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The political networks of Mexico and measuring centralization

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Abstract

For over twenty years a major project describing the political networks of Mexico has been undertaken at the National University of Mexico. In their analyses of these networks, Gil and Schmidt, make use of a node centrality index, the power centrality index. The use of this index to index the centralization of political networks of Mexico is described.

Keywords: Centrality, centralization, political networks

1. Introduction

A comprehensive database, REDMEX III, containing information on members of the government of Mexico through the last century has been developed at The Laboratory of Networks (LARS) at the National University of Mexico (the UNAM). From REDMEX III it is possible to derive political networks, typically in these networks the nodes represent politicians and other influencial members of the government, and the edges represent one or more relationships between pairs of actors e.g. worked together. A network of particular interest is the political network of power of Mexico which is a connected network formed from the elite politicians, including all the presidents, from the time of Mexican Revolution through to the end of the century. LARS was instigated by Jorge Gil Mendieta in 1995 and publications about the research into political networks at LARS has included three books, the most recent of these, 'Studies on the Political Network of Mexico' (Gil and Schmidt, 2005), contains chapters on: the origins and evolution of the political network of Mexico, the dynamic analysis of the network of power of Mexico, analyses of political groups and their development as well as specific case studies about the transition to power of individual presidents. Gil and Schmidt (1996a) developed a centrality index the power centrality index, to help them with their analyses. The current paper examines how this index can be used to index network centralization.

In order to explain some of the context and motivation behind the research from LARS some brief notes are first given on topics that have influenced the development of the political network of Mexico. The years 1910 through to 1921 are known as the Mexican Revolution, and the Mexican Constitution was declared in 1917. Part of what the

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Revolution was fought for, and fundamental to the Constitution, is that any president can serve only one term in office. The Revolution was violent and the first three presidents were assassinated, but the government that emerged in the 1930's was stable. The first generation of politicians was composed of generals from the Revolution; an important member of this generation was Lázaro Cárdenas del Rio (presidency, 1934-1940), who did much to develop the political system and lay down the rules of the precursor of the ruling Institutional Revolutionary Party (PRI). A second generation of politician appeared in the 1940's, for example Miguel Aléman Valdés (presidency, 1946-1952). The politicians who originated from the revolutionary army are called 'politicos' and they dominated through to the 1970's, by which time the first generation of politicians had left the net and a third generation were coming to power. Aléman was the first civilian president, although he had important connections with generals from the Revolution, and during his administration a new type of politician emerged. The new breed, called 'financieros', arose from the country's financial elite, they were professionals who worked in banks and financial departments of government. From Aléman's administration onwards, two subnetworks composed of 'politicos' and 'financieros' developed and competed for power within the one political network of Mexico. The first financiero president was Miguel de la Madrid Hurtado (presidency, 1982-1988). By the end of his administration in 1988 the competition between the two groups had become so heated, that there appeared a serious split within the PRI, the financieros kept hold of the presidency and a group of politicos formed a separate party. The situation deteriorated, and in 1994 both the presidential candidate of the PRI and the secretary of the PRI were assassinated, the PRI finally losing the presidency at the 2000 election.

If Mexico is thought of as a Latin American country then a pertinent question is, Why has the political system been so stable? While some explanation for its stability lies in the authoritarian nature of the government and the military culture brought to the political scene by the politicos, Gil and Schmidt argue that a key to understanding its stability is the political network of power of Mexico. A related idea in the literature is that of a so called 'revolutionary family', a 'governing elite interested in accruing and holding power, prestige and wealth, fearful of political defeat and of anti-revolutionaries gaining power' Gil and Schmidt (1996b), or as Camp (2007) explains ' … the National Revolutionary Party [later renamed the PRI] did not bring the leadership to power. Rather the leadership established the party as a vehicle to remain in power'. The political network of power can help us to understand how this political elite are coordinated.

