
Analyzing Shareholder Network in the Tehran Stock Exchange

Reza Taghizadeh*

*Corresponding author, Assistant Prof., Faculty of Economic, Management and Accounting, Yazd University, Yazd, Iran. (Email: rezataghizadeh@yazd.ac.ir)

Amin Nazemi

Assistant Prof., Department of Accounting, School of Economics Management and Social Sciences, Shiraz University, Shiraz, Iran. (Email: anazemi@rose.shirazu.ac.ir)

Mohammad SadeghzadehMaharluie

Ph.D. Candidate, Department of Accounting, Faculty of Economic and Management Sciences, Shiraz University, Shiraz, Iran. (Email: s.msadeghzadeh@rose.shirazu.ac.ir)

Abstract

The stock market plays an important role in the economic development of countries. Network analysis is one of the latest methods in analyzing the stock market. It is a new concept for a macro view of the whole market in quantitative science literature. Therefore, this research analyzes the available Shareholder network in the Tehran Stock Exchange from 2013 to 2017. This research is based on a type of data collected and analyzed is quantitative research. And, its' type is network analysis. The research results indicate that many of shareholders are connected to each other, although a class structure governs their relations. Some of the shareholders, in comparison with others, have a better position. Having a better position caused them to encounter fewer mediators in gaining access to other shareholders, and also easier access to available resources. The shareholders' ability in gaining access to information through the cluster of network members enhances too. Therefore, it is claimed that these shareholders can play the role of key actors in the governing structure. Also, the results of the Pareto distribution indicate that the distribution of power among the Shareholders is approximately 25/75, that is, 75 per cent of the strength in the hands of 25 per cent of the Shareholders.

Keywords: Shareholder, Network Analysis, Tehran Stock Exchange

JEL Classification: L14, G32

Introduction

The basic concept of the governance pillars is broadly defined as a network of given relationships. It encompasses a company and its owners, and all stakeholders that include employees, customers, people, society, etc. (Hashemi and Bakrani, 2010: 112; Fakhari et al., 2012: 31; Abedini et al., 2016: 94). In fact, corporate governance is the structure of relationships and responsibilities among a group of stakeholders. An important issue in corporate governance knows an ownership structure and its ranking in standard scales (Namazi and Kermani, 2008). One of the controlling tools is to determine the type of ownership structure and the composition of stakeholders. It can be investigated in various aspects such as the distribution of ownership, the concentration of ownership, institutional shareholders and their ownership percentage, managerial ownership and private and governmental ownership (Monks and Minow, 2008). Moebert and Tydecks (2007) have pointed to the relationship between the ownership and control among companies. They believe changes in ownership have an effect on merger and acquisition activities among companies, the influencing power of companies on each other, and the trends of the stock market. Therefore, these relationships represent their own corporate governance network (Moebert and Tydecks, 2007).

Stock markets are somehow considered to be complex multimodal networks due to the interaction between different types of companies and investors (Huang et al. 2009). Studies performed in the field of financial data modeling show that network models of financial data refer to many characteristics of the stock market (Rotundo and D'Arcangelis, 2010). By considering the characteristics of complex networks in real networks we can take advantage of analytics related to complex networks in analyzing these networks. The characteristics of companies and the relationships between information and companies features have been studied in many accounting types of research (Namazi and Nazemi, 2005). Although, the relationship of units to one another, regardless of their characteristics, can have a decisive effect on the financial state and stock market trends it has been underestimated.

On the other hand, the managerial owners have had significant influence in the companies due to the ownership of a substantial portion of their companies' shares, and their strategic role, which in turn causes to have motives for monitoring their activities. Meanwhile, they have enough motivation and power to apply precise control over managers and to make changes in the management structures. This research focuses on shareholders and managerial owners (those shareholders and owners that specify the

members of the board of directors or CEO). Therefore, according to the importance of relationships' patterns in shareholders and creditors' decision making, the present research studies the relationship network between the shareholders and managerial owners in Tehran Stock Exchange. In fact, this research tries to answer three key questions: a) which pattern is followed by the shareholder relations in Tehran Stock Exchange? b) Which shareholders are the key actors in this structure? c) How is the power distributed among different shareholders?

