

Malagasy Directors Network: Worrying Prospects on Political-Business links in Madagascar

Didier Dupertuis Mampandra Antonia Ngavozafy

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Abstract

Using data from the Malagasy *Registre du Commerce*, we study the networks of boards and directors in important Malagasy companies. In this setup, two directors (companies) are connected in the directors' (companies') network if they sit on the same board (share a common director).

We find a high presence of political figures and state officials in the directors network. Leaders of important Malagasy businesses have direct access to political decision-makers. Notably, Madagascar's sitting president is among the three most central nodes of the directors network.

We find that the boardrooms of semi-public companies create a very selective club of well-connected private and public decision-makers that meet on a regular basis.

We also compare the statistical features of our networks with other similar graphs built for developed countries. We find they are generally consistent with each other.

That boardrooms' lobbies have such a direct access to top politicians is a worrying prospect for public governance in Madagascar. Those results prove the importance of open access to boardrooms' data and show how to use it to assess governance in developing countries.

1 Introduction

The role of public and corporate governance for a nation's economic performance is fundamental. Decisions taken at the largest companies in a country or by its government have a macroeconomic impact on the economy.

It is common for directors at large corporations to sit on multiple boards. The high degree of interlocks of important companies is well documented [2], [1]. This creates dense interlocks networks linking directors sitting in the same boards and companies through shared directors, as shown in figure 1.

Interlocks allow firms and decision-makers to channel information and power. For example, before investing in a joint-venture, a company might learn private information on the financial health of its future associate thanks to its network.

Moreover, state involvement in boardrooms can allow for corporate leaders to mingle with government officials. *Revolving doors* between the public and private sector is a common practice in developed countries such as the US. There is a clear moral hazard in those situations, and this is why this practice is usually well monitored in developed countries.

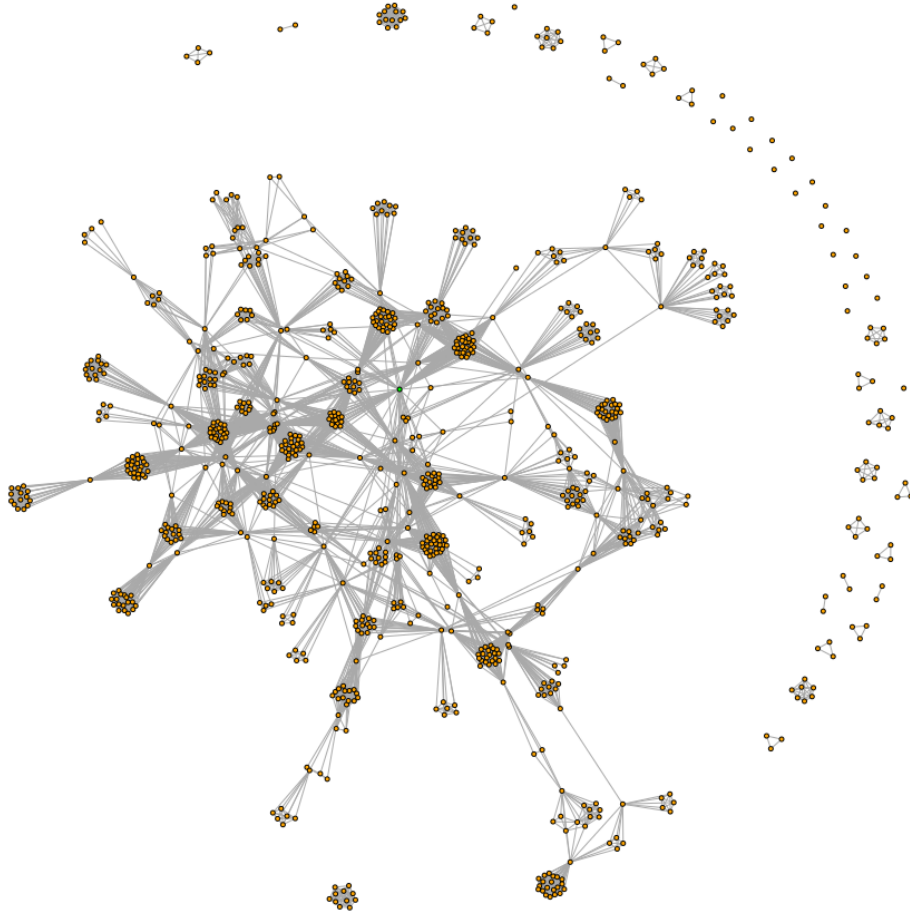


Figure 1: Directors' network in Madagascar. Each node is a director, each edge represent a membership in the same board. Madagascar's president's node is in green.

This is not the case in Madagascar. Hence, politicians and directors have the opportunity to meet in boardrooms without proper public scrutiny.

Studying links between boardrooms and directors using complex networks techniques allows to unveil those links. Revealing central companies and directors, it establishes whether influence in the network is well-distributed or concentrated in the hands of a few, and who those are. Those are all issues relevant to the public debate in Madagascar as well as for research on governance.

The case of Madagascar is especially interesting for 2 reasons. First, to our knowledge it is the first study looking at boardrooms' networks in a developing country using complex networks' techniques. Second, Madagascar is a highly unequal country where lacking public governance is an already documented issue. Using Gini coefficients, it is ranked 25th most unequal country in the world [6]. As such complex networks' analysis might be a promising tool to look for conflicts of interest in the public sphere.

Since its independence in 1960, Madagascar has experienced several Republics and governments which tried to apply various economic strategies, ranging from free market to socialist economic policies. Madagascar is still ranked fifth least developed countries in 2014 in terms of GDP. Income inequality is soaring at unprecedented levels. In addition to the mismanagement of its resources, the main culprits are series of political crises which drown the country into deep poverty. The most recent crisis in date is the one of 2009-2013 at the end of which millions of Malagasy people are starving. In mid-2014, the country entered into the fifth republic, currently led by President Hery Rajaonarimampianina.

In this paper, we study the statistical features of Madagascar's boards and directors networks and compare them with the literature in developed countries. Doing this, we find that government officials and the state are central in both networks. We then make a detailed analysis of the relationships between the private sector, semi-public companies, government officials and the state. Moreover, given the prevalent inequality in Madagascar, we will make a quick inspection of the dynastical features of the directors network.

The remaining of this reports is structured as follows. Section 2 provides information about the data we used for this study. In section 3, we give brief explanations on graph terminology and on the complex networks' construction. Then, the quantitative results are reported in section 4. We discuss political involvement in boardrooms in section 5, and dynastical properties of the directors network in section 6. We finally conclude on our findings in section 7.

2 Data collection

Malagasy companies are legally obliged to declare any change in their general information as well as their board. This information is collected by the *Registre National du Commerce et des Sociétés* of Madagascar and then made publicly available on its online platform [4].

In this analysis, we are interested in the capitalization of companies and the composition of their boards. Since the mid-90s, many important malagasy companies are private, but there is still no Stock Market in Madagascar. Hence, market capitalizations of companies are not available and we rely on book capitalizations provided by the *Registre* for our study.

Interestingly, when a director represents a natural or legal person, it is explicitly mentioned in the *Registre*.

We focus our analysis only on the most important companies in Madagascar and used 2 selection criteria. First, we took all the companies with a book capitalization of more than 500'000\$ in the *Registre*. Second, we added all the Malagasy firms listed in the *top 500 des premières entreprises de l'océan indien* published by the economics journal *L'Eco Austral* [5], which ranks companies from countries of the Indian Ocean by turnover.

There are 2 main quality issues with our data.

For a few randomly chosen companies, we compared the boards we obtained with those given in the corresponding annual reports to verify for data quality. In all cases, the boards we obtained had all the directors in the annual reports. In many, they also had a few (1 to 5) additional ones. Our explanation for this

is that sometimes former directors are not immediately taken out of the *Registre* when they leave a board, and only new ones are added.

Hence, our boards should not be considered as a single snapshot in time, but rather as a list of all board members of the company in the course of the last few years. Two directors, or two companies, are then connected if they have recently sat together in a boardroom, which is still a meaningful link.

The second quality issue is with "representing" directors. There are some cases where government officials representing the Malagasy state are not correctly reported. We have reasons to believe this is also the case with directors representing private institutions. It is mainly a problem with government officials, for which this data is most useful. Hence any number obtained on government involvement is a lower bound.

3 Graphs terminology and networks construction

A graph $G(V, E)$ is made of a set of vertices (or nodes) V and a set of edges $E \subseteq V \times V$ linking the nodes. Let N be the number of vertices $N = |V|$.

A bipartite graph $G(V_1, V_2, E)$ is a graph containing two distinct types of vertices belonging to subsets V_1 and V_2 with $V_1 \cap V_2 = \emptyset$. Moreover, edges only links vertices of different types: $E \subseteq V_1 \times V_2$.

3.1 Graphs construction

In our case, our data gives us a bipartite graph where the two types of nodes are boards and directors and edges make the link between directors and the boards they sit in.

From this original network we build the two separate projections: the directors' network and the boards' network.

In the boards' graph, nodes are exclusively boards. Two boards are connected if they share a common board member. In this sense, each edge is a shared director linking two companies. A shared director creates an *interlock* between two companies. Note that there can also be multiple interlocks.

Inversely, there are only directors nodes in the directors' graph. Two directors are connected in the directors' graph if they sit on the same board(s): each edge represents membership in the same board.

The construction of those 2 projections is visually represented in Figure 2.

Hence, there are three ways to represent the relationships between boards and directors. We can use the bipartite graph with its two types of nodes, or the 2 projections of the boards' and directors' graphs.

The bipartite graph does not allow for easy quantitative analysis: as the two types of nodes are not comparable, any aggregate measure taking them as equivalent is non-relevant.

This is why we will focus our analysis on the two projections of the boards and directors networks.

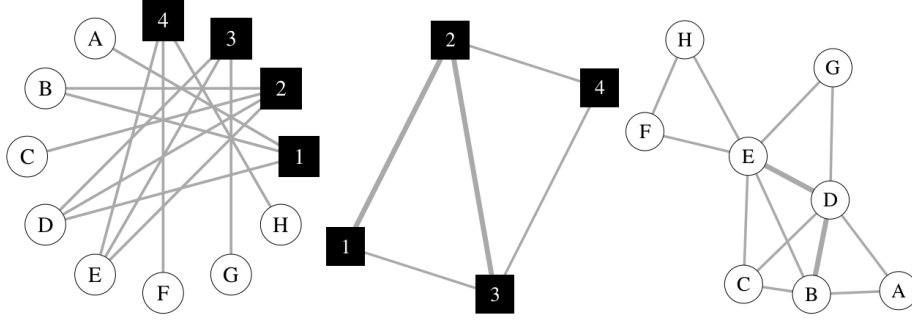


Figure 2: A bipartite graph and its 2 associated projections. Boards are represented as squares, and board members as circles. Source: F. Daolio et al. (2011)

4 Quantitative results: boards and directors networks

4.1 Average quantities

In tables 1 and 2 we report aggregate measures for the boards' and directors' networks. As a comparison, we also give those measures for corresponding networks already studied in the literature.

There are 3 such graphs. The most recent one is a study of the boards of the 108 biggest Swiss companies in 2009 [1]. The 2 others cover the quoted companies in the Milan Stock Market in Italy in 2002 and the Fortune 1000 companies in the USA [2].

Table 1: Directors' networks statistics

	D-MG, 14	D-CH, 09	D-IT, 02	D-US, 99
Nb. of vertices	1029	818	1906	7680
Nb. of edges	7900	3971	12815	55437
Largest comp. relative size	0.87	0.61	0.84	0.89
Mean degree	15.35	9.71	13.45	14.44
Network density (%)	0.75	1.19	0.71	0.79
Avg. clustering coefficient	0.762	0.859	0.915	0.884
Avg. path length	3.8	7.2	3.6	3.7

First, it is interesting to see how similar most of the aggregate measures for the directors' networks are, except for Switzerland. All those networks are observed years apart. Each of them is in a different country with different institutions, especially in Madagascar, a developing country. Yet, most of the statistics are in the same order of magnitude for all countries but Switzerland.

Of course, it would be presumptuous to draw any conclusion on a sample of 4 countries.

Compared to the other countries, we observe deviations in the Malagasy boards' network. The largest component and network density are both smaller compared to other countries. For both measures, it is not the case with the

Table 2: Boards' networks statistics

	B-MG, 14	B-CH, 09	B-IT, 02	B-US, 99
Nb. of vertices	184	108	240	916
Nb. of edges	215	91	636	3321
Largest comp. relative size	0.55	0.62	0.82	0.87
Mean degree	2.34	1.69	5.3	7.25
Network density (%)	0.64	1.57	2.22	1.57
Avg. clustering coefficient	0.358	0.246	0.318	0.376
Avg. path length	3.966	6.4	4.4	4.6

directors' networks.