Intrinsic to the stability of the system has been the succession of the presidency, and Gil and Schmidt use political networks to help to explain this process. From after the Revolution to the end of the century, the choice of the PRI presidential candidate, made by the incumbent president, was the equivalent to the choice of the next president – an exception being Louis Donald Colosio Murrieta who was assassinated, but even then the 1994 president, Ernest Zedillo (presidency 1994-2000), was chosen from the political elite of the PRI. To most Mexicans the presidential succession has been shrouded in mystery, as Schmidt and Gil (1997) explain,

> The naming of the PRI's presidential candidate is hidden from the average citizen, so Mexicans firmly believe that the selection of the next president is made by a higher power. The pre-candidate is waiting tapado/veiled for the power to unveil and appoint him as candidate for a post which he will undoubtedly win. The 'unveiling' has been designated as the dedazo/being 'selected', implying the higher power's finger pointing at the 'chosen one'.

Although the incumbent president chooses the presidential candidate from some kind of competition it is not always clear what the reasoning behind his decision is. Within the PRI, groups or camarillas, compete for power, and although the presidential successor was always a secretary of the presidential cabinet, the presidential cabinet was not necessarily composed solely of 'the presidents men'. Camp (2007) defines a camarilla as being a group of people who have political interests in common and rely on one another to improve their chances within the political leadership. The members of a camarilla are loyal to a chief – initially these were military heads from the Revolution – and often the camarilla and its members are named after the leader e.g. the cardenistas, or the alemanistas. At times the camarillas have had influence on the succession of presidency.

A politician's power can be seen as developing through his membership of different groups and cliques, because it is only through his membership of these groups that he can make use of political resources and exert influence. Centrality has thus been used to help to identify the distribution of power in the networks and thereby to identify potential presidential candidates and those who support them.

1.2 The political networks database – REDMEX III

The REDMEX III political database maintained at the LARS spans more than 70 years and includes personal and political information on over 7000 members of the government of Mexico. The database includes information taken from databases on the political elite created by researchers, and information from autobiographies and interviews. The fields in the database contain information on: personal attributes, education, political activities, membership of social groups, electoral positions, positions in congress, positions in government, political activities, academic positions, publications, membership in professional associations, honours and decorations, international delegations and military commissions (Gil and Schmidt, 2005).

A type of network that arises naturally from the political database is the affiliation network, these also correspond to hypergraphs (see Gil et al, 1997). At different times the affiliation of politicians to geographic regions, university departments, government departments, financial institutions, business syndicates etc can be seen as providing the context for the formation of groups. For example, the Sonora group, named after the state of Sonora were especially powerful in the years of the Mexican Revolution, later, ties formed at colleges and universities in Mexico were important, and more recently ties made at foreign universities have also been significant. In the example of Figure 1, derived from Gil and Schmidt (1999) (Table 2.1), the nodes in the left partition represent politicians and the nodes of the right partition represent groups. The coincidence of a pair of politicians in a group at a given time can imply a relationship between the pair.

One mode networks of politicians can be obtained by joining pairs of nodes together through relations such as ‘is a friend of’, ‘is related to’, or ‘worked for’, etc. Many networks can be derived from the database, for example, cross-sectional networks, that typically contain several hundred nodes, have been made at five yearly intervals, and longitudinal networks that show how the political elite are connected from one administration to the next. The example of Figure 2, from Gil and Schmidt (2005), shows a political network that illustrates the significant connections that link Aléman (presidency, 1946-1952) with Salinas de Gortari (presidency, 1988-1994). Underlying this network are four relationships categories: political, friendship, family, and military subordination. The first two of these form the majority of the ties, but the number and type of ties will not be differentiated between.