Theoretical background

The ownership structure is introduced as one of the corporate governance criteria (Yegon et al. 2014). The managerial ownership is one of the ownership structure mechanisms that is defined as the stock per cent belonging to the company's managers. The levels of managerial ownership are different. Such levels can be used as a criterion to measure the conflict of interests between managers and owners (Jensen and Meckling, 1976). On the other hand, the behavior of the stock markets reflects the results of mutual interaction among participants in the market who try to maximize their own benefits. Such mutual interactions result in increasing the complexity in the behavior of financial markets. A network effect in stock markets presents a better perception on how people have access to information about events. Also, it shows how people's reactions to the events can have effects on stock markets. The network analysis plays a key role in revealing the internal structure of stock markets and their evolution over time (Babu Roy and Kumar Sarkar, 2011). Furthermore, the relationships of ownership and control among networks and the change of ownership have an effect on companies' influencing power on each other, and stock market trends. Therefore, these relations reveal themselves within the corporate governance network (Moebert and Tydecks, 2007).

A social network represents a group of people or objects that are cooperating or competing with each other. These interactions may be represented by a simple graph or a multigraph. Each co-worker or competitor is represented by a node and their cooperation or competition is shown by a tie. Nodes are usually the actors of the network (Garton et al. 1999). These actors can be a person, an organization, a group, a live creature, etc. Any unit which can be connected to other units can be considered as a social network. In social network theory, network analysis is not merely a theory of social science, but a strategy to study the social structures. That is why social network analysis is often referred to as structural analysis. The most important difference between network analysis and traditional research methodologies is that the content of an actor or the relation among actors is the main concern. While the traditional

researches mainly address the individuals' characteristics (Taghizadeh et al. 2019).

Some network analysts believe that the success and failure of a community or organization are often dependent on structural patterns that they create in a social network graph. Graphical representation of network theory is related to a wide range of sciences, such as mathematics, computer science, psychology, geography, communications science and sociology. On the other hand, stock markets are considered as complex networks due to the interaction among a variety of companies and investors. In fact, a financial market can be represented as a network in which nodes show financial institutions (such as stocks) and their connector ties represent the relation among their returns (Boginski et al, 2005; Mantegna, 1999). Applying the characteristics of complex networks in real networks makes it possible to take advantage of the analyses of complex networks in analyzing these networks (Taghizadeh and Nazemi. 2019).

In figure 1, a very simple network is represented which each letter shows a point or node (e.g. company) in the network. The lines connected to the letters indicate that these points are connected to each other by specific patterns (e.g. a board member or joint shareholder). The concept of link is the most important and permanent way to denote this feature of the network and therefore, in figure 1, there are links between B-A (a member of the board or joint shareholder B and A; W_{BA}), A-C (a member of the board or joint shareholder A and C; W_{AC}), A-D (a member of the board or joint shareholder A and D; W_{AD}), B-E (a member of the board or joint shareholder B and E; W_{BE}), D-C (a member of the board or joint shareholder D and C; W_{DC}) and E-D (a member of the board or joint shareholder E and D; W_{ED}). It is not only necessary to identify the points of the network that are connected, but also the ideas about the nature of communication among these points that must be specified.

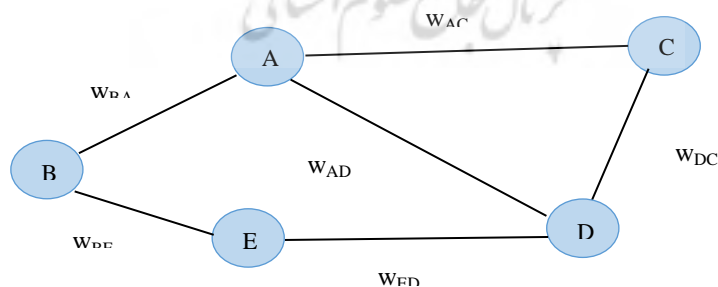


Figure 1. A simple network

Glattfelder (2010) has globally explored the ownership network and corporate control. This research has tried to answer the following questions: how is the distribution of control? Who are the key actors in the economy? He has studied the multilateral relationship of stockholding defined it as an ownership network. The results of this study have indicated that in Anglo-Saxon countries, where ownership at the local level tends to be scattered among a large number of shareholders, the control is centralized at the global level, and it is accessible for a very few shareholders. However, it is exactly vice versa in European countries.