The explanation is that many important companies in Madagascar have small boards. Indeed, 24% of companies have only 1 or 2 directors, compared to less than 5% in the Italy and US data. This gives less opportunities for having any interlocks. This lowers the network density and leads those companies to stay out of the main component.

4.2 Distributions

Let us turn our attention to distributions. First, let's consider the distribution of the number of boards a director sits in. As can be seen in figure 3, most directors sit on only one board. Moreover, high numbers of seats per director are quickly very unlikely.

As stated before, there are many companies with small boards in Madagascar. Actually, the board sizes distribution displays "fat tails", with relatively many small and large boards. It is very different from that found in the US and Italy by S. Battiston and M. Catanzaro (2004)[2] as shown in 4. The most common board size is indeed of 1 or 2 seats in Madagascar compared to between 7 and 11 for the Italy and US.

One way to explain this is the distribution of types of business entities of Malagasy companies shown in table 3. 32% of companies are business entities that don't need a board and can be represented only by top managers. Those numbers are not given for the other countries, but one reasonably expects to see more firms with real boards.

Table 3: Business entities in Madagascar

business entity	proportion	mean nb. board size
SA with board	68%	11
SA with general manager	6%	4.6
Limited liability company	22%	2.4
Company under foreign law	3%	2.3

We report the two empirical cumulative degree distribution functions on a log-log scale. The empirical cumulative degree distribution $F(k)$ gives for each degree k the probability that any randomly drawn node node has an equal or higher degree, or equivalently, the fraction of nodes with equal or greater degrees in the network.

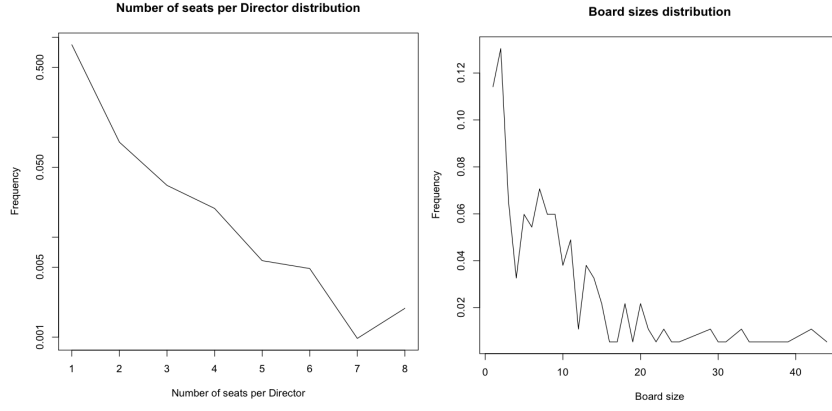


Figure 3: Distributions of number of seats per director and number of seats per board in Madagascar.

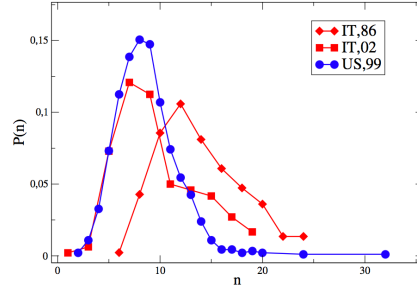


Figure 4: Distributions of number of seats per board in the US in 1999 and Italy in 1986 and 2002. Source: S. Battiston and M. Catanzaro (2004)[2]

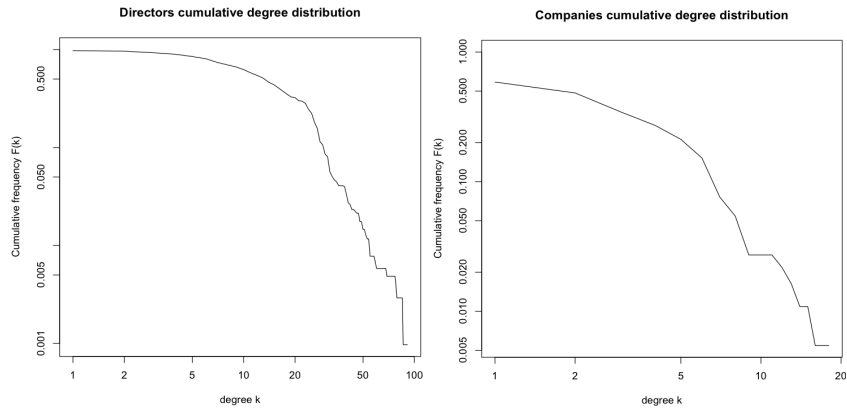


Figure 5: Cumulative degree distributions in log-log scale.

As can clearly be seen in both graphs, the distributions for the two networks decrease faster than a power-law, which would yield a straight line. Seen on a log-lin scale, both distributions seem close to an exponential law. However as our samples are small, we will not attempt to fit a distribution.

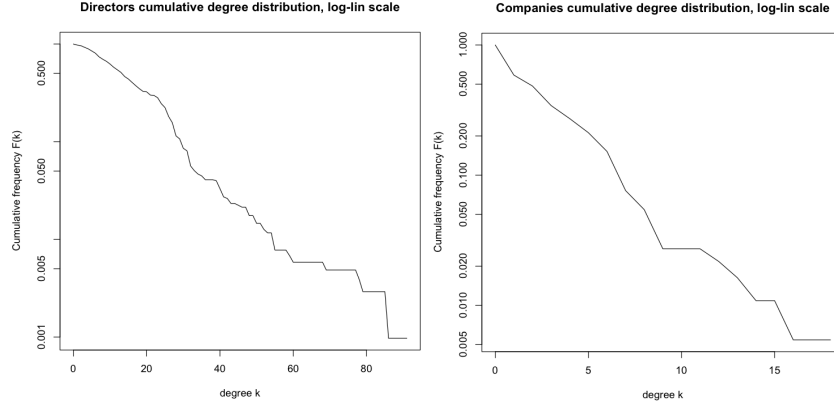


Figure 6: Cumulative degree distributions in log-lin scale.