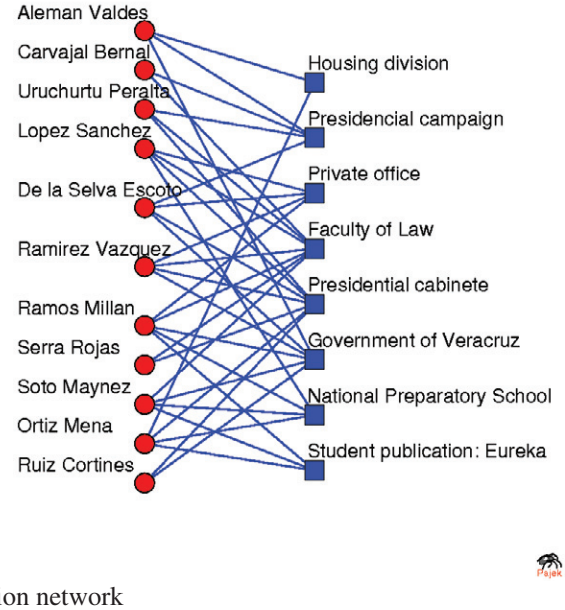

Figure1: Example of an affiliation network

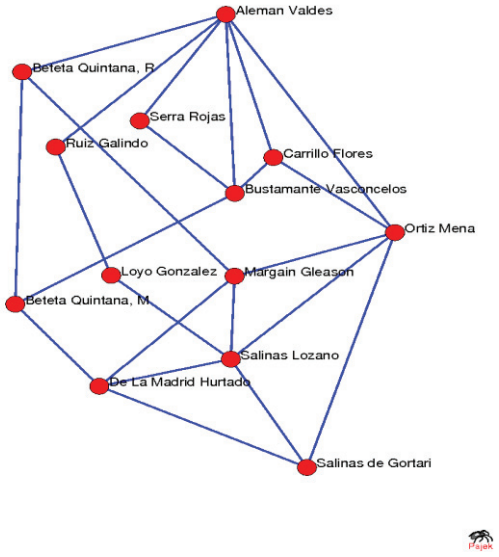

Figure 2: Political network showing connections linking Aléman to Salinas de Gortari

Power lies in the hands of the president and a relatively small elite, and much of the analyses by Gil and Schmidt are based on a connected longitudinal network of this elite. This network of power of Mexico contains 39 politicians and spans from 1920 through to 1990, it includes 17 presidents and 22 other important political figures.

2. Main

Gil and Schmidt (1996a) introduce a node index of centrality, the power centrality index, the rational behind the index is similar to that of the degree centrality index (Freeman, 1979) in that a politician can gain power through connections within the network. A good presidential candidate in a network can be identified as one with high centrality score because he has built up the necessary connections in his career. One way that Gil and Schmidt make use of the power centrality index is similar to that of the graph centrality index of Sabidussi (1966), in that they compare the centrality of presidents through time and they equate node centrality with network cohesion. In the situation after the Revolution the network is cohesive, the soldiers were united around a common cause and there is a correspondingly high centrality for the presidents, the political system was stable and predictable. Later on in the century, as the two subnetworks of the politicos and the financiers developed, the centrality score of some politico presidents is not very high e.g. Manuel Avita Camacho (presidency, 1940-1946) had centrality score 0.722 in 1940 whereas Luis Echeverriá Álvarez (presidency, 1970-1976), perhaps the last president to have explicit military support, had centrality score of just 0.475 in 1970 (Gil et al, 1997). The latter, relatively weak centrality score, reflects less integration and cohesion in the network.

To define the power centrality index some notation for networks first has to be introduced. Let the nodes in a network N be labeled $1 \ldots n$. For a node i, let $n_k(i)$ be the number of nodes at distance k from i. The power centrality index can be thought of as a generalization of the degree centrality index for simple networks in that when indexing node i the neighbours of i each count one, but then all other nodes in the same component as i also count, weighted according to their distance from i. For node i, Gil and Schmidt (1996b) define,

$$I(i) = \frac{1}{p_i - 1} \{ n_1(i) + \frac{n_2(i)}{2} + \cdots + \frac{n_k(i)}{k} + \cdots \} \quad (1)$$

where p_i is the number of nodes in the component of the network containing i. Note that nodes that do not belong to the same component as i do not contribute to the centrality score of node i. The above definition is limited in the sense that a node in a non-trivial clique network, that is a network in which each node is joined to each other node, will have centrality value one regardless of the number of nodes in the network, whereas in actual fact the larger the clique the more resources will be available to a member of the network; this is also a problem in some sense for other centrality indices. Of course politicians are never found alone, but the definition of equation (1) can also be extended by defining an isolated node to have zero centrality score. Further discussion of the power centrality index can be found in Sinclair (2009).