Senkoska and Ciodak (2016) have studied the networks of the board of directors and corporate executives of big companies in the Polish capital market in 2014. They have also investigated the real networks of the board of directors and corporate executives, compared to the randomly constructed networks. The experimental results have represented that real networks have the characteristics of small-world networks. Furthermore, the networks are organized and classified and certain behaviors are applied over them.

Singh and DeLose (2017) have studied the relationship between the structure of the board of directors and the risky behavior of emerging companies. Their focus was on examining the individual and joint effects of the board structure, the centrality of the network by communication and the ownership structure in the company's development strategies. The research results have shown that companies with non-executive members of the board of directors and CEO duality, as well as companies that are central to the other corporate networks, are more likely to develop through new domestic or foreign investments.

Dastkhan and Shamsgarneh (2018) have studied how the ownership structure becomes inclusive in financial markets. Also, they have introduced an ownership network-based simulation model for analyzing systematic risk events. Research results have shown that the network structure influences the probability and extension of financial systems and for each network structure, different values of parameters lead to a significant difference in the systemic risk measurements.

Khajavi, Sadeghzadeh Maharluie and Taghizadeh (2013) in the research of "accounting information systems and social network analysis" have studied how social network analysis helps to evaluate the users of accounting information systems. They have shown the use cases of social network analysis in accounting information systems.

Research Questions

As above mentioned, this research aims to analyze the communication network between shareholders and managerial owners (shareholders and owners that assign the members of the board of directors or CEO) involved in the Tehran Stock Exchange.

To achieve the research goal, the following questions have been addressed:

1. Which pattern does the shareholding relation structure in stock market follow?
2. Which shareholders are the key actors in this structure?
3. How is the power distributed among different shareholders?

Research method

This research is practical. Its methodology is quasi-experimental by using a retrospective approach (through past information). Also, according to the type of the collected and analyzed data, the research is quantitative research of network analysis. The main approach of this study is to use graphical techniques based on graph theory (a branch of topology). In this theory, the researchers apply matrix algebra that allows the notion of relationships among actors (nodes) in a network to be studied in a visual, algebraic or logical manner.

1. Network Analysis Method

The network theory is based on the importance of structure and arrangement way of different components. In fact, the focus of network analysis is on interactions and relationships between individuals or Cliques. It tries to recognize the structural pattern of communication and the structural characteristics of these communications and their subsets (Edwards, 2010). Some of the most commonly used concepts in social network analysis are as follows:

Social network: It refers to a set of actors, communications and their linking nodes. The network analyst will attempt to represent the group structure by designing a model for these relationships (De Nooy et al. 2005; Wasserman and Faust, 1994).

Nodes: Individuals or agents involved in the network are called nodes. Nodes can be individuals, Cliques, organizations and even countries.

Links: The relations between nodes are called links.

Graph: To analyze the social relations, it is necessary to have an explicit representation and pattern about these social relations. Therefore, actors can be represented as nodes and relations as shown by lines can be drawn as a graph

or social network (De Nooy et al. 2005; Scott, 2000; Wasserman and Faust, 1994, Mirzaie, 2010).

Relational data: The two major types of data are attribute data and relational data. Relational data includes communications, nodes, links, etc. which connects one person to another person and cannot be reduced to only the characteristics of individual agents. The relational data are the major issue of research related to the structure of social action. Relations create structures. Therefore, structural issues can be solved by collecting and analyzing relational data. In contrary, most literature on research methodologies has focused on variable analyses for research on attribute data (Scott, 2000; De Nooy et al. 2005). The first and foremost difference between the network data and other researches is that the network data consists of testing one or more types of relations among the set of actors (Wasserman and Faust, 1994).

In addition to the overall analysis of the shareholding network, the performance of each node in the network is also studied using the micro indicators. Centrality, as one of the most important concepts of network analysis, studies the importance and influence of individuals on the network. The network node centrality can be studied using three indicators of degree, betweenness and closeness. The centrality degree of a node in the social network represents the number of links that a node has with other nodes in the network. In other words, in a shareholding network, the centrality degree of each individual represents the number of his/her relations with other members involved in the network through joint corporates (the corporates in which shareholders have assigned the members of the boards of directors or CEO). The centrality degree of node k (p_k) is calculated by eq. (1):

$$C_D(p_k) = \sum_{i=1}^n a(p_i, p_k) \quad (1)$$

Where n is the number of nodes in a network, $a(p_i, p_k)=1$ if two nodes p_i and p_k are connected and otherwise it is zero.

The betweenness indicator of a node indicates the number of times that node is located in the shortest path between two other nodes in the network. Nodes with high betweenness play a key role in the information stream and network connectivity and also they have a central position in the network. The betweenness indicator of node k (p_k) is obtained by eq. (2):

$$C_B(p_k) = \sum_{i < j}^n \frac{g_{ij}(p_k)}{g_{ij}} ; i \neq j \neq k \quad (2)$$

Where g_{ij} is the shortest path between p_i and p_j link; and $g_{ij}(p_k)$ is the shortest path between p_i and p_j link passing through p_k .

The closeness indicator of a node represents the average length of the shortest paths between that node and other nodes in the network. Nodes with high closeness indicator have a greater influence on the network. They play a key role in the network and have higher availability for other nodes. The closeness indicator of node k (p_k) is obtained by eq. (3):

$$C_C(p_k) = \sum_{i=1}^n d(p_i, p_k)^{-1} \quad (3)$$

Where $d(p_i, p_k)$ is the shortest path between two nodes p_i and p_k (Abbasi et al. 2012).

Pareto distribution: Most natural quantities related to socioeconomic phenomena are distributed as certain distributions with high sequences at the right side. For example, it can refer to city population rate, stocks growth and degradation rate distribution, companies' size distribution, individuals' income distribution, etc. Pareto distribution has addressed these issues (Pourtaheri, 1991). Pareto distribution is a probability distribution that describes most social, scientific, geophysics and actuary phenomena. In other words, Pareto distribution states that 80% of consequences (outcomes or outputs) come from 20% of the causes (inputs), asserting an unequal relationship between inputs and outputs. In our case, Pareto distribution states that if 20% of individuals (entities) who are in first-class have 80% per cent of the wealth (attribute), remaining individuals, who are in the second class, have 20% of the wealth. But not necessarily the obtained per cent is in the ranges of 80-20 and it can be 70-30 or 60-40, etc.

2. Conceptual and Operative Definition of Research Variables

In this research, according to Soma et al. (2006), Retunda et al. (2010), Glottdfelder (2010) and Singh and DeLose (2017), the names of shareholders or managerial owners who have assigned the members of the board of directors or CEOs, have been used to obtain the communication network among the involved shareholders in Tehran Stock Exchange. Therefore, the relations among shareholders are studied based on those companies in which they have assigned the members of the board of directors or CEO. In fact, if multiple shareholders have assigned the members of the board of directors or CEO in a company, this leads to communication among them through the joint company; which leads to the creation of relation networks. To analyze the shareholding network, in the case of general network, the researchers discussed and analyzed the isolated units, closeness, betweenness and degree. It should be mentioned that degree, closeness and betweenness are criteria related to centrality indicator, this indicator refers to the location of specific nodes within the

network. In fact, the position of units in networks measured based on centrality degree, closeness, and betweenness indicators. Better position means the specific unit gains better points in these measures and therefore, has better power in communication, proximity, and impact.

3. Data, Research Period, and Sample

The statistical population of this research is all the shareholders or managerial owners (shareholders who can assign the board members or CEO) involved in Tehran Stock Exchange. In this research, the researchers studied all managerial shareholders who were active in the stock market in 2013-2017, and their information was available. It must be mentioned that no sampling is performed. Therefore, according to the terms, 1143, 1201, 1549 and 1564 shareholders have been selected to be reviewed from 2013 through 2017. The data have mainly been collected through the databases of the Tehran Stock Exchange and Rahavard Software. In addition, the results were analyzed using the network analysis method as well as Excel 2016, PreMap v1 and UCINET v6.

Research Findings

As above mentioned, in this research, the relation network of shareholders in Tehran Stock Exchange is analyzed (it should be noted that figures 2, 3, 4, and 5 show the sample network of 2017).

1. Descriptive Statistics

The descriptive statistics of the quantitative data are presented in table (1) to be used in research patterns. These statistics are related to those communications established between shareholders through joint companies in which they have assigned the members of the board of directors or CEO.

Table1. descriptive statistics of research variable in the research period

	2013	2014	2015	2016	2017
Mean	1.91	1.92	1.92	1.66	1.64
Median	1	1	1	1	1
Standard deviation	2.37	2.43	2.43	1.85	1.75
Minimum	1	1	1	1	1
Maximum	35	38	36	31	28
Total	2171	2311	2396	2584	2567
Number of observation	1134	1201	1242	1549	1564

The number of observations in each year shows how many relationships between several shareholders have been investigated. The sum represents the total number of members of the board of directors or CEO's appointed by the shareholders in different companies. The average shows that each year, on average, each shareholder has assigned several members of the board of directors or CEO in different companies. Maximum represents the shareholder who has appointed the highest number of members of the board of directors or CEOs which was owned by SABA Tamin investments in 2013-2016 as well as the integration of SABA Tamin investment and Melli investment in 2017. Minimum represents the shareholder who has appointed the least number of members of the board of directors and CEO. In general, the descriptive statistics show that from 2013 to 2017, the abundance of the number of shareholders who have assigned the board members and the CEO has had an increasing trend.

2. Overall Network

Figure (2) represents the overall network of shareholders' relationships through joint companies in which they have assigned the board members and CEO. The shareholder network usually consists of three parts: the main, marginal and isolated parts. The number of marginal and isolated units is lower than the main part, but it is a big number. There are shareholders with different degrees of communication in the main part.

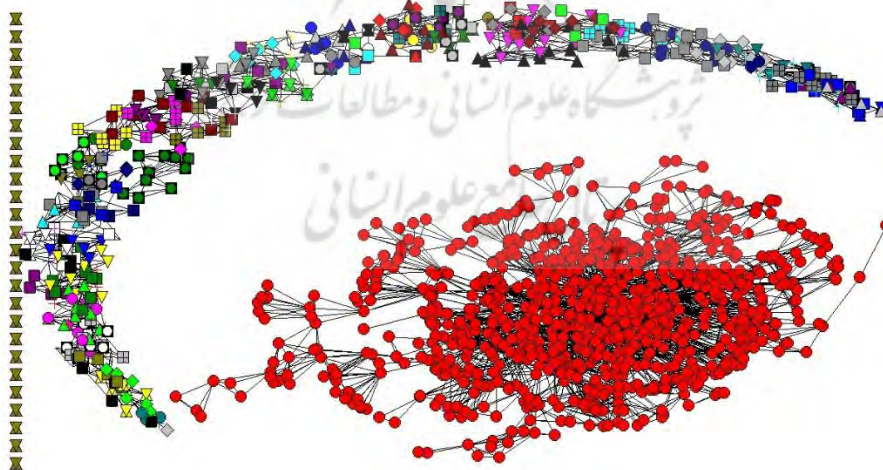


Figure 2. Overall networks related to shareholders (year: 2017)

The main part of the network (which is shown by red color) is divided into three levels: core, semi-periphery and periphery; where the communications are dense, semi-dense and scattered, respectively. The main part has a closed structure and there is a relationship between each level with the next levels. The core level has a dense structure. It has a high relation and centralized power; however, it has a relation with the next level. The semi-periphery level has a more open and semi-dense state (i.e. the amount and density of relation are lower than the previous level). The monopoly is lower in this part. The peripheral level has a scattered and open structure. The structure of the peripheral part is more open than the semi-periphery level and the semi-periphery is more open than the core level. Also, the power is decreased in swipec from core level to the peripheral level.

3. Isolated Unit

Table 2 lists the number of isolated units per year. Isolated units are those units that are not related to the rest (the yellow units at the margin of figure 2 are isolated units). For example, in 2017, 33 shareholders are not associated with the rest of the shareholders through any joint company (a company in which they have appointed a member of the board of director or CEO). As can be seen, the maximum number of isolated units belongs to 2017.

Table 2. Number of Isolated units

2013	2014	2015	2016	2017
13	15	22	32	33

4. Cliques

A “clique” may be defined as nodes that are connected to each other by no more than N links (e.g. a 1-clique would mean that all nodes have direct connections to each other) (Richardson, 2009). The larger the number of Cliques, the more the units gathered together; thus the communications have transformed from a dual state into multiple states, and to some extent, the dispersion is lower and coherence is higher. The maximum number of Cliques belongs to 2016. Table 3 lists the number of Cliques annually.

Table 3: Number of Cliques

2013	2014	2015	2016	2017
507	550	571	617	588

5. Degree

The degree centrality is simply the number of direct relationships that a node or entity (here the individual) has; a node or entity has a high degree of centrality; in general, it is the active actor in the network, often it is a relation or pillar in the network, but it is not necessarily the most relevant entity or node within the network, it may be in a privileged position on the network, it may have alternate ways to satisfy or meet the organizational requirements. Therefore, the dependency on other individuals is low and can often be considered as a handler. The higher the centrality degree of an individual, the more and effective relations and connections exist (Taghizadeh and Nazemi, 2018). Figure 4 shows a network based on degree centrality (degree).

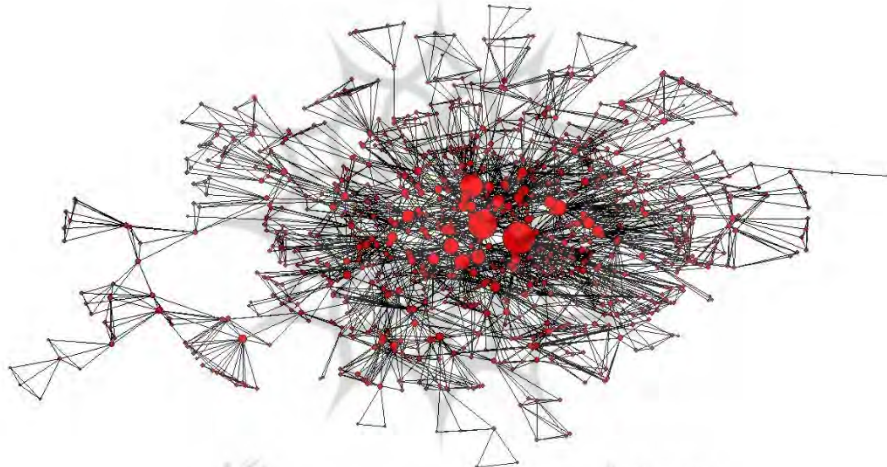


Figure 3. Network Related to Degree (year: 2017)

As shown in figure 3, in terms of the degree, shareholders represented by large circles and located at the center of the network, have the highest relation in the network and have significant differences with other units. On one hand, these extended relations can lead to appropriate communication and work opportunity for the central units, and on the other hand, may result in monopoly economic rent opportunity for those units. In the following table, the shareholders with the highest degree and significant difference are presented (shareholders shown in large red circles).

Table 4. Shareholders related to the maximum degree

2013	2014	2015	2016	2017
Saba Tamin Investment corporation	Saba Tamin Investment corporation	Saba Tamin Investment corporation	Saba Tamin Investment corporation	Saba Tