canada

- AB Corporate Donations
  - 2003-2006: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- AB Individual Donations

- 2003-2006: The parties with the highest closeness centrality CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- 2007-2010: The parties with the highest closeness centrality were CPC, NDP, and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- 2011-2014: the parties with the highest closeness centrality were an alternation between LPC and CPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- 2015-2018: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- BC Corporate Donations
  - 2003-2006: The parties with the highest closeness centrality were an alternation between CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- BC Individual Donations
  - 2003-2006: The parties with the highest closeness centrality CPC and NDP, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2007-2010: The parties with the highest closeness centrality were CPC and NDP, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2011-2014: The parties with the highest closeness centrality were an alternation between LPC and CPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.

- 2015-2018: The parties with the highest closeness centrality were CPC and NDP, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- MB Corporate Donations
  - 2003-2006: The parties with the highest closeness centrality were CPC and LPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- MB Individual Donations
  - 2003-2006: The parties with the highest closeness centrality LPC and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2007-2010: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2011-2014: The parties with the highest closeness centrality were an alternation between CPC and LPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2015-2018: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- SK Corporate Donations
  - 2003-2006: The parties with the highest closeness centrality were CPC and LPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- SK Individual Donations

- 2003-2006: The parties with the highest closeness centrality CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- 2007-2010: The parties with the highest closeness centrality were LPC and NDP, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- 2011-2014: The parties with the highest closeness centrality were CPC and NDP and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- 2015-2018: The parties with the highest closeness centrality were CPC and NDP, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.

From this analysis, we can see that in Western Canada, CPC was the best-positioned party to efficiently spread its influence on the entire corporate and individual donations network. It also has dominated all the Western provinces. Furthermore, it has the lead in most of the other provinces. CPC has been dominantly more efficient than LPC, in building a coalition of donors for donations. The reforms did not affect CPC's dominant position in Western Canada.

#### 6.4.3. Closeness Centrality Analysis in Northern Canada

- NT Corporate Donations
  - 2003-2006: The parties with the highest closeness centrality were LPC, NDP, and CPC. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- NT Individual Donations
  - 2003-2006: The parties with the highest closeness centrality CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.

- 2007-2010: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- 2011-2014: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- 2015-2018: The parties with the highest closeness centrality were CPC, LPC, NDP, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- NU Corporate Donations
  - 2003-2006: The party with the highest closeness centrality was LPC and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- NU Individual Donations
  - 2003-2006: The parties with the highest closeness centrality CPC, GPC, and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2007-2010: The parties with the highest closeness centrality were CPC, GPC, and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2011-2014: The parties with the highest closeness centrality were CPC, LPC, NDP equally. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2015-2018: The parties with the highest closeness centrality were CPC and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- YT Corporate Donations

- 2003-2006: The party with the highest closeness centrality was LPC and CPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
- YT Individual Donations
  - 2003-2006: The parties with the highest closeness centrality CPC, NDP, and LPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2007-2010: The parties with the highest closeness centrality were CPC and NDP, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2011-2014: The parties with the highest closeness centrality were CPC and PC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.
  - 2015-2018: The parties with the highest closeness centrality were CPC, NDP, and GPC, respectively. They had first-mover advantage and were better positioned than other parties to connect more efficiently with donors for donations.

From this analysis, we can see that in Northern Canada, LPC was the best-positioned party to spread its influence on the entire corporate donations network. However, this was not the case for individual donations in which CPC dominated the region and has been more efficient in spreading its influence in the entire network.

### 6.5. Summary of Analyses

The Jaccard distance and the three centrality measures provide vital insights into the power structure and evolution of political parties in Canada. The major takeaways are the following:

• Jaccard distance: The findings showed that before 2006, there was little similarity among political parties. It was not only after the 2006 reforms that there were increasingly more

definite similarities between LPC and other parties, especially with CPC. It means that after 2006, the competition among political parties for donations intensified.