2.1 Network centralization

Centralization is a network level index that measures the dispersion of centrality scores relative to the most central score in the network, in a similar way as to how the variance of centrality scores measures the dispersion of centrality scores with respect to the mean centrality score (Høivik and Gleditsch, 1975; Freeman, 1978; Snijders, 1981).

In order to make comparisons between networks more meaningful the sum of the differences between the centrality of the most central node and the centrality of each other node is normalized, or standardized, by the maximum possible for a given class $\mathcal{N}$ of network. The centralization index for a network N is defined as

$$I(N) \quad = \quad \frac{\sum_j \{I(1) - I(j)\}}{\max_{N \in \mathcal{N}} \sum_j \{I(1) - I(j)\}} \qquad (2)$$

where 1 is a most central node in the network. The index can take values between zero and one, with the minimum value zero being obtained when all nodes have the same centrality value, for example if the network is a clique. A highly centralized network is one in which the most central node, 1, has high degree and is connected to relatively distinct groups. It is quite easy to show that if $\mathcal{N}$ is a class of connected networks then the network(s) that has maximum centralization will be such that the number of edges not incident to the most central node is minimal. Thus if there are no restrictions, for example on minimum degree or density, a network that achieves maximum centralization will be a tree. Usually, standardization for centralization is made for the class of networks with a given number of nodes or the class of connected networks with a given number of nodes. Theorem 1, derived in Sinclair (2009), gives the value for the denominator of equation 2 for connected networks on n nodes.

Theorem 1 *For a connected network,*

$$\max \sum_j \{I(1) - I(j)\} \quad = \quad \frac{n-2}{2}$$

The maximum is obtained uniquely by the star network on n nodes.

Table 1 gives the value of the centralization index for subnetworks of the Mexican network of power as described in Gil and Schmidt (2005, Chapter 3). For example, the network of Figure 3 is for when Cárdenas del Río was president. The results in Table 1 appear to confirm the results obtained by Gil and Schmidt (1996b) in that the centralization index has relatively high value to start with and then diminishes as the two subnetworks of politicos and financiers compete.

Table 1: Centralization scores for five year cuts from the Mexican network of power

Year	President	Order	Density	Centralization
1940	Cárdenas del Río	19	0.31	0.560
1945	Ávila Camacho	19	0.29	0.534
1950	Alemán Valdés	24	0.24	0.412
1955	Ruiz Cortines	23	0.25	0.396
1960	López Mateos	24	0.24	0.387
1965	Díaz Ordaz	23	0.26	0.395
1970	Echeverría Álvarez	21	0.24	0.392
1975	Echeverría Álvarez	18	0.26	0.471
1980	López Portillo	15	0.3	0.483
1985	de la Madrid Hurtado	13	0.37	0.510
1990	Salinas de Gortari	11	0.4	0.511