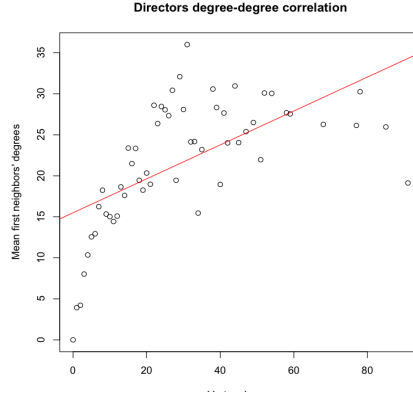


Figure 7: Plot of nodes' mean neighbors' degree averages versus their degree. The red line is a simple linear fit, significant at 1%

4.3 Assortativity

A graph is said to be *assortative* if vertices tend to connect to other nodes with similar degree. The mean neighbors' degree of a vertex is the average of the degree of its first neighbors. A positive correlation between the degree of a vertex and its mean neighbors' degree is an easy approximation for degree-degree correlation.

In figure 7, we plot the averages of *mean neighbors' degree* for each degree-level for the directors' network. The red line is a simple linear fit of the mean neighbor's degree averages against the degrees. The positive correlation is significant at 1%.

As is generally found in social network, the directors' graph displays *assortativity*. For the boards' network, there is a positive but insignificant relationships, probably due to the relatively small number of connected companies.

Daolio et al. [1] also found assortivity for the directors' network in Switzerland. Battiston and Catanzaro [2] found assortivity in directors' as well as boards' networks for Italy and US using a different measures. However, their

statistic didn't include any significance test.

4.4 Centrality measures

In a social network, it is of great interest to find the most important nodes. In our case, which directors have the most acquaintances? Which directors are central to connect disparate parts of the network? etc...

Degree is the first such measure that comes to mind to find such nodes. For directors for example, a high degree means one know many other colleagues in the network. It is a good measure of importance but it is not sufficient by itself.

For example, a director *A* sitting only in the largest board in our sample (42 seats) might have a higher degree than another director *B* sitting in 3 boards of 10 persons. Director *B* influences more companies than *A*. In each of the board he seats in, his voice will have more impact since there are only 9 other directors. It would be absurd to consider that degree is sufficient to say *A* is more central than *B* in the network as a whole.

Importance in a network has multiple dimensions. Following *Daolio et al.* [1], we use four centrality measures to distinguish them. We refer to their paper for explanations of the measures' computation. We describe here their interpretations for the directors' network:

- Degree: The number of other directors one sits in boards with.
- Eigenvector: Here, the importance of a director is measured by how important the other directors he is connected to are (according to the same Eigenvector centrality).
- Betweenness: Measures the "brokerage" potential of a director. It counts how many of the shortest paths between other directors pass through him.
- Closeness: Measures the average number of intermediaries a director needs to go through to reach any other person in the network (calculated as the inverse of average distance to other nodes).

In tables 7 and 8 in the appendix, we report the top ten directors and companies according to our 4 indicators. For each director, we also mention whether he currently holds a government position, or if he ever did, and the highest position held. For each company, we also mention its sector.

We assemble the four centrality rankings in one using the Borda count method and report only their degrees.

Generally the difference between scores are quite uniform. The different centralities have no common interpretation. Hence, ranking using Borda is relevant as it gives an equal importance to each measure and only cares about the rank a director has in each of them.

Note that from now on, when we refer to a company or director as *central*, it means he/it appears in those rankings.

The first striking result is the presence at the very top of most measures of the current president of Madagascar Rajaonarimampianina Hery and the government's Director of Financial Operations Randriantsarafara Voninirina Noro, as well as multiple other current/former government officials.

This is in stark contrast with the Swiss directors' network [1] (the only other study naming top directors) where no single current or former politician appears

at the top of such rankings. This is sadly the only available point of comparison, and one can reasonably wonder what would be the result in other countries.

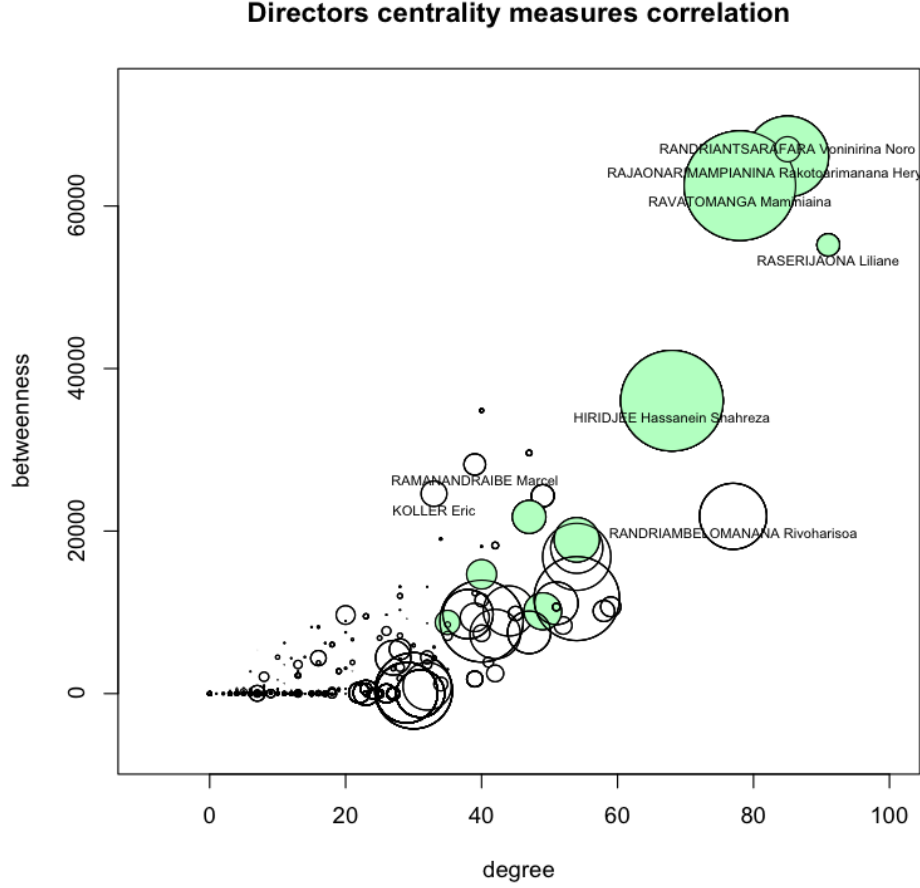


Figure 8: Scatter-plot of directors' degree versus betweenness. Circles' sizes proportional to Eigenvector centrality. Nodes in color are the top ten nodes according to closeness centrality.

This is the most striking novelty this paper uncovers, and as such we will discuss it in greater detail in section 5.

Another observation is that the directors at the top are quite recurrent. There are 27 unique directors filling the 40 slots of the 4 top ten rankings.

5 directors are clearly coming out of the pack, as shown in the scatter-plot of correlations between centrality measures in figure 8. In each measure, they are clearly ahead of the other nodes.

Directors' degree is well correlated with betweenness and eigenvector centrality. Otherwise the other measures' correlation stay quite low.

The boards' network displays an even stronger concentration of importance in a few nodes. There are only 17 unique companies present in the 4 top ten. 5 companies clearly are prevalent in the different centrality measures: Madarail, Air Madagascar, Galana, Telecom Malagasy and Jovenna.

Moreover, the correlations between centralities are higher than for directors

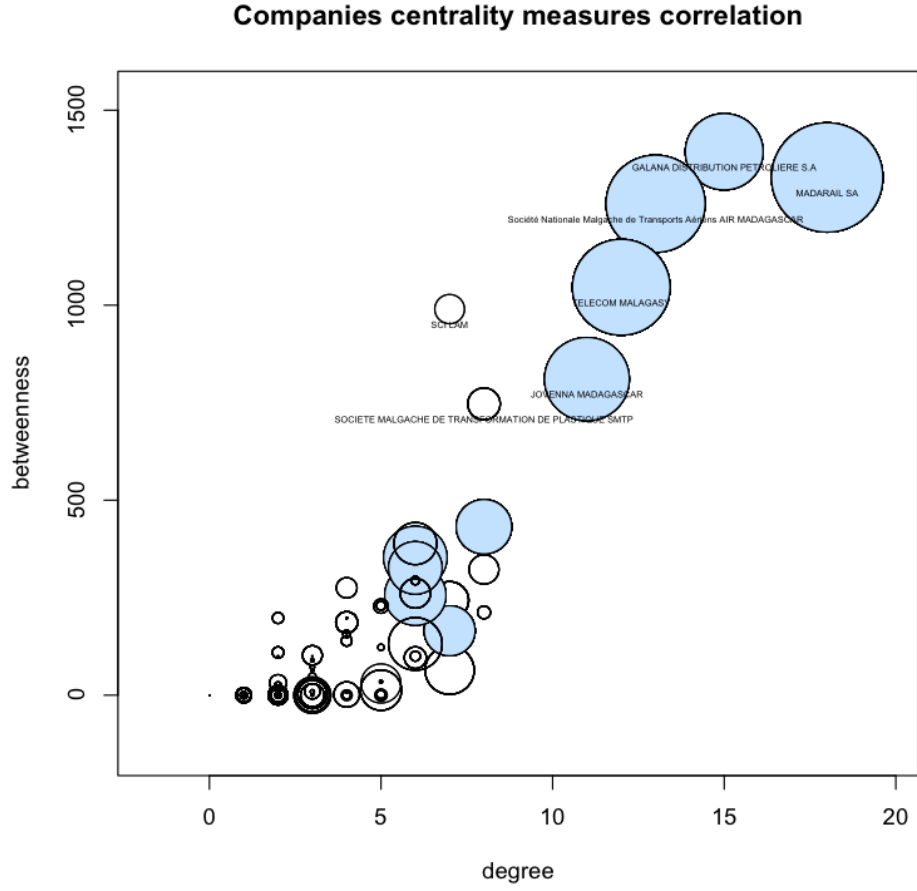


Figure 9: Scatter-plot of boards' degree versus betweenness. Circles' sizes proportional to Eigenvector centrality. Nodes in color are the top ten nodes according to closeness centrality.

with all measures apart from Closeness quite well correlated among them.

Table 4: Correlation matrix for centralities for directors.

	betweenness	eigenvector	degree	closeness
betweenness	1	0.18	0.79	0.12
eigenvector	0.18	1	0.68	0.18
degree	0.79	0.68	1	0.32
closeness	0.12	0.18	0.32	1

Table 5: Correlation matrix for centralities for boards.

	betweenness	eigenvector	degree	closeness
betweenness	1	0.89	0.91	0.35
eigenvector	0.89	1	0.92	0.48
degree	0.91	0.92	1	0.59
closeness	0.35	0.48	0.59	1

5 Politicians in boardrooms

As can be seen in table 7, current and former officials of the Malagasy state are central in the directors’ network (for an explanation of centrality, see section 4.4).

Why is it the case? Is this specific to Madagascar or is this feature also present in other countries? Are current government officials central only because they represent the state in firms’ boards? Is there a link between close ties to political figures and centrality in the network?

Those are all paramount questions regarding governance, both private and public.

First, the centrality of government officials implies nested interests, and boardrooms’ lobbies have privileged access to the government. In the case of Madagascar, this directly includes the chief of state, Hery Rajaonarimampianina.

Second, this importance of state officials (especially former ones) can also indicate that they take advantage of a *revolving door* carrier path. Whether this is the result of legitimate merit-based selection or public resource misallocation is out of the scope of this paper.

The rest of this section will be organized as follows. First we will build a few counter-factuals and re-estimate centrality measures accordingly. Second, we will detail companies where the state is represented in. Third we will discuss former politicians and the central directors with whom the government is connected to.

All along the way, we will attempt to put this in context with regard to other countries, the only firm comparison in the literature being Switzerland [1].

5.1 Representation and counter-factual

The clue we have on government involvement in boardrooms are representing directors: directors that have a seat to represent the interests of a non-physical institution. As stated before, the *Registre* explicitly mentions the entities directors represent, if they do, including the Malagasy government. However, there are misreporting issues with this data.

Politicians representing the government are sometimes not reported as doing so. Hence, if a sitting director is denoted as not representing any other entity in a boardroom, we cannot ensure he is actually not. Two quantitatively important case are Hery Rajaonarimampianina, the president, and Voninirina Noro Randriantsarafara, the state’s director of financial operation. We make no correction in the data (we would then need to inspect all 1029 directors) but take this into account in our discussion of results.

In 3 cases, represented institutions are actually also one of the company whose board we are studying in this paper. We don’t expect this 3 links to have

an important impact on the new graph we build as those companies are not central anyway. Thus, we do not make any corrections for them.

Most of the represented institutions are foreign investors and companies. The state is the one with the most delegates in boardrooms.

In this counterfactual, we assign a new node to each represented entity in the directors' graph. Then, in each board where a director represents such an entity, we replace him by the entity itself. After that, if a director does not sit in any board, we remove him from the network. Then we recompute the directors' graph.

We want to reveal two features of the directors' network with this approach. We can compute the importance of those represented institutions, among directors which is totally neglected in the study of the original network.