- Degree centrality analysis reveals that they are three major parties within the donations network: LPC, CPC, and NDP. From 2003 to 2006, LPC would have an absolute advantage in terms of direct connections with donors and direct monetary influence in the corporate and individual donation sphere except in Western Canada, where CPC had an absolute advantage over LPC. However, the 2006 reforms have waned LPC's leadership position in favor of other parties, especially CPC.
- Betweenness centrality analysis reveals that for corporate donors before 2006, LPC had more leverage than other parties to influence donors' connections except in Western Canada, where CPC would have the absolute advantage. However, CPC would have a greater ability than LPC to influence donation flows, except QC, where the advantage went to BQ. As for individual donations, CPC had more accessibility than other parties, not only to influence and leverage donors' connections but also to influence donation flows in general. It indicates that the 2006 reforms benefitted CPC greatly as it maintained its advantage.
- Lastly, Closeness centrality reveals that LPC capability to spread its influence has waned after the 2006 reform. CPC was the best-positioned party to efficiently spread its influence on the entire corporate and individual donations network. Its dominant position continues to this day.

In summary, the 2006 reforms have shifted the balance of power from LPC to CPC.

# Chapter 7.

# **Community Detection and Cluster Structure**

This chapter explores the topics of clustering and community detection of political donations in Canada. The reason for their importance in studying network structure lies in their ability to help us understand the structure and organization of political donations networks.

## 7.1. Clustering Properties

The question that needs to be answered is the degree of clustering within the political donations network. One measure that exists to find such a property is the clustering coefficient. The average clustering coefficient is the average of all the local coefficients. The local clustering coefficient is the level of a node belonging to a clique (triangles). It is defined as the fraction of pairs of the nodes that are connected with each other. In essence, the clustering coefficient tries to measure the tendency for nodes which share lots of connections. The average clustering coefficient measures the degree to which nodes within the network tend to cluster; in other words, how nodes within a network are strongly connected. The metric ranges between 0(unconnected) to 1(fully connected) (Lind et al. 2005) [31], (Latapy, Matthieu, et al. 2008) [32]. The formula for the clustering coefficient and average clustering can be seen below:

$$C_{i} = \frac{2 L_{i}}{k_{i}(k_{i} - 1)}$$
Clustering coefficient
$$C = \frac{1}{n} \sum_{i=1}^{n} C_{i}$$
Average
Clustering coefficient

where  $K_i$  is the degree of node i and  $L_i$  is the number of edges between the  $k_i$  neighbors of node i

The following example shows an application of the clustering coefficient and the average clustering coefficient [<u>60</u>]:



**Node 1**:  $K_1$ = 2,  $L_1$ = 1,  $C_1 = \frac{2(1)}{2(2-1)} = 1$ 

**Node 2**: K<sub>2</sub>= 2, L<sub>2</sub>= 1, C<sub>2</sub> =  $\frac{2(1)}{2(2-1)} = 1$ 

**Node 3**: K<sub>3</sub>= 3, L<sub>3</sub>= 1, C<sub>3 =  $\frac{2(1)}{3(3-1)}$  = 0.33</sub>

**Node 4**: K<sub>4</sub>= 1, L<sub>4</sub>= 0, C<sub>4</sub> = 
$$\frac{2(0)}{1(1-1)} = 0$$

**Average Clustering Coefficient**:  $\frac{1}{4}(1 + 1 + 0.33 + 0) = 0.58$ 

The clustering coefficient has no bearing on bipartite graphs since these graphs do not have triangles. Nevertheless, since bipartite graphs are used for modelization, they have to be adapted (Zhang et al., 2008) [46].

In the context of political donations, the clustering coefficient can help us understand the degree of clustering of political parties with donors. Another measure that can be used is the Robin-Alexander Clustering coefficient, which measures the degree of reinforcement or embeddedness among nodes. It is the ratio of four times the number of four cycles to the number of three paths in a bipartite graph. (Robins & Alexander, 2004) [33]. In the context of political donations, the Robin-Alexander clustering coefficient informs us of the degree of embeddedness between political parties and donors within the network. The next section analyzes the evolution of these two clustering coefficients by province.
### 7.1.1. Clustering Properties in Eastern Canada

- NB Clustering Properties:
  - Corporate Donations
    - A decline of average clustering from 0.74 to 0.58: a declining clustering trend between political parties and geographical donors (FSA)
    - A rise of Robin Alexander clustering from 0.21 to 0.57: a strengthening of ties between political parties and geographical donors (FSA).
  - Individual Donations:
    - A rise of average clustering from 0.48 in 2003 to 0.81 in 2018: a rising clustering between political parties and geographical donors (FSA).
    - A rise of Robin Alexander clustering from 0.45 in 2003 to 0.60 in 2017: a reinforcement of ties between political parties and geographical donors (FSA). A decline in 0.05 in 2018 (weakening)



Figure 6: NB Political Donations Clustering Properties

- NL clustering Properties
  - Corporate Donations:
    - A decline of average clustering from 0.77 to 0.63: a declining clustering between political parties and geographical donors (FSA)
    - A rise of Robin Alexander clustering from 0.22 to 0.60: a reinforcement of ties between political parties and geographical donors (FSA).

- Individual Donations:
  - A rise of average clustering from 0.45 in 2003 to 0.75 in 2018: a rising clustering trend between political parties and geographical donors (FSA).
  - A rise of Robin Alexander clustering from 0.44 in 2003 to 0.70 in 2017: a reinforcement of ties between political parties and geographical donors (FSA). A decline to 0 in 2018 (weakening)



Figure 7: NL Political Donations Clustering Properties

- NS Clustering Properties
  - Corporate Donations:
    - A decline of average clustering from 0.60 to 0.57: a declining clustering between political parties and geographical donors (FSA)
    - A rise of Robin Alexander clustering from 0.42 to 0.57: a reinforcement of ties between political parties and geographical donors (FSA).
  - Individual Donations:
    - A rise of average clustering from 0.47 in 2003 to 0.82 in 2018: a rising clustering trend between political parties and geographical donors (FSA).
    - A rise of Robin Alexander clustering from 0.68 in 2003 to 0.82 in 2017: a reinforcement of ties between political parties and geographical donors (FSA). A drop to 0.09 in 2018 (weakening)



Figure 8: NS Political Donations Clustering Properties

- ON Clustering Properties
  - Corporate Donations:
    - A constant average clustering from 0.60 to 0.61: a stable clustering between political parties and geographical donors (FSA)
    - A rise of Robin Alexander clustering from 0.32 to 0.57: a reinforcement of ties between political parties and geographical donors (FSA).
  - Individual Donations:
    - A rise of average clustering from 0.56 in 2003 to 0.84 in 2018: a rising clustering trend between political parties and geographical donors (FSA).
    - A rise of Robin Alexander clustering from 0.72 in 2003 to 0.87 in 2017: a reinforcement of ties between political parties and geographical donors (FSA). A drop to 0.18 in 2018 (weakening)



Figure 9: ON Political Donations Clustering Properties

• PEI Clustering Properties

- Corporate Donations:
  - A rise of average clustering from 0.63 to 0.83: a rising clustering between political parties and geographical donors (FSA)
  - A rise of Robin Alexander clustering from 0 to 0.83: a reinforcement of ties between political parties and geographical donors (FSA).
- Individual Donations:
  - A rise of average clustering from 0.47 in 2003 to 0.78 in 2018: a rising clustering trend between political parties and geographical donors (FSA).
  - A rise of Robin Alexander clustering from 0.69 in 2003 to 0.78 in 2017: a reinforcement of ties between political parties and geographical donors (FSA). A drop to 0 in 2018 (weakening)



Figure 10: PEI Political Donations Clustering Properties

- QC Clustering Properties
  - Corporate Donations:
    - A decline of average clustering from 0.76 to 0.56: a declining clustering between political parties and geographical donors (FSA)
    - A rise of Robin Alexander clustering from 0.23 to 0.45: a reinforcement of ties between political parties and geographical donors (FSA).
  - Individual Donations:

- A rise of average clustering from 0.48 in 2003 to 0.83 in 2018: a rising clustering trend between political parties and geographical donors (FSA).
- A rise of Robin Alexander clustering from 0.50 in 2003 to 0.63 in 2017: a reinforcement of ties between political parties and geographical donors (FSA). A drop to 0.07 in 2018 (weakening)



Figure 11: QC Political Donations Clustering Properties

### 7.1.2. Clustering Properties in Western Canada

- AB Clustering Properties
  - Corporate Donations:
    - A rise of average clustering from 0.48 to 0.59: a rising clustering between political parties and geographical donors (FSA)
    - A decline of Robin Alexander clustering from 0.49 to 0.4: a weakening of ties between political parties and geographical donors (FSA).
  - Individual Donations:
    - A rise of average clustering from 0.56 in 2003 to 0.89 in 2018: a rising clustering trend between political parties and geographical donors (FSA).
    - A constant Robin Alexander clustering from 0.74 in 2003 to 0.74 in 2017: a stability of ties between political parties and geographical donors (FSA). A drop to 0 in 2018 (weakening)



Figure 12: AB Political Donations Clustering Properties

- BC Clustering Properties
  - Corporate Donations:
    - A decline of average clustering from 0.61 to 0.57: a weakening clustering between political parties and geographical donors (FSA)
    - A rise of Robin Alexander clustering from 0.34 to 0.48: a reinforcement of ties between political parties and geographical donors (FSA).
  - Individual Donations:
    - A rise of average clustering from 0.61 in 2003 to 0.81 in 2018: a rising clustering trend between political parties and geographical donors (FSA).
    - A rise Robin Alexander clustering from 0.76 in 2003 to 0.85 in 2017: a reinforcement of ties between political parties and geographical donors (FSA). A drop to 0.19 in 2018 (weakening).



Figure 13: QC Political Donations Clustering Properties

• MB Clustering Properties

- Corporate Donations:
  - A decline of average clustering from 0.61 to 0.53: a weakening clustering between political parties and geographical donors (FSA)
  - A rise of Robin Alexander clustering from 0.21 to 0.51: a reinforcement g of ties between political parties and geographical donors (FSA).
- Individual Donations:
  - A rise of average clustering from 0.55 in 2003 to 0.75 in 2018: a rising clustering trend between political parties and geographical donors (FSA).
  - A constant Robin Alexander clustering from 0.75 in 2003 to 0.80 in 2017: a reinforcement of ties between political parties and geographical donors (FSA). A drop to 0.04 in 2018 (weakening)



Figure 14: MB Political Donations Clustering Properties

- SK Clustering Properties
  - Corporate Donations:
    - A rise of average clustering from 0.47 to 0.55: a strengthening clustering between political parties and geographical donors (FSA)
    - A rise of Robin Alexander clustering from 0.36 to 0.49: a reinforcement of ties between political parties and geographical donors (FSA).
  - Individual Donations:

- A rise of average clustering from 0.58 in 2003 to 0.77 in 2018: a rising clustering trend between political parties and geographical donors (FSA).
- A declining Robin Alexander clustering from 0.81 in 2003 to 0.79 in 2017: a reinforcement of ties between political parties and geographical donors (FSA). A drop to 0.15 in 2018 (weakening)



Figure 15: SKI Political Donations Clustering Properties

### 7.1.3. Clustering Properties in Northern Canada

- NT Clustering Properties
  - Corporate Donations:
    - A rise of average clustering from 0.66 to 1: a strengthening clustering between political parties and geographical donors (FSA)
    - A rise of Robin Alexander clustering from 0 to 1: a reinforcement of ties between political parties and geographical donors (FSA).
  - Individual Donations:
    - A rise of average clustering from 0.57 in 2003 to 0.67 in 2018: a rising clustering trend between political parties and geographical donors (FSA).
    - A declining Robin Alexander clustering from 0.57 in 2003 to 1 in 2017: a reinforcement of ties between political parties and geographical donors (FSA). A drop to 0 in 2018 (weakening)



Figure 16: NT Political Donations Clustering Properties

- NU Clustering Properties
  - Corporate Donations:
    - A rise of average clustering from 0. to 0.53: a strengthening clustering between political parties and geographical donors (FSA)
    - A rise of Robin Alexander clustering from 0 to 1: a reinforcement of ties between political parties and geographical donors (FSA).
  - Individual Donations:
    - A decline of average clustering from 0.61 in 2003 to 0 in 2018: a strengthening of clustering trend between political parties and geographical donors (FSA).
    - A declining Robin Alexander clustering from 0.61 in 2003 to 0 in 2018: a weakening of ties between political parties and geographical donors (FSA).



Figure 17: NU Political Donations Clustering Properties

• YT Clustering Properties

- Corporate Donations:
  - A rise of average clustering from 0.66 to 1: a strengthening clustering between political parties and geographical donors (FSA)
  - A rise of Robin Alexander clustering from 0 to 1: a reinforcement of ties between political parties and geographical donors (FSA).
- Individual Donations:
  - A decline of average clustering from 0.56 in 2003 to 0.5 in 2018: a declining clustering trend between political parties and geographical donors (FSA)
  - A rising Robin Alexander clustering from 0.59 in 2003 to 0.69 in 2017: strengthening ties between political parties and geographical donors (FSA). A drop to 0 in 2018 (weakening)



Figure 18: YT Political Donations Clustering Properties

### 7.2. Modularity and Community Detection

Another aspect of political donations analysis is the topic of community detection. Community detection is of great importance in sociological systems as it helps gain critical insights into clusters (Fortunato, 2010) [<u>34</u>]. Detecting donation communities could be achieved using various algorithms. The most effective tool to evaluate the quality of these algorithms is the measure called modularity (Newman & Girvan, 2004) [<u>35</u>]. High modularity means that nodes in communities are densely connected within, but sparsely connected without. Modularity is always comprised between -0.5 and 1. For a given graph, there always exists at least one partition of the vertices with optimal modularity above 0. One of the widely popular algorithms is the Newman and Girvan algorithm. The algorithm goes through an iterative process of removing links lying between communities until distinct communities are found via values of edge betweenness centrality (Girvan and Newman, 2002) [<u>36</u>]. Another algorithm that is most widely used and the most popular up to date is the Louvain Method. The algorithm, which is an improvement of the Girvan-Newman method, optimizes the partitioning of a network into distinct mutually exclusive communities by first applying a fast-greedy algorithm to maximize the detection of communities, then using these detected communities, construct a new network. Links between the clusters are self-loops, while links within clusters are iteratively combined to form new nodes until a single cluster is formed. (Blondel VD et al., 2008) [<u>37</u>]. The main advantage of the Louvain method is its ability to grow linearly with the network size at fast speed and high modularity (Lancichinetti & Fortunato, 2009) [<u>38</u>].

In this project, the two algorithms are implemented and compared to the Clauset-Newman-Moore Greedy maximization algorithm, combining pairs of communities to maximize the modularity until no pairs longer exist (Clauset, Newman, & Moore 2004) [39]. The modularity score of these three algorithms shows that Louvain is generally the most optimal community algorithm in all provinces except for YT corporate donations, in which the Girvan method has a better performance. The Clauset-Newman-Moore Greedy maximization algorithm performed the worst, as shown below, and hence would not be used in our analysis.

• Corporate Donations Modularity and Communities:



Figure 19: Eastern Canada Corporate Donations Modularity & Number of Communities















Figure 21: Northern Canada Corporate Donations Modularity & Number of Communities



There are interesting observations concerning the number of Louvain corporate donations communities. The Louvain corporate donations communities from 2003 and 2006 generally saw an increase. In Eastern Canada, the corporate communities tended to rise, particularly in NB, NS, ON, QC, and NL to a certain extent. The only exception was PEI, which generally remained constant and only declined in 2005. The average number of communities in NB, NL, NS, ON, PEI, and QC was 2, 3, 4.25, 9, 1.75, and 9, respectively. Western Canada Louvain communities would also see a rise over the years in all provinces: AB, BC, MB, and SK. The average number of communities in AB, BC, MB, and SK was 5, 8, 5.3, and 3.25, respectively.

On the other hand, Northern Canada Louvain communities would generally fluctuate year by year, either seeing a rise, a decline, or remaining constant. The average number of communities in NT, NU, YT was 1.67, 2, and 2, respectively. Provinces with the highest number of communities would be QC, ON, BC, with averages above 7.9 communities. They are mostly located in Eastern Canada except for BC. The provinces with a moderate number of communities are mostly located in all regions (MB, AB, NS, SK, NL, NB, NU, and YT). They average between 2 and 5 communities. The remaining with averages would average 2 communities are in PEI and NT. What is interesting about the provinces with the highest number of communities is that if one were to take the ratio between the average number of communities by the average number of parties, the results would be 1.5 for QC, 1.14 for BC, and 1.09 for ON. It means that every party would have more than 1 community. Whereas for moderate and remaining provinces, their ratio would be below 1. It shows the highly competitive landscape of provinces with a moderate number of communities.

#### • Individual Donations Modularity and Communities:



#### Figure 22: Eastern Canada Individual Donations Modularity & Number of Communities



Figure 23: Western Canada Individual Donations Modularity & Number of Communities





Figure 24: Northern Canada Individual Donations Modularity & Number of Communities



There are interesting observations concerning the number of Louvain individual donations communities. In Eastern Canada, the number of communities would generally fluctuate. The average number of communities in NB, NL, NS, ON, PEI, and QC was 3.87, 2.87, 3.62, 5.56, 2.56, and 6.25, respectively. QC had the highest average in the number of individual

donations communities while ON came second. PEI would generally have the lowest average in the number of communities. Another observation that can be made is that the communities' patterns would generally oscillate every four years. This oscillation pattern would generally coincide in election years (2006, 2011, 2015, 2018). The only exception would be PEI with oscillations taking place every two years. Western Canada would also see similar oscillations trends. The average number of communities in AB, BC, MB, and SK was 4.62, 5.06, 4.31, and 3.68, respectively.

BC would have the highest average in the number of individual donations communities. In Northern Canada, the number of communities was constant. The average number of communities in NT, NU, YT was 1.93, 1.37, and 1.56, respectively. The provinces with the highest number of different communities would be QC, ON, BC, AB, MB, with averages above 4 communities. They are mostly located in Western Canada except for ON and QC in Eastern Canada. The provinces with a moderate number of communities are mostly located in Eastern Canada (NB, NL, NS, and PEI) except for SK in Western Canada. They average between 2.1 and 4 communities. Northern Canada territories would average below 2.1 communities. The ratio community-party for all provinces and territories would be below 1, making the landscape more competitive than in other provinces.

The Louvain community graphs generally display a structure that is between a monopolistic structure and a duopolistic structure for corporate donations, mainly clustered around LPC. Whereas for individual donations, the structure would be between a duopolistic and triopolistic structure clustered around CPC, LPC, and NDP.

## Conclusion

The main contribution of this paper is that it is believed to be the first in its attempt to use complex network methodologies to study political donation networks in Canada. The objective of this research was to study the impact of Canada's 2006 campaign funding reform on the Canadian political donations landscape. The goal was mostly to see whether the reform has been successful in ensuring a fairer political donation environment in Canada. Public data on corporate donations from 2003 to 2006 and on individual donations from 2003 to 2018 were collected, cleaned, and analyzed.

After a series of campaign financing scandals and legal loopholes, the Liberal Party (LPC) government under the leadership of Prime Minister Jean Chretien was under pressure to institute significant campaign financing reforms. As a result, the government enacted Bill C-24 in 2003. The 2003 reform put in place by the Liberals increased public funding, extended further disclosures requirements, placed annual limits on all donations, and banned donations made by non-citizens and permanent residents. It was not until 2006 that campaign financing laws would reach a new milestone under the Conservative Party (CPC) minority government. The new government under the leadership of Prime Minister Harper instituted a new set of reforms that banned businesses, corporations, labor unions, and foreign entities from making contributions to political parties and contestants. These new set of reforms would change the structure and dynamic of Canada's political donation networks.

Statistics show that LPC has had an absolute advantage over all other parties when it comes to individual donations (2003-2018) and corporate donations (2003-2006) in Canada. The results show LPC having a massive lead in Eastern, Western, and Northern Canada for corporate donations. The results also show that LPC had a considerable lead in Eastern Canada, most of which was focused in the top two provinces ON and QC but was second to CPC in Western and Northern Canada. These results reveal CPC's effectiveness when it comes to individual donations.

An analysis was conducted comparing the structure of corporate donations by political party (2003-2006) and the structure of individual donations by political party (2003-2006; 2007-2010; 2011-2014; 2015-2018). The results showed that the donations structure began to change post-2006 reform. Fundamentally, the reforms shifted the

donations structure in favor of CPC and disadvantaging LPC. LPC lost a big chunk of their donation shares that it used to enjoy pre-2006 reform era. The donation structure after 2006 gradually moved from a duopolistic structure to a triopolistic structure as a result the reform.

Given the discovery of a shift in donation structure, the next step was to measure the inequality of donations among political parties across Canada's regions before and after the 2006 Reform. The Gini index analysis of individual donations after the reforms show a high inequality among parties collecting donations. The average Gini index was over 0.7 for both individual and corporate donations. Gini indexes were high in Eastern and Western Canada, but low in Northern Canada. However, the Gini index has had a downward trend across Canada since the reform. Moreover, the Gini index for corporate donations was higher than the Gini index for individual donations in most provinces and territories in Canada except for ON, AB, and YT. The latter were areas where the Gini Indexes for individual donations rose. The analysis also showed that LPC had a near-monopoly on corporate donations, while CPC had an advantage over LPC in individual donations.

The decline in the Gini index between 2007 and 2014, coincides with the arrival of the Harper government. PM Harper led two minority governments (one in 2006 and the other in 2008) and a majority government in 2008 that would last until 2014. The Prime Minister was able to create a strong coalition of political parties, notably with CRCA and PCPC merging with CPC to diminish the Liberals' dominant position [42]. The minority governments under which the Conservatives had to operate in, meant that the interests of other political parties had to be considered. The CPC banned corporate donations putting the Liberal campaign funding system in disarray. The CPC and other parties saw their donations increased, with CPC becoming the biggest winner. The party saw its collected donations skyrocketed with a 150% increase from 2003 to 2010, overtaking LPC in the end. Furthermore, as pointed out earlier, the donation structure would gradually move to become triopolistic.

These factors explain the reason why the Gini Index declined. Overall, the 2006 reforms have reduced the inequalities among political parties, in which CPC took the most significant size of the pie.

The next step was to assess the degree of competition and the balance of power among political parties within the donation networks. To this end, the Jaccard similarity and centrality measures analysis, notably degree centrality, betweenness centrality, and closeness centrality, were conducted. The findings showed that after 2006 there were increasingly stronger similarities among parties, especially between LPC and CPC. Prior to 2006, similarities among parties were weak. It means that after 2006, the competition among political parties for donations intensified. Centrality measures revealed that LPC, CPC, and NDP were the most popular parties in terms of donors and donations, respectively. After 2006, LPC has seen its leadership position waned over the years despite being the most important in terms of connections to donors and donations. However, according to the betweenness and closeness centralities, CPC had more control and influence spread on donors and donations across the country but particularly in all Western provinces and Northern Territories. In 2011, Distinguished Professor, Dr. Flanagan from the University of Calgary wrote an interesting article stating: "Stephen Harper's conservative coalition conforms with the game-theoretic ideal of a minimum connected winning coalition and, as such, should be internally stable and difficult for opponents to break up" [42]. The minimum connected winning coalition is a political theory based on the idea that it is optimal to form alliances with partners that are closer in ideology. The term "minimum connected" refers to having a coalition with the right size so that it can be easily managed. The term "winning coalition" focuses on the notion of efficiency. Finally, the term "internally stable and difficult to break up" focuses on the notion of stability control.

Interestingly, this game-theoretic ideal can be reflected in the centrality measures results. CPC's degree centrality mirrors "minimum connected" explained by the coalition of CRCA, PCPC, and CPC's direct donors. CPC's betweenness centrality mirrors the "winning coalition" with the emphasis on influence spread efficiency explained by the pool of high-caliber political talents. Lastly, CPC's closeness centrality mirrors "difficult to break and internally stable," explained by the 2004 merger of CRCA and PCPC under the CPC umbrella for control over donors and donations. This game-theoretic ideal is the very strategic philosophy that outplayed LPC.

Louvain community detection algorithm revealed a varying number of communities across regions. The highest number of communities would be in QC, ON, and BC, respectively. Analyzing the community-party ratio, we found that the corporate donations ratio tended to be higher than the individual donations ratio. It means that there was less competition in corporate donations than in individual donations, a situation that benefitted LPC at the time but no longer. Upon looking at the corporate donations networks visualizations, the structure seems to be in between monopolistic and duopolistic with LPC. The communities seem to be centered around LPC. In contrast, Canada's individual donation network structure seems to follow a duopolistic or triopolistic structure in which LPC, CPC, and NDP are the top 3, respectively. The structure moved from a duopolistic nature before 2006 (LPC & CPC) to a triopolistic nature after 2006 (LPC, CPC, NDP). The communities in general seem to gravitate around LPC, CPC, and NDP. These results also indicate that the 2006 reforms did have an impact on the competition for political donations by making it a little fairer than the pre-2006 era. These reforms benefitted many parties and especially CPC.

While this paper provides valuable insights into Canada's political donations networks, there are some limitations. Due to a lack of time, the analysis is not complete. Other centralities could have been explored, such as the eigenvector centrality, which is a measure of prestige and identifies nodes connected to other important nodes (Rusinowska, A., Berghammer, Swart, & Grabisch, 2011) [28]. Another limitation is that this paper focuses mainly on political parties and pays little attention to the influence of geographical regions. Additional data on regional clusters, regional employment, and other data could give more insights into the attractiveness of regions and their link to donation networks. Socio-demographic data could have been explored, but this is outside the scope of this thesis. An analysis by constituencies would have been interesting because that is what is generally used.

Peoples and Gortari (2008) argued that Bill C-24 reforms in Canada were more of a symbolic initiative than decisive one, given that the reforms targeted hard money. The authors state that soft money donations may be more important in Canada and is said to have the strongest influence on policymaking [10]. This claim could be a catalyst for a possible extension to this paper comparing Canada's hard money and soft money donations networks. Moreover, the current literature on soft money contributions is sparse.

Overall, the belief is that this thesis will contribute to the literature of complex networks and political science as it gives insights onto the structure and evolution of Canada's donation networks. By using complex networks, this paper brings more transparency into the light by painting a clearer picture of Canada's campaign financing climate that would not have been made possible by looking at the data alone. I believe the incorporation of complex networks into political studies could help researchers and policymakers gain deeper insights on various political networks and systems. These insights can help enhance our democratic practices for the safeguard of our democracies.

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# Appendix A.

## Donations Networks Graph Representation

## Corporate Donations Networks Graph Representation (2003-2006)

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## Individual Donations Networks Graph Representation (2003-2018)

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