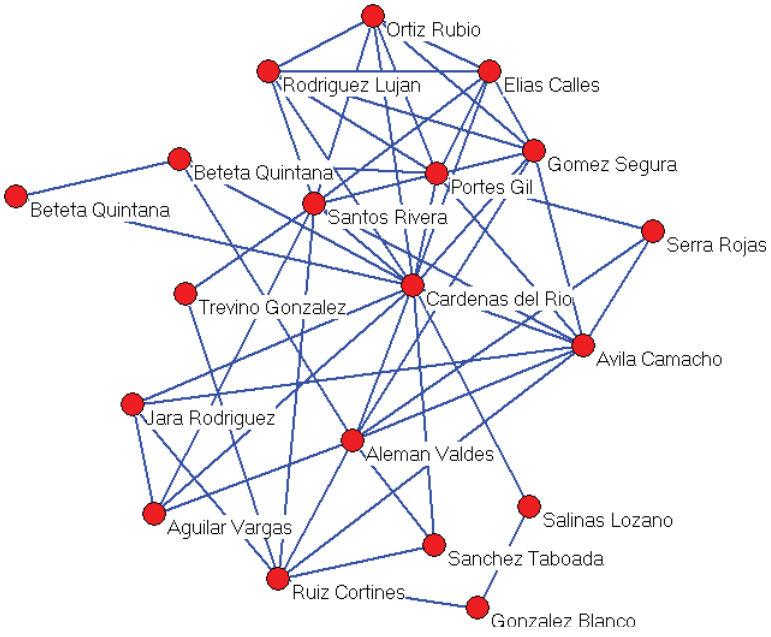

Figure 3: The network of power 1940

Empirical social networks tend to have much more structure than 'random' networks. Using the *network* package for R (Butts, 2008), the graph in Figure 4 shows the centralization index for 10 000 networks on 20 nodes sampled from a uniform (Bernoulli p=0.3) distribution. Comparison of the values obtained in Table 1 with the simulation for random networks suggests that the early political networks that have approximately 20 nodes have high centralization index, however for random networks of lower orders, high centralization scores are more common.

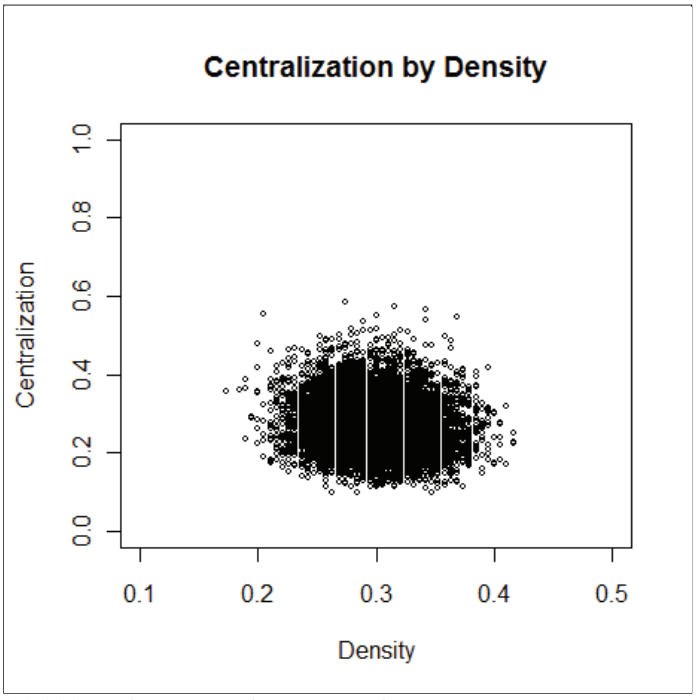

Figure 4: Centralization for 10 000 random networks on 20 nodes.

2.2 Cliques in networks

Cliques are fundamental to the development of the political networks of Mexico and some influential cliques have had long lives, having their origins in the educational institutions. Gil and Schmidt (1996b) introduce a clique centrality index similar to the power centrality index, and they also make use of a count of clique membership in their political connectivity factor (Gil and Schmidt, 1999, 2005), which takes into account the amount of time that a politician has belonged to some clique.

A representation for large political networks that compresses each clique of the network into a node was introduced in Sinclair (2007). The example in Figure 5 shows a network taken from the presidency of Miguel de la Madrid Hurtado (presidency, 1982-1988), the original cross-sectional network has 335 nodes. In Figure 5, the nodes $K_1, \ldots, K_{14}$ represent the cliques in the network, and the order of each of these cliques is given in Table 2. The nodes that are not labelled represent politicians that belong to more than one clique and the edges indicate the membership of these politicians to specific cliques. Cliques can be identified visually using a net drawing program such as Krackpot (Krackhardt et al, 1994) or there are several programs, such as Pajek, that run procedures to identify all cliques in the network.

It is possible to calculate a clique index of centrality from the reduced network that takes into account the order of the cliques in the network, for example by weighting the nodes that represent cliques by the order of the cliques and then normalizing the index by the order of the network again weighting clique nodes by the order of the underlying cliques. However, a simpler index of clique centrality can be made by ignoring the orders of the cliques and just taking into account the position of each clique in the network. The centrality index for each clique in the connected component (calculated as for equation 1) is given in Table 2, for example

$$I(K_1) = \frac{1}{31}\{13+\frac{8}{2}+\frac{5}{3}+\frac{2}{4}+\frac{1}{5}+\frac{1}{6}\} = 0.630$$. Then K_1 is the central clique.

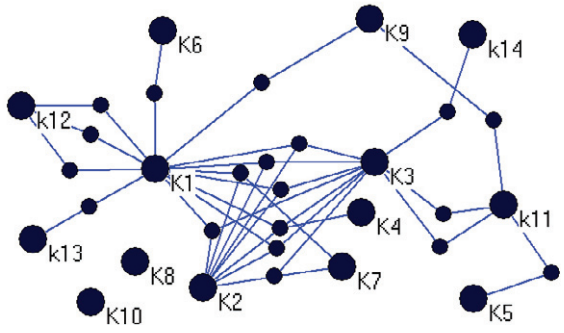

Figure 5: A compressed political network of 1987

Table 2: Clique orders and centrality scores for the network of Figure 5.

Clique	K_1	K_2	K_3	K_4	K_5	K_6	K_7	K_8	K_9	K_{10}	K_{11}	K_{12}	K_{13}	K_{14}
Order	66	8	62	8	17	43	27	5	25	15	14	17	31	25
$I(K_i)$	0.63	0.49	0.56	0.40	0.22	0.29	0.35		0.34		0.37	0.33	0.29	0.27

A clique centralization index can be obtained by making the sum of differences between the most central clique node and each other clique node in the network. Calculating this sum of differences gives, $\sum_j \{I(K_1) - I(K_j)\} = 3.042$. The network of Figure 5 is a bipartite network, the clique nodes form one partition and the nodes representing actors that belong to more than one clique form the other partition. A bipartite network with same number of nodes in each partition that achieves the maximum for the sum of differences is given in Figure 6, it is quite similar to the star graph of Theorem 1 in that it is a tree and the central node 1 has maximum degree possible given the fixed orders of the node partitions.

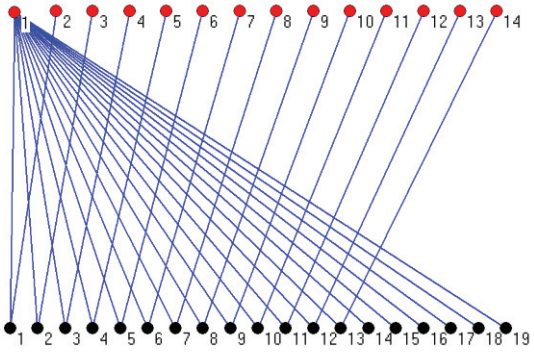

Figure 6: A bipartite network for which centralization is maximum

Calculating the centrality scores for the nodes in the top partition (corresponding to clique nodes) of Figure 6 gives:
$I(1) = 0.797$ and $I(j) = 0.328$ for $j \neq 1$, thus the sum of differences for the graph of Figure 6 is:
$\sum_{j \in top} \{I(1) - I(j)\} = 6.094$. The normalized centralization index for the network of Figure 5 is then 3.042/6.094=0.50. A general formula for the centralization of bipartite networks with fixed number of nodes in each partition is derived in Sinclair (2009) and the networks that obtained a maximum for the sum of differences are also described there.

3. Conclusion

At LARS, researcher have investigated the Mexican political system explicitly using the network paradigm and employing tools of social network analysis to throw light on questions of stability, changes in the political elite, presidential succession, and the evolution of the political system of Mexico. Although centrality indices have been fundamental to their analyses, it is also true that much of the interest in their analysis of the political networks of Mexico lies in the detail, for example the strength as well as number of ties can be significant. The Mexican political system has continued to change as the political system develops towards a more democratic and less authoritarian style (Camp, 2007). Not only has the context of relationships changed as the system becomes less corporate, but in the current system there are now three major political parties (as compared to one) and this suggests further complications in interpreting social network analysis of the networks.

For political power structures, a centralization index can be of interest for use in comparing networks, and to obtain a centralization index with values that lie between 0 and 1 an appropriate normalization needs to be made. The analysis on cuts from the network of the political elite suggests that the networks were initially highly centralized, but that this centralization diminished. The centralization index then increases again, but this may partly be because the networks are smaller. The normalization of centralization for affiliation networks is discussed in Sinclair (2009) (see also Borgatti and Everett, 1997), the most interesting normalization is when like is compared with like, for example when the sum of differences is made between the most central politician and each other politician or the most central institution and each other institution.

References

Batagelj, V. & Mrvar, A. *Pajek – Program for large network analysis*. Home page: http://vlado.fmf.uni-lj.si/pub/networks/pajek/

Borgatti, S. P., & Everett, M. G. (1997). Network analysis of 2-mode data. *Social Networks, 19, 243-69*.

Butts, C. T., (2008). Network: A package for managing relational data in R. *Journal of Statistical Software, 24(2).* http://www.jstatsoft.org/v24/i02/.

Camp, R. (2007). *Politics in Mexico. The democratic consolidation* (5th ed.). Oxford University Press.

Freeman, L. C. (1978). Centrality in social networks. Conceptual clarification. *Social Networks 1, 215-39.*

Gil, J., & Schmidt, S. (1996a). The origin of the Mexican network of power. *International Social Network Conference. Charleston, SC., 22-25.*

Gil, J., & Schmidt, S. (1996b). The political network in Mexico. *Social Networks 18, 355-81.*

Gil, J., Schmidt, S., Castro, J., & Ruiz, A. (1997). A dynamic analysis of the Mexican power, *Connections 20(2), 34-55.*

Gil, J., & Schmidt, S. (1999). *La Red Política en México: modelación y análisis por medio de la teoria de gráficas.* México: IIMAS, UNAM.

Gil, J., & Schmidt, S. (2005). *Estudios sobre la red politica de México.* México: IIMAS, UNAM.

Høivik, T., & Gleditsch, N. P. (1975). Structural parameters of graphs: A theoretical investigation. In H.M. Blalock et al (Eds.), *Quantitative sociology* (pp. 203-23). New York: Academic Press.

Krackhardt, D., Blythe, J. & McGrath, C. (1994). KrackPlot 3.0: An improved network drawing program. *Connections*, *17(2),* 53-55.

R Development Core Team (2009). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. Version 2.10.1. http://www.R-project.org/

Sabidussi, G. (1966). The centrality index of a graph. *Psychometrika 31, 581-603*.

Schmidt, S., & Gil, J. (1997). The political network in Mexico: Between conflict and stability. *PROFMEX WWW On-line Journal*, 2(2) Spring/May. http://www.profmex.org/mexicoandtheworld/volume2/2spring97

Sinclair, P.A. (2007). A representation for the Mexican political networks. *Social Networks 29, 81-92.*

Sinclair, P.A. (2009). Network centralization with the Gil Schmidt power centrality index. *Social Networks 31(3), 214-219.*

Snijders, T.A.B. (1981). The degree variance: an index of graph heterogeneity. *Social Networks 3, 163-223.*