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Summary

The purpose of this paper is to analyze the effects on the Italian directorship network of the corporate governance reform that was introduced in Italy in 2011 to prevent interlocking directorships in the financial sector. Interlocking directorships are important communication channels among companies and may have anticompetitive effect. We apply community detection techniques to the analysis of the networks in 2009 and 2012 to ascertain the effect of the reform. We find that, although the number of interlocking directorships decreases in 2012, the reduction takes place mainly at the periphery of the network whereas the network core is stable, allowing the most connected companies to keep their strategic position.

Keywords: Interlocking Directorships, Corporate Governance, Community Detection, Social Networks
JEL Classification: C33, G34, G38, L14

The analysis and views presented are exclusively those of the authors in their personal capacity and they do not reflect the positions of the public authorities they are affiliated with.

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Abstract

The purpose of this paper is to analyze the effects on the Italian directorship network of the corporate governance reform that was introduced in Italy in 2011 to prevent interlocking directorships in the financial sector. Interlocking directorships are important communication channels among companies and may have anticompetitive effect. We apply community detection techniques to the analysis of the networks in 2009 and 2012 to ascertain the effect of the reform. We find that, although the number of interlocking directorships decreases in 2012, the reduction takes place mainly at the periphery of the network whereas the network core is stable, allowing the most connected companies to keep their strategic position.

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1. Introduction

The Italian corporate governance system features large ownership concentration and the presence of control-enhancing mechanisms in a way that is conducive to controlling shareholders' dominance at the expenses of minority shareholders. At director level, the Italian corporate governance system is characterized by the widespread recourse to interlocking directorships (directors sitting in more than one board at the same time, ID thereafter). A number of reforms have been implemented over the last 15 years to open up the market for corporate control and to protect minorities. The latest addition to this wave of reforms was a new law provision in 2011: article 36 of the "Save Italy" Law ruled out interlocking directorships within the financial industry, effective from 2012.

The purpose of this paper is to assess which effects this reform had on ID. Using the instruments of network analysis, we compare the network before (2009) and after (2012) the reform and we find that after this regulation the concentration of the Italian network of companies decreased only slightly. The companies at the center of the director network managed to reduce their links with the periphery while keeping their strategic connections. Therefore the law has not been effective in delivering its aim of dispersing the ID network.

This work is organized as follows: section 2 reviews some model of ID, in section 3 we present the reforms of corporate governance in the period 2010-2011, then we introduce the dataset and the methodologies used (both in section 4). We present the results in section 5, and section 6 concludes.

2. Interlocking directorship: some theory

ID had been pointed out as the "root of many evils" by Brandeis (1914). Probably because Brandeis was one of President Wilson's counselors, in 1914 the Clayton Act prohibited ID among competitors. According to the principle that "no man can serve two masters", ID were seen as a tool to decrease competition, therefore damaging the market.

During the past decades, the first theoretical problem was to justify the presence of ID on the board of directors. Among the theories trying to explain it, there are two main views: the first one sees ID as a relation between institutions; the second one focuses its attention on the relationship among individuals.

The first model that sees ID as an instrument to connect institutions is the *Resource Dependence Model* proposed by Selnick (1947). According to this model, companies face enormous uncertainty in their business life about customers, suppliers, competitors, macroeconomic conditions or other features. This model sees ID as a tool to reduce uncertainty. Firms create interlocks in order to have more power to control and predict at least some part of the uncertainty they face. That is why a part of ID brings vertical/horizontal integration or is between institutions belonging to the same industry. Moreover, firms look for intangible resources, such as information, business practice or prestige, when they interlock.

In the *Financial Control Model* capital is the key source to explain ID, because it is a tool to have easier access to this crucial resource. There is large empirical evidence of ID among banks and industrial companies. Dooley (1969), Mizruchi (1998) and Mizruchi and Stearns (1988) found more ID with banks in those companies with an increasing demand

for capital. Having a banker (the director holding both industrial and banking directorships) on a company board reduces information asymmetries between the bank and the industrial company. Therefore, companies may benefit in raising more debt capital; in addition, the banker ensures better monitoring during debt life (Pfeffer and Salancick 1978). The banker faces a conflict: sitting on the board of the industrial company should maximize shareholders' values; at the same time he should maximize bank debt value. A simple way to maximize bank debt value is to reduce company leverage. But reducing company leverage is a benefit for shareholders only if the current leverage ratio is above the optimal level. On the other hand, we explained before how having a banker on their board may give industrial company the opportunity to raise more debt.

According to the *Collusion Theory*, ID permits the creation of communication channels between companies to make agreements against consumers. Interlocking directorships is seen as an instrument to cartelize a market because sharing directors allows cartel participants to have an observer in place monitoring activities that could undermine the cartel agreement. A system based on direct IDs may thus potentially produce economic inefficiencies. Pennings (1980) found a positive association between industry concentration and horizontal ties.

The *Management Control Model* is the first that considers ID as a link among individuals and not institutions. The model stresses the power of managers in pursuing strategies that are not in line with shareholders' interests. Managers tend to appoint as directors managers from other companies so that they are busy and passive, and do not contradict those who called them in their role. Palmer (1983) investigated what happens when a link between two firms disappears due to the death or retirement of the director. Only a minority of these links are created again after they disappear: if these links were

functional to connect two institutions they would be promptly reconstituted. According to Koening et al. (1979), managers use ID to increase their power. Interlocked directors are often passive and never vote against managers that "hired" them. Hallock (1997) studies the effect of cross interlocks between CEO's on director's compensation, finding an increase in CEO salary of about 17% due to the presence of interlocks.

The *Class Hegemony Model* describes ID as the result of a strong social cohesion. In Useem (1984) directors contact other directors following a relationship pattern: for example, they go to the golf club or country club, they share the same beliefs and values, and they often have a shared political view. In other words, they all belong to the same upper class and form a business elite. Etzion and Davis (2008) find that the Bush administration recruited more heavily from among corporate officers and directors than the Clinton administration. The *Career Advancement Model* (Stockman et al., 1988; and Perry and Peyer, 2005) focuses on the interest of each single interlocked director. Directors interlock following three drivers: compensation, prestige, and future networking and job opportunities. This theory supports the idea that interlocks is about skills and knowledge: in order to gain a higher salary, prestige and opportunities, directors will strive to offer those competences that the market is looking for. This creates a serious problem for the effectiveness of corporate governance: directors may be captured in a closed circle of people which promotes conformism and therefore less questioning on the choices of the managers reducing monitoring (Subrahmanyam, 2008).

3. Corporate Governance Reforms

During the last 15 years the Italian capitalism has undergone a deep reform process, pointing towards a corporate governance model based on the Anglo-American form (Enriques, 2009; Enriques and Volpin, 2007). The Italian capitalism has been characterized by the presence of cross shareholdings, pyramidal groups and as well as ID. Santella et al. (2009) and Drago et al. (2015) provide evidence that Italian capitalism was characterized by the use of the cross-financial participation by the "industrial families". In both cases cross-financial participation was typically associated with a dense interlocking directorship structure. Rinaldi and Vasta (2005) consider the historical relevance of ID in the inter-war period, in particular they consider the capacity of the "big linkers" to stabilize the system. Pyramidal groups (Bianchi et al., 2001) arise in this context as instruments to separate ownership and control. Within this framework Dyck and Zingales (2004) claim that in Italy there is a relation between high private benefits of control and lower levels of investor protection. In order to protect the minority rights and to enforce these rights, various reforms of corporate governance have been enacted:

1. The Legislative Decree n. 58/1998 (the so called "Draghi Law"),
2. The self-regulation code by the Italian Stock Exchange,
3. The Law n. 366/2001;
4. The legislative Decree n. 6/2003 and the law 262/2005 (the so called "Law of Savings");
5. The interlocking directorship reform in 2011 ("Save Italy" Decree):

Article 36 "prohibition of interlocking" is in the "Save Italy" decree.[1] It began as a decree law no. 201/2011, published in Official Gazette of December 6, 2011. This decree was converted into law with amendments in the law n. 214 of 2011 published in the

[1] For a study of the Save Italy Decree see Marroni (2013).

Official Gazette of December 27, 2011. By provision of the law (see Art. 36 paragraph 2b) the calculation of the term of 120 days runs from December 27, 2011. Therefore, a director of a bank or insurance company who had an assignment incompatible should have exercised the choice (option) between one of the two (or more) positions by April 27, 2012 otherwise losing the appointments.

We point out that the effects of the Law were in place when the data for our study was collected (December 31, 2012). Therefore, it is legitimate comparing 2012 to 2009 to check whether the provision was effective in reducing ID in the financial sector.[2]

4. Data and Methods

This study considers two ID networks, the first one related to 2009 and the second one to 2012. Data were collected among listed companies by considering the board of directors for each firm at 31/12. Only the management board is considered for the few companies that have the two-tier system.[3] We consider the public data collection in Consob (the Italian stock market regulator) which allows to extract data relating to the board and the ownership of the Italian companies. To collect the network data we consider the single name and the related company and we are thus able to create the two-way matrix, from which we are able to perform the one mode projection in order to obtain the adjacency matrices both for the network of directors and for the network of companies. From the adjacency matrices we are able to detect the communities.

[2] This cannot exclude a similar pattern in the non-financial sectors, but if existing this should be slower given the three-year appointment of the boards of directors, whereas the art. 36 rule will change the composition of the board in during its term.

[3] Members of the Statutory Board of Auditors are also not considered.

To detect the global changes of the network data structure before and after the reforms (see De Nooy et al., 2011), the data analysis is divided in two distinct parts: first, we graphically analyze the networks and we obtain the structural indicators as the Freeman degree, the betweenness, the density[4] for both years 2009 and 2012. We consider whole network multiple measures as: Components, Component Ratio, Connectedness, and Fragmentation[5] (Wasserman and Faust, 1994). The results are compared and the nodes with the highest betweenness and Freeman degree centrality are taken in to account in order to observe the network zone which is characterized by the most central nodes.

Then we consider the community detection techniques to ascertain whether there are differences in the community structures of 2009 and 2012. We expect that the corporate governance reform of art. 36 in 2011 will have changed the structure of the network in 2012 and that there are different community structures in the two years. Community detection methodologies allow us to ascertain groups of nodes which present more dense structure as connections and weaker connections belonging to other communities. In particular, it is possible to observe that the distribution of the edges is locally inhomogeneous and that there is a concentration of very high edges in these groups and there is a low concentration between the different groups (Fortunato, 2010). Community detection allows us to detect different groups of nodes that may have similar function in the network. Moreover, we can identify the single position or role of the nodes in the

[4] The Freeman degree and the betweenness are different measures of node centrality in a network. The Freeman degree is based on the connections of the nodes inside a network. The betweenness is a computed by considering the shortest paths passing through the defined node to all the different vertices. The density is the ratio of the number of the edges on a specific network on the possible edges.

[5] Components are network subgraphs which are typically connected within. Component ratio is the number of a components minus 1 on the number of nodes minus 1. The connectedness is the number of the connections on the possible theoretical number. Fragmentation is the proportion of the nodes on a network which are not connected to each other.

different communities (Fortunato, 2010). The most central nodes in the groups can have an important role in maintaining the stability and the order in the node groups. Furthermore, nodes in the boundaries of the network may mediate between different communities and allow both information diffusion and exchange between different communities (Fortunato, 2010; Csermely, 2008).

Several methods have been proposed to detect communities in a network, yielding to different results (Leskovec et al., 2010). Following Fortunato (2010) and Newman (2004), it is possible to distinguish them in traditional methodologies (hierarchical clustering, partitioned clustering, and graph partitioning and spectral clustering), and divisive algorithms (the Newman-Girvan algorithm see Newman and Girvan 2004). There are also many methods based on the optimization of the modularity.[6] The clear advantage of using methods based on modularity is that these methods allow us to choose the number of communities considered with an objective matrix (Newman and Girvan 2004). In fact, there is the assumption that a very good partition is associated with a high value of modularity (Fortunato, 2010; Newman, 2006).[7]

The Newman-Girvan algorithm we use in this work detects communities by progressively removing edges from the original network. The connected components of the remaining network are the communities. Vertex betweenness is an indicator of highly central nodes in networks. For any node *i*, vertex betweenness is defined as the number of shortest paths between pairs of nodes that run through it. The algorithm extends this definition to the case of edges, defining the "edge betweenness" of an edge as the number of shortest paths between pairs of nodes that run along it. If there is more than one shortest

[6] Modularity measures to what extent a network can be divided in different parts.

[7] Other methods include greedy techniques, the simulated annealing and the extremal optimization, spectral algorithms like random walk (Hughes, 1995) and those based on blockmodeling (Fortunato, 2010).

path between a pair of nodes, each path is assigned equal weight such that the total weight of all of the paths is equal to unity. If a network contains communities or groups that are only loosely connected by a few inter-group edges, then all shortest paths between different communities must go along one of these few edges. Thus, the edges connecting communities will have high edge betweenness (at least one of them). By removing these edges, the groups are separated from one another and so the underlying community structure of the network is revealed.

The algorithm's steps for community detection are summarized below

1. The betweenness of all existing edges in the network is calculated first.
2. The edge with the highest betweenness is removed.
3. The betweenness of all edges affected by the removal is recalculated.

Steps 2 and 3 are repeated until no edges remain.

The method maximizes the Q modularity index (see Newman and Girvan, 2004; Chen et al., 2014 for a discussion of the methods), to obtain the best partitions. From the partition obtained for the year 2009 and the year 2012 we are able to compute the transitions between the different communities. The methods used here generalize those adopted in Drago et al. (2013).[8]

5. Results

We start by analyzing the structural characteristics of the networks. In particular we visualize the networks of 2009 and 2012 by observing their structure. Figures 1 and 2

[8] Software used are Ucinet (Borgatti et al. 2002), Netdraw (Borgatti 2002) and programming language R (R Core Team 2013).

show a somehow stable situation in the two years. In fact, the density is slightly reduced from 0.02 to 0.017 (table 1), and the structure of the network seems stable. The components increase from 66 to 80, and the component ratio is increasing. Finally, the connectedness and the fragmentation of the two networks are different. In particular, the reduction of the connections over the period increases the number of isolates. As a result, the overall level of connectedness of the network increases: since connectedness is the number of the actual connections over the number of possible connections, once loose connections have been lost this reduces the number of possible connections and the connections that have been kept raise the ratio. The network in 2009 seems to be more connected, compact and less fragmented than in 2012 (table 2). In table 3 we can observe that there is an increase of the clustering coefficient in 2012 in comparison to 2009. The growth of the clustering coefficient[9] is expected and it is due to the reduction of the edges and the convergence of the network to a small world structure (Watts and Strogatz, 1998).

[Figures 1 and 2 about here]

[Tables 1, 2 and 3 about here]

What is changing is the number of the nodes which show a higher betweenness. It is possible to note that there is an increase in the number of nodes which show a higher betweenness. This is probably due to a reduction of the density in the network in 2012. In fact with the reduction of the edges, some nodes can become more relevant on the network flow (the concept of centrality and network flow is studied in Borgatti 2005).

Figures 3 and 4 show the core of the networks. The core of the network (Milakovic et al. 2011) is defined as the group of connected nodes which show the highest centrality in

[9] Clustering coefficient can be defined as the density of connections by considering the neighbor's node (Watts and Strogatz 1998).

the network structure. In this case we consider the structure of the network by considering the thirty most central companies selected by the computed betweenness. It is possible to observe that the network in 2009 tends to have more strength in their ties because of higher betweenness. At the same time the structure of the network seems to have a well-defined center (the most central companies tend to have significant higher centrality indicators as betweenness than other companies). The situation is different in 2012 where there is less strength on ties and at the same time there are an increasing number of the centers. The results are confirmed in tables 4 and 5 by considering the Gini index both for the Freeman degree and the betweenness: in both cases there is a reduction in concentration.

[Figures 3 and 4 about here]

[Tables 4 and 5 about here]

The growth of the clustering coefficient is interesting and could be related to the decrease in the connections. We can detect a most central node in the entire system by considering both the local (Freeman Degree) and the global criteria (betweenness). Notice that the most central companies are similar both in 2009 and 2012, in particular at the highest ranks. The main difference is that the measured distance between the first and the other positions is higher in 2009 than in 2012. This observation is in line with figure 2 in which many companies have high centrality levels. There is not a single center but rather many centers. This is supported by the Gini index in tables 4 and 5 which show a higher equality in both Freeman degree and betweenness in 2012 than in 2009. This result shows that there is an empowerment of the companies which are in the first positions in the ranks and lower network centralization in 2012.

At this point we are able to detect the communities: we consider all the nodes and use the Girvan-Newman method to detect the communities to be found in the network. We are able to identify 34 communities in the first year and 32 in the second year. We maximize the Q index (in order to maximize the modularity) by considering all the different possible partitions from Q = 2 to Q = 45. The results show that partition 34 has the highest value one in 2009 (Q = 0.447) and partition 32 has the highest value t in 2012 (Q = 0.532).

The two different partitions are analyzed in order to detect the patterns it is possible to observe in the data. It is interesting to note that the community "0" increases from 41 companies to 60 (table 6), receiving firms from most of the other communities.[10] The community "1" was small in 2009 (4 companies) but three years later it grows to 23 receiving 19 companies from community "3". In turn community "3" shrinks from 51 to 6, and growing from 31 to 50 companies. Most of the changes occur in these three groups, whereas the others remain quite stable. The companies which are in the stable groups in 2009 and 2012 are also characterized by high betweenness and in general by high centrality (see the averages but also the minima and the maxima for the considered observations in table 7).

[Tables 6 and 7 about here]

The Appendix reports to which community each company belongs in the two years. Financial companies fit in community "3" in 2009, where most of the switching happened in 2012. For example, *Assicurazioni Generali* moves to group "1" and its controlled branch *Banca Generali* to group "11". Many financial companies (such as *Gemina, Intesa San Paolo, Mediobanca, Unione di Banche Italiane*) move to group "1", which becomes the

[10] Note that the number associated to each community is just a label, which does not say anything about the importance of the group or other possible rankings.

new community for banks and insurance companies. Therefore, the "financial community" is basically rebranded, but still highly interlinked Interestingly, *Unicredit* remains in group "3", and represents the main financial company seceding from the others.[11]

We can observe that the community considering the some from the most central companies in the network tends as well to be strongly connected. Thus we are able to observe that these linkages seem to be very stable over time. In particular we have repeated the same analysis for the companies by considering the community result for 2009 and for 2012, and we can conclude that the most central companies tend to exhibit a stronger stability in their structures. However, the related linkages on the entire network seem to lose strength in their ties and we can visualize as well that in the center of the network there is a reduction of the edge ties (figure 3 and figure 4). This means that there is a similar structure which is maintained by considering less interlocking directorships between the companies. So the structure seems to be "economized" whilst maintaining the original structure. The only change in the structure is the increased equality of the central nodes in 2012 related to Freeman degree and betweenness.

These results are consistent with previous results on the Italian network. We briefly summarize some relevant results for the Italian directorship networks found in literature in table 8. Some authors (Bellenzier and Grassi 2013, Gambini et al. 2012, Santella et. al. 2007) found that the network density tends to reduce over the years 1998-2006. In this sense the results need to be considered in a longer time window. In any case the reduction of some important structural indicators for the network seems to be confirmed in this work. At the same time we found that the centrality tends to reduce for the nodes over time.

[11] The companies belonging to the Ligresti family (*Fondiaria Sai*, *Milano Assicurazioni* and *Premafin*) moved to group "3" to group "18" because they were rescued by *Unipol*, which in 2012 also moved to group "18".

Corrado and Zollo (2006), who studied the interplay between privatizations and corporate governance reforms in Italy focusing on ownership, found evidence of destructuration at the macro level of the network, with substantial stability at lower levels of the analysis.

Similar effects of different regulations on networks were found by Drago et al. (2009) which showed that the reforms of corporate governance in the period 1998-2007 had an impact on the networks considered. We also found a community structure in the Italian directorship network and in this case the result is consistent with Piccardi et al. (2009). However, here we were interested in studying the stability of the communities and more importantly the stability of their structure in the period 2009-2012. Therefore, it is interesting to note that there is a considerable stability of the network communities extracted at the center of the network. In particular, they tend to preserve the number of participants over 2009-2012 and to preserve their characteristics of centrality in the system. This result is interesting as it shows a particular role of these nodes as general connectors of the system. A similar result for Italy and Germany was obtained by Bellenzier and Grassi (2013) and by Milaković et al. (2009, 2011). Therefore, the final empirical evidence shows that there exists a core at the center of the network showing characteristics of stability but have at the same time the characteristics of a network community in line with the definitions in literature (higher internal density weak external connections).

6. Conclusions

In this work we have investigated the structure of the Italian network during the period 2009-2012 and the impact of a reform on corporate governance in the period. Beside standard network statistics, we have introduced the tool of community detection to

highlight the changes (and the continuity) of the network after the reform that outlawed ID in the financial sector. We found that there were some changes in the network structure over the period, as the density and the connectedness decreased in the period, and the isolates increased in number. At the same time increased fragmentation is observed. This is evidence of some changes in the network functioning. However, the community of financial companies – to which the reform was addressed – and which represent the core of the network, tended to remained closely connected, therefore overcoming the reform. Specifically, most of the financial community moved to another group, keeping its links.

Therefore, it appears that the reform has failed to deliver its expected results. One reason could be that ID are a symptom of cross-shareholding and therefore regulation aimed at breaking these networks should firstly address the former rather than the latter.

Acknowledgements

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Figure 1. Company network: year 2009

[Figure 1 Here]

Note: node size represents the betweenness, link size represents the tie strength – as the number of directors

Figure 2. Company network: year 2012

[Figure 2 Here]

Note: node size represents the betweenness, link size represents the tie strength – as the number of directors

Figure 3. Company network: the thirty most centralized companies by betweenness in year 2009

[Figure 3 Here]

Note: node size represents the betweenness, link size represents the tie strength – as the number of directors

Figure 4. Company network: the thirty most centralized companies by betweenness in year 2009

[Figure 4 Here]

Note: node size represents the betweenness, link size represents the tie strength – as the number of directors

Table 1. Density in the periods 2009-2012

Year	Average value	Standard deviation
2009	0.020	0.192
2012	0.017	0.182

Table 2. Network Multiple Measures in the periods 2009-2012.

	2009	2012
Avg Degree	5.144	4.084
Components	66	80
Component Ratio	0.235	0.316
Connectedness	0.554	0.432
Fragmentation	0.446	0.568

Table 3. Clustering Coefficients by year

	2009	2012
Overall graph clustering coefficient	0.512	0.639
Weighted Overall graph clustering coefficient	0.410	0.438

Table 4 Top 10 Ranks in Freeman Degree and Gini index: network 2009-2012

2009		2012	
Rank	Freeman Degree	Rank	Freeman Degree
1	34	1	21
2	28	2	20
3	22	3	18
4	22	4	16
5	21	4	16
6	18	5	14
7	17	5	14
8	15	5	14
9	15	9	13
10	15	10	12
	15		
	15		
Gini Index	0.17	Gini Index	0.11

Table 5 Top 10 Ranks in Betweenness and Gini index: network 2009-2012

2009		2012	
Rank	Betweenness	Rank	Betweenness
1	4838.837	1	2214.323
2	2394.215	2	1877.439
3	1685.374	3	1733.175
4	1584.452	4	1504.775
5	1322.307	5	1314.09
6	1272.022	6	1115.692
7	1134.799	7	1105.422
8	1094.481	8	987.494
9	1089.911	9	960.994
10	1000.632	10	938.547
Gini Index	0.31	Gini	0.19

Table 6. Transitions between different communities in the period 2009-2012.

Community	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	30	31	32	Total
0	30			1	1		1	1				1		1			1		1			1					2						41
1		1		2										1																			4
2	1																							1									2
3	3	19		3					1		3	3	7						3	2			2			1		2			1	1	51
4	1			2															1										1	1			6
5			1		1																												2
6	6				2											2																	10
7						2																											2
8										2																							2
9	1																																1
10	1										1																						2
11								1					1																1				3
12	3				1																	2				1			1				8
13	3	1					1										1	1							4								11
14	1								4						1																		6
15							1					4			1			1															7
16														1				1	2														4
17	1			5																1													7
18											3																						3
19												1																					1
20	1		4																														5
21		1																															1
22			1																														1
23	1				1														2		3												7
24	1						1																										2
25													1																				1
26	1																			2													3
27	1						1						3											1									6
28	1																																1
29	2																																2
31											1																						1
32		1										1																					2
33																		1													1		2
34	1																																1
Total	**60**	**23**	**6**	**13**	**6**	**2**	**5**	**2**	**5**	**2**	**8**	**10**	**12**	**3**	**2**	**2**	**2**	**4**	**9**	**5**	**3**	**3**	**2**	**2**	**4**	**2**	**2**	**2**	**3**	**1**	**2**	**1**	**208**

Note: The network is considered without isolates. In the row there are the community number in 2009, where in the column the number in the 2012. Every cell represents the number of companies which move from community ID to another, i.e. 30 companies were in community 0 in 2009 and remained in the same community.

Table 7. Patterns of stability and transition on the communities.

Communities		N	min Degree	mean Degree	max Degree	min Betw	mean Betw	max Betw
0	0	30	1.00	1.00	1.00	0.00	0.00	0.00
0	26	2	2.50	3.00	3.50	0.00	36.18	72.35
1	3	2	4.50	5.50	6.50	253.33	261.60	269.87
12	0	3	1.50	3.33	5.50	0.00	288.38	661.15
12	21	2	4.50	4.75	5.00	192.84	211.76	230.68
13	0	3	1.50	2.17	2.50	0.00	76.76	177.56
13	24	4	2.50	3.50	4.00	10.39	315.76	653.86
14	8	4	4.00	6.00	8.00	2.09	59.88	112.07
15	11	4	6.00	10.25	13.00	134.21	588.86	942.15
16	18	2	2.50	4.50	6.50	29.67	259.00	488.33
17	3	5	6.50	8.30	10.00	2.40	89.76	191.11
18	10	3	5.00	5.83	6.50	57.22	108.13	158.57
20	2	4	8.50	10.25	14.00	230.40	590.73	1039.69
23	18	2	4.00	4.50	5.00	165.85	167.85	169.85
23	20	3	2.50	2.67	3.00	33.59	58.00	86.82
26	19	2	3.50	5.00	6.50	44.78	163.23	281.67
27	12	3	3.50	5.67	9.50	95.58	252.83	552.44
29	0	2	1.50	1.50	1.50	0.00	0.00	0.00
3	0	3	3.00	4.00	5.50	26.22	78.17	137.21
3	1	19	4.50	12.16	27.50	51.50	765.70	3526.58
3	10	3	3.00	7.00	10.50	3.65	246.43	480.82
3	11	3	5.00	5.83	7.50	48.28	166.37	374.77
3	12	7	5.50	9.79	16.00	101.94	425.15	943.06
3	18	3	8.00	9.17	10.00	281.41	533.10	780.82
3	19	2	5.00	7.00	9.00	115.33	523.68	932.04
3	22	2	2.50	5.75	9.00	0.00	201.29	402.58
3	27	2	2.50	3.25	4.00	2.80	62.14	121.47
3	3	3	3.50	9.33	12.50	4.28	349.66	670.32
4	3	2	5.00	5.00	5.00	81.50	244.37	407.25
6	0	6	2.00	2.83	4.50	0.00	96.08	380.45
6	15	2	2.50	2.75	3.00	73.57	161.95	250.32
6	4	2	2.00	3.75	5.50	0.00	161.06	322.13
7	5	2	2.50	2.50	2.50	0.00	0.00	0.00
8	9	2	2.00	3.75	5.50	0.00	116.94	233.89

Note: The first number in the Communities column is related to the community ID in 2009 while the second number is related to the community ID in the 2012. The degree and betweenness values are related to the group of companies with the same pattern. N represent the number of the companies in the group. Patterns with only N>1 are reported.

Table 8. Studies on characteristics of the Italian interlocking directorship network

Article	Methodology	Results	Years
Battiston and Catanzaro (2003)	Data Analysis/Statistical Analysis	Common network structure for the corporate networks in Italy and US. All networks considered are Small World	1986, 2002
Drago et al. (2015)	Social Network Analysis/ Statistical Analysis	Corporate governance reforms had an impact on the number of interlocking directorships in the period 1998-2007	1998-2007
Farina (2008)	Social Network Analysis	Financial companies tend to be "the most influential" actors of the center of the network	2006
Gambini et. al. (2012)	Social Network Analysis	Blue Chip companies tend to be more connected than other companies in the network	2009
Grassi and Bellenzier (2013)	Social Network Analysis	Existence of a persistent core over time in the network	1998-2011
Piccardi et al. (2010)	Community Detection	Existence of a community structure in the network which overlaps with the ownership network	2008
Santella et al. (2009a)	Social Network Analysis	Stable network structure over the period considered. Decreasing density over time.	1998-2006
Santella et al. (2009b)	Social Network Analysis	The Italian network structure is more similar by considering structural characteristics to France and Germany than the US and the UK.	2007

Appendix

Company	2009	2012
ACSM-AGAM SPA	0	0
AICON SPA	0	0
AS ROMA SPA	0	0
ASCOPIAVE SPA	0	0
AUTOSTRADE MERIDIONALI SPA	0	0
B&C SPEAKERS SPA	0	0
BANCA IFIS SPA	0	0
BANCA POPOLARE DELL'ETRURIA E DEL LAZIO SCARL	0	0
BIESSE SPA	0	0
BORGOSESIA SPA	0	0
CAD IT SPA	0	0
CDC POINT SPA	0	0
CELL THERAPEUTICS INC	0	0
CONAFI PRESTITO' SPA	0	0
CSP INTERNATIONAL FASHION GROUP SPA	0	0
DIGITAL BROS SPA	0	0
ELICA SPA	0	0
EMAK SPA	0	0
EXPRIVIA SPA	0	0
GIOVANNI CRESPI SPA	0	0
GRUPPO CERAMICHE RICCHETTI SPA	0	0
IRCE SPA - INDUSTRIA ROMAGNOLA CONDUTTORI ELETTRICI	0	0
ISAGRO SPA	0	0
LA DORIA SPA	0	0
MONTEFIBRE SPA	0	0
OLIDATA SPA	0	0
RCF GROUP SPA	0	0
SOCIETA' SPORTIVA LAZIO SPA	0	0
TERNIENERGIA SPA	0	0
UNI LAND SPA	0	0
VALSOIA SPA	0	3
BEST UNION COMPANY SPA	0	4
FIERA MILANO SPA	0	6
NOVA RE SPA	0	7
FULLSIX SPA	0	11
EUROTECH SPA	0	13
ARENA AGROINDUSTRIE ALIMENTARI SPA	0	16
BIANCAMANO SPA	0	18
CEMBRE SPA	0	21
BOLZONI SPA	0	26
NOEMALIFE SPA	0	26
A2A SPA	1	1

EDISON SPA	1	3
SABAF SPA	1	3
ANSALDO STS SPA	1	13
CAIRO COMMUNICATION SPA	2	0
SOL SPA	2	23
GABETTI PROPERTY SOLUTIONS SPA	3	0
RDB SPA	3	0
SEAT PAGINE GIALLE SPA	3	0
ASSICURAZIONI GENERALI SPA	3	1
ATLANTIA SPA	3	1
BREMBO SPA - FRENI BREMBO	3	1
ENI SPA	3	1
EXOR SPA	3	1
GEMINA SPA - GENERALE MOBILIARE INTERESSENZE AZIONARIE	3	1
INDESIT COMPANY SPA	3	1
INTESA SANPAOLO SPA	3	1
ITALCEMENTI SPA FABBRICHE RIUNITE CEMENTO	3	1
ITALMOBILIARE SPA	3	1
MEDIOBANCA SPA	3	1
PIRELLI & C. SPA	3	1
POLTRONA FRAU SPA	3	1
RCS MEDIAGROUP SPA	3	1
SAIPEM SPA	3	1
SARAS SPA RAFFINERIE SARDE	3	1
TELECOM ITALIA SPA	3	1
TOD'S SPA	3	1
UNIONE DI BANCHE ITALIANE SCPA	3	1
FIAT SPA	3	3
JUVENTUS FOOTBALL CLUB SPA	3	3
UNICREDIT SPA	3	3
STEFANEL SPA	3	8
ARNOLDO MONDADORI EDITORE SPA	3	10
MAIRE TECNIMONT SPA	3	10
MEDIASET SPA	3	10
BANCA GENERALI SPA	3	11
MARCOLIN SPA	3	11
PREMUDA SPA	3	11
AUTOGRILL SPA	3	12
CARRARO SPA	3	12
DEA CAPITAL SPA	3	12
IMPREGILO SPA	3	12
LUXOTTICA GROUP SPA	3	12
PARMALAT SPA	3	12
SORIN SPA	3	12
FONDIARIA - SAI SPA	3	18

MILANO ASSICURAZIONI SPA	3	18
PREMAFIN FINANZIARIA SPA HOLDING DI PARTECIPAZIONI	3	18
TELECOM ITALIA MEDIA SPA	3	19
TXT E-SOLUTIONS SPA	3	19
BANCO POPOLARE SOCIETA' COOPERATIVA	3	22
CREDITO BERGAMASCO SPA	3	22
BASTOGI SPA	3	25
CREDITO EMILIANO SPA	3	27
DAVIDE CAMPARI - MILANO SPA	3	27
MITTEL SPA	3	31
VITTORIA ASSICURAZIONI SPA	3	32
K.R.ENERGY SPA	4	0
ACEA SPA	4	3
CICCOLELLA SPA	4	3
ZUCCHI SPA - VINCENZO ZUCCHI	4	18
TAS TECNOLOGIA AVANZATA DEI SISTEMI SPA	4	28
INVESTIMENTI E SVILUPPO SPA	4	30
DATALOGIC SPA	5	2
MONRIF SPA	5	4
ANTICHI PELLETTIERI SPA	6	0
BIALETTI INDUSTRIE SPA	6	0
BIOERA SPA	6	0
GEFRAN SPA	6	0
PANARIAGROUP INDUSTRIE CERAMICHE SPA	6	0
SERVIZI ITALIA SPA	6	0
ACOTEL GROUP SPA	6	4
LANDI RENZO SPA	6	4
POLIGRAFICA S. FAUSTINO SPA	6	15
REPLY SPA	6	15
ACQUE POTABILI SPA - SOCIETA' PER CONDOTTA DI ACQUE POTABILI	7	5
CENTRALE DEL LATTE DI TORINO & C. SPA	7	5
AMPLIFON SPA	8	9
DIASORIN SPA	8	9
DANIELI SPA - OFFICINE MECCANICHE DANIELI & C.	9	0
RETELIT SPA	10	0
MEDIOLANUM SPA	10	10
AEDES SPA	11	7
PIERREL SPA	11	12
DAMIANI SPA	11	28
AEFFE SPA	12	0
CAPE LISTED INVESTMENT VEHICLE IN EQUITY SPA	12	0
FNM SPA	12	0
PIQUADRO SPA	12	4
BANCA PROFILO SPA	12	21
GEOX SPA	12	21

BRIOSCHI SVILUPPO IMMOBILIARE SPA	12	25
SCREEN SERVICE BROADCASTING TECHNOLOGIES SPA	12	28
BOERO BARTOLOMEO SPA	13	0
SADI SERVIZI INDUSTRIALI SPA	13	0
YOOX SPA	13	0
EL.EN. SPA	13	1
ERGYCAPITAL SPA	13	6
DMAIL GROUP SPA	13	16
ASTALDI SPA	13	17
BASIC NET SPA	13	24
ERG SPA	13	24
GRUPPO MUTUIONLINE SPA	13	24
PININFARINA SPA	13	24
FIDIA SPA	14	0
ALERION CLEAN POWER SPA	14	8
INDUSTRIA E INNOVAZIONE SPA	14	8
RENO DE MEDICI SPA	14	8
SIAS - SOCIETA' INIZIATIVE AUTOSTRADALI E SERVIZI SPA	14	8
PRIMA INDUSTRIE SPA	14	14
BANCA POPOLARE DI MILANO SCRL	15	6
CIR SPA - COMPAGNIE INDUSTRIALI RIUNITE	15	11
GRUPPO EDITORIALE L'ESPRESSO SPA	15	11
PIAGGIO & C. SPA	15	11
SOGEFI SPA	15	11
FINMECCANICA SPA	15	14
BANCA INTERMOBILIARE DI INVESTIMENTI E GESTIONI SPA	15	17
ENERVIT SPA	16	13
SNAI SPA	16	17
BEGHELLI SPA	16	18
RISANAMENTO SPA	16	18
AZIMUT HOLDING SPA	17	0
CALTAGIRONE EDITORE SPA	17	3
CALTAGIRONE SPA	17	3
CEMENTIR HOLDING SPA	17	3
VIANINI INDUSTRIA SPA	17	3
VIANINI LAVORI SPA	17	3
BANCA MONTE DEI PASCHI DI SIENA SPA	17	19
CLASS EDITORI SPA	18	10
COMPAGNIA IMMOBILIARE AZIONARIA - CIA SPA	18	10
MOLECULAR MEDICINE SPA	18	10
MEDIACONTECH SPA	19	11
I GRANDI VIAGGI SPA	20	0
DE LONGHI SPA	20	2
INTERPUMP GROUP SPA	20	2
TAMBURI INVESTMENT PARTNERS SPA	20	2

ZIGNAGO VETRO SPA	20	2
ENGINEERING - INGEGNERIA INFORMATICA - SPA	21	1
PRYSMIAN SPA	22	2
MID INDUSTRY CAPITAL SPA	23	0
HERA SPA (HOLDING ENERGIA RISORSE AMBIENTE)	23	4
ESPRINET SPA	23	18
UNIPOL GRUPPO FINANZIARIO SPA	23	18
BANCO DI SARDEGNA SPA	23	20
MARR SPA	23	20
TISCALI SPA	23	20
NICE SPA	24	0
DADA SPA	24	6
BANCO DI DESIO E DELLA BRIANZA SPA	25	12
KINEXIA SPA	26	0
EEMS ITALIA SPA	26	19
SAES GETTERS SPA	26	19
MERIDIE SPA	27	0
COBRA AUTOMOTIVE TECHNOLOGIES SPA	27	6
IL SOLE 24 ORE SPA	27	12
RATTI SPA	27	12
SAFILO GROUP SPA	27	12
BUZZI UNICEM SPA	27	23
CALEFFI SPA	28	0
CHL - CENTRO HL DISTRIBUZIONE SPA	29	0
ROSSS SPA	29	0
ENEL SPA	31	10
GAS PLUS SPA	32	1
TREVI - FINANZIARIA INDUSTRIALE SPA	32	11
IMMSI SPA	33	17
SOCIETA' CATTOLICA DI ASSICURAZIONE SOCIETA' COOPERATIVA	33	31
MONDO TV SPA	34	0

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