Directors derive some of their centrality from the institutions they represent. With this modified network, we can compute their centrality without the delegated powers they obtain. This is especially interesting in the case of government officials, to consider their influence in boardrooms besides their political involvement.

Aggregate statistics on the new network, *R-MG 14* are given in table 9 and central nodes in 10. There are in total 92 represented institutions. 132 directors that were always representing are removed from the networks. Others lose some edges, as those are rewired to the entities they represented in certain boards. The resulting graph has 989 vertices and 6914 edges. The Malagasy state is represented by 50 distinct directors, 5% of the directors in the original graph.

In the new network, all sitting government officials apart from Hery Rajaonarimampianina and Voninirina Noro Randriantsarafara are excluded from all top ten rankings. Moreover, those two make it in the top ranking only because of the aforementioned misreporting issues.

Hence, sitting politicians derive their centrality from the power delegated to them by the state.

Regarding former government officials, in the three that made it previously top the top-ten, only Frédéric Rasamoely gains some traction while the two others drop out.

Let's turn our attention to the newly introduced represented institutions.

Without surprise, the Malagasy state is the most central node in the new network. Its degree of 192 is an order of magnitude greater than the second one at 92.

The type of represented institutions that distinguish themselves are auditors' cabinets, CGA, PriceWaterhouse Coopers, Delta Audit (Deloitte) and Mazars Fivoarna. Their representants often have the position of statutory auditor.

Cabinet CGA is the company Hery Rajaonarimampianina was working at before joining the government. PriceWaterhouse Coopers is always represented by Liliane Raserijaona, wife to José Yvon Raserijaona, minister of finance in the 90's (which is also present in the network, although not central).

As robustness checks, we computed two other ad-hoc networks. The first one is *NR-MG 14*, which excludes all occurrences where a director represents another entity. It compares directors only, and without their delegated powers. The second is *NRG-MG 14* which only excludes entries where a director represents the Malagasy government. Here, we distinguish the centrality of government officials without their political representation in corporate boards. Their aggregate statistics are given in table 9. The results are unchanged.

5.2 The state and companies

The state is represented in 17 companies in total. Five of them make it in the top-ten centrality rankings. Those are shown in table 6.

Table 6: Central semi-public companies.

Company	Borda score	ratio of gov. seats in board
Madarail	1	0
Air Madagascar	2	0.23
Telecom Malagasy	4	0.14
Ny Havana	6	0.2
Logistique Pétrolière	15	0.05

The Malagasy state is not represented in Madarail, where it has a 25% ownership stake[9].

Telecom Malagasy is a semi-public company where the government has a minority ownership stake. It was fully state-owned before 2004[8].

Air Madagascar and Ny Havana are semi-public company where the government has majority stakes[7]. We have no information on the ownership links between Logistique Pétrolière and the government.

Out of the 27 central directors we have identified, only 4 do not sit on any of the board of these companies. This exemplifies how important those (semi-)public companies are in Madagascar. Air Madagascar, Telecom Malagasy and Ny Havana respectively are the second, fourth and sixth most central Malagasy companies according to our Borda ranking. They allow businessmen to mingle with government officials, but this centrality implies they also connect businessmen among themselves.

This is a powerful demonstration of how those semi-public companies' boardrooms create a very selective club of private and public decision makers which interact regularly.

All this is in stark contrast with Switzerland [1]. The equivalent Swiss semi-public companies are the CFF (railways), Swiss (national airline) and Swisscom (Telecom). Only CFF make it amongst the most central companies and the authors make no mention of its directors as central ones.

5.3 Politicians and central directors

In figure 10, we detail the subnetwork of central directors that appear in the top ten of at least one of the four centrality measures.

Out of the 20 non-government central directors, only 4 are not connected to any politician. 7 of them have direct access to Madagascar's president.

5 agents seem to distinguish themselves by their Borda scores among the central directors: the president Rajaonarimampianina, the state's director of financial operations, Voninirina Noro Randriantsarafara, and three business people Ravatomanga Maminiaina, Liliane Raserijaona and Hiridjee Hassanein Shahreza.

As director of the government's financial operation, it is not astonishing to find Voninirina Noro Randriantsarafara representing it in companies. Her centrality derives from the importance of semi-public companies as seen in the previous section.

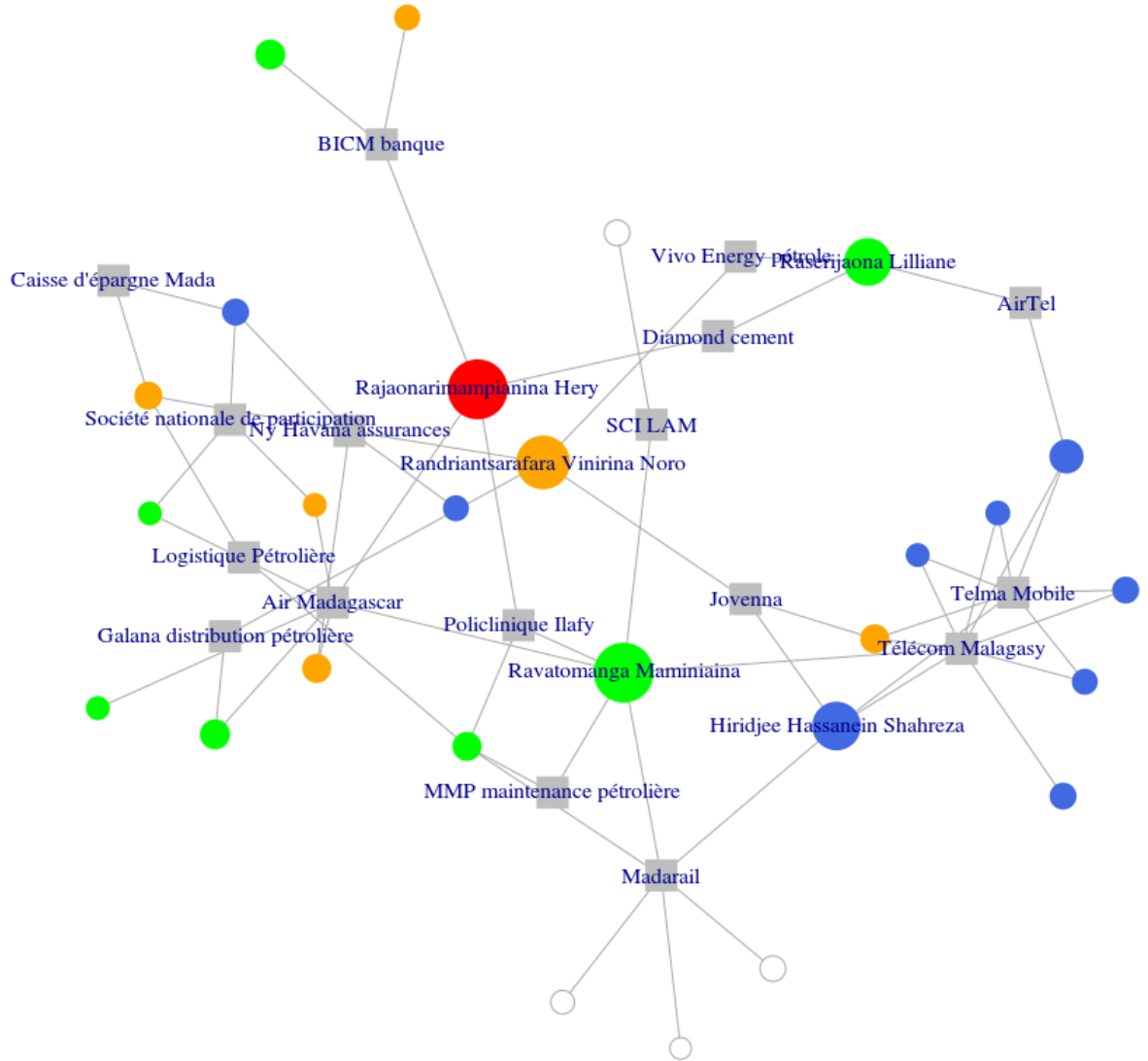


Figure 10: Subset of the bipartite graph including only central directors and the boards they sit in. Square nodes are boards with company names, circles are directors. Only the names of the five most central directors are given. In **red** is the president. In **orange** are other state officials. In **Green** are non-politician directors sitting in a board with the president. In **blue** non-politician directors sitting with other government officials. Non-colored nodes don't have any political connections. The size of each circle is proportional to the Borda score of each director in the whole directors' graph

It is more astonishing to find president Rajaonarimampianina sitting in cor-

porate boards. This is usually not the role of a chief of state. Moreover, in two cases he is actually representing the company he was working at before joining the government: auditeurs CGA.

Let's focus on our very central businessman. Ravatomanga Maminiaina possesses media outlets and is heavily connected to politicians. He has been a staunch supporter of both the former and current presidents of Madagascar, appearing publicly with them. Some sources even credit him with introducing Rajaonarimampianina in politics in the first place [11] [10]. In our data, he is even one of the representatives of the Malagasy state in Telecom Malagasy. That he is so well placed in the directors network further demonstrates his clout in Madagascar.

As stated before, Liliane Raserijaona is the sole representant of PriceWaterhouseCoopers in Madagascar and is married to a former minister of finance, José Yvon Raserijaona.

Finally, Hiridjee Hassanein is the only of our 5 top directors for which we didn't find links with the political sphere outside of our networks.

The only comparison is Switzerland, where no politician is central. One can reasonably wonder what is the situation in other countries.

Berlusconi in Italy, Nicolas Sarkozy in France and the Bush family are famous examples of politicians with strong business ties in developed countries. However, it would have been astonishing to see one of these figure distinguish itself so strongly in a corporate boards' network while in government office.

6 Families in boardrooms

In this section, one final network is created. Until now the only considered link between directors is sitting in the same board. There is no doubt directors have other connections, such as having studied at the same university, being parts of the same sports club or family links.

It is impossible to account all those links. However, there is one good proxy in our dataset for family links: last names. It is not perfect, as women might change names with marriage and some cousin links are still absent, but it is still relevant.

The directors families network is built by grouping together directors by family name. If 2 directors have the same family name, they are fusionned in a single node denoting their family.

The aggregate statistics for the resulting network *F-MG 14* are given in 9, the top families in table 11. 147 nodes disappear in the new network. 94 families have more than one member, 11 have more than three. The network density increases and the average path length decreases: the graph is better connected.

The subgroup of families occupying top-positions is highly concentrated. There are only 15 families appearing in them, compared to 27 in the directors' graph, and 17 in the boards' graph. This concentration is the most notable difference of the families graph.

As before, politicians play an important role. The family of the president is much less important than before. However, the Ravatomangas hold their ground. The other four families in the top 5 of the Borda ranking contain a current or former politician.

7 Conclusion and further research

The greatest discovery of our study is the centrality of political figures, including the island's current president, in the directors network as well as that of semi-public companies in the boards network.

Exploring the links between boardrooms and central directors, we find that the boardrooms of those semi-public companies gather a very selective club of well-connected private and public decision-makers.

When taking into account family relationship (using as proxy common family names), centrality is even more concentrated. Most central families count current or former politicians in their rank. Hence, there is a determinant dynastical element in Malagasy boardrooms.

Those evidences raise important questions on both public and private governance in Madagascar.

That the government is well represented in boardrooms is a result of the pre-eminence of partly publicly owned companies in the economy of one of the least developed countries of the planet. Boardrooms' lobbies have privileged access to the government, including the chief of state, Hery Rajaonarimampianina. Political figures seem to take advantage of a *revolving door* carrier path.

This paper is the first study to reveal such features. Studying the centrality of political figures and semi-public companies in directors and boards networks in other countries, especially developing ones, is of great interest. It would demonstrate to what extent this is specific to Madagascar or a general feature of directors' network.

Whether all this is the result of legitimate merit-based selection or public resource misallocation is out of the scope of this paper. Similarly, we do not provide any evidence on whether those connections are positive or negative for the development of Madagascar. Those are also relevant questions for further research.

The directors and boards network in Madagascar display a topographical structure similar to those of other such graphs studied in the literature. The main difference is the distribution of board sizes. Many important Malagasy companies are legal entities that do not require a proper board and only have 1 to 3 top managers.

Throughout this paper, we use no data other than board membership. Bringing new informations such as ownership links would also be of interest to better understand the structure of corporate governance in Madagascar.

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A Appendix

Table 7: Top directors appearing in at least on of the top-ten rankings of a centrality-measure. The columns Crt. and Frmr. indicates whether this person is a current or former government official. The score column is obtained aggregating the four top-ten rankings with the Borda count method (with maximum and minimum scores 10 and 1.)

Score	Name	Degree	Degree rank	Betweenness rank	EV rank	Closeness rank	Crt.	Frmr.
34	RAJAONARIMAMPINANINA Hery	85	2	2	5	1	x	President
34	RAVATOMANGA Maminiana	78	4	3	1	2		
28	RANDRIANTSARAFARA Voninirina Noro	85	2	1		2	x	Dir. of Fin. Operations
23	HIRIDJEE Hassanein	68	6	5	2	8		
22	RASERIJAOA Liliane	91	1	4		6		
10	WHITE David Kenneth	54	9		3			
7	RAZANANIRINA Bruno Richard	47				4		
7	FIENENA Richard Désiré	40			4		x	Energy Minister
6	ROBIMANANA Rivomanantsoa Orlando	40				5	x	Secretary of Treasury
6	RANDRIAMBELOMANANA Rivoaharisoa	77	5					
5	BENICHOUE Stéphane	30			6			
5	CATEIN Gérard Marie Pierre	40		6				
4	RAJAONARIVELO Andriamasy	35				7		
4	RAZANAMPARANY Eric	54	9			9		
4	LESCHAEVE Geneviève Jeanne	47		7				
4	RAMAMONJISOA Virapin	59	7				x	Congressman and Consul in la Réunion
4	ALLARD Ronald	30			7			
4	BECKERS Eugene	30			7			
3	RAMANANDRAIBE Marcel	39		8				
3	RASAMOELY Roland Jean	58	8					
3	WAN SWYGENHOVEN Michel Jacques	54	9		10			
2	KOLLER Eric	33		9				
2	RASAMOELY Frédéric	54	9				x	Gov. of Central Bank
2	PISAL HAMIDA Patrick	30			9			
1	RABETSTONTA Lala Harinoa	49				10		
1	RAELISON RAJAOBELINA Léon Maxime	49				10	x	Finance Minister
1	ANDRIANTSITOHAINA Niaina	49		10				

Table 8: Top companies appearing in at least on of the top-ten rankings of a centrality-measure. The score column is obtained aggregating the four top-ten rankings with the Borda count method (with maximum and minimum scores 10 and 1.)

score	Denomination	Degree	Nb. gov. seats	Nb. seats	Prop. of gov seats	Degree rank	Betweenness rank	EV rank	Closeness rank	Sector
38	Madarail SA	18		29		1	2	1	2	Transport
35	Air Madagascar	13	7	30	0.23	3	3	2	1	Airline
31	Galana	15		20		2	1	5	5	Gas stations
31	Telecom Malagasy	12	6	44	0.136	4	4	3	2	Telecom
25	Jovenna Madagascar	11		12		5	6	4	4	Gas stations
15	Ny Havana	8	5	25	0.2	6	9	8	6	Insurance
10	Madagascar Maintenance pétrolière	6		7				6	6	Oil
9	SMTP	8		9		6	7			Petrochemicals
8	Aye-Aye Madagascar	8		7		6	8			Jewelry
7	Polyclinique d'Ilfy SA	6		7				7	8	Health
6	SCI LAM	7		2			5			Housing
5	Société J.B	8		18		6				Food
5	Société Orimbato	8		6		6				Manufacturing
3	Telma Mobile	6		13				10	9	Telecom
2	Ocean Trade Cie.	6		11				9		Commodity trade
1	Logistique pétrolière	7	2	38	0.053				10	Oil
1	MariMa	6		6			10			Food

Table 9: Top directors, represented institutions and families networks aggregate statistics. See section 5.1 and 6 for details.

	D-MG, 14	R-MG, 14	NR-MG, 14	NRG-MG, 14	F-MG, 14
Nb. of vertices	1029	989	897	990	882
Nb. of edges	7900	6914	5433	7008	7306
Largest component relative size	0.87	0.83	0.75	0.86	0.9
Mean degree	15.36	13.98	10.43	13.58	16.57
Network density (%)	0.75	0.71	0.68	0.72	0.94
Clustering coefficient	0.762	0.703	0.833	0.78	0.64
Avg. Path length	3.81	3.67	4.497	4.04	3.21

Table 10: Top directors and represented institutions. The score is obtained aggregating the four top-ten rankings with the Borda count method.

Rank	Directors and represented institutions	degree	score
1	Malagasy State	192	30
2	Cabinet auditeurs CGA	92	27
3	Price Waterhouse Coopers	85	25
4	RAVATOMANGA Maminiana	42	16
5	Cabinet Delta Audit (Deloitte)	69	16
6	HIRIDJEE Hassanein Shahreza	63	15
7	RASAMOELY Frédéric	54	13
8	RANDRIANTSARAFARA Voninirina Noro	64	10
9	Assurance ARO	53	9
10	DELMOTTE Emile Nicolas	44	8
11	RABETSAROANA Sylvain	42	7
12	RAZANAMPARANY Eric Maminirina	49	7
13	Cabinet Mazars Fivoarna	54	7
14	VAN ASS Guy André Benoît	38	6
15	CATEIN Gérard Marie Pierre	40	5
16	PUN Tak Hung	31	5
17	RAELISON Hajatiana Minosoa	41	5
18	RATSIFERANA Hugues Aimé	41	5
19	HUI Chi Ming	31	4
20	LESCHAEVE Geneviève Jeanne	43	4
21	RANDRIAMBELOMANANA Rivoaharisoa	31	4
22	Development Partners Limited	31	4
23	ANDRIANIFAHANANA Brigitte Monique Nirina	31	3
24	RAZANARIJAONA Vololomanarivo Marthe	31	3
25	TONG Wai Yuen Dennis	31	3
26	VONY Roger	31	3
27	LALLMAHOMED Elam	52	2
28	RAJAONARIMAMPIANINA Hery Martial	35	1

Table 11: Top families appearing in at least on of the centrality measures in the families' network. The score is obtained aggregating the four top-ten rankings with the Borda count method.

Last name	Family size	Score
RANDRIANTSARAFARA	2	33
RASAMOELY	3	28
RASERIJONA	2	27
RAVATOMANGA	2	25
RAMAMONJISOA	4	20
RAKOTOARISOA	5	19
HIRIDJEE	7	17
RAJAONARIMAMPIANINA	1	11
RANDRIAMBOLOLONA	2	10
RAJAONARIVELO	3	8
RAMANANDRAIBE	5	7
ANDRIANTSITOHAINA	3	6
RANDRIAMBELOMANANA	1	6
RAKOTOARIMANANA	3	4
CATEIN	1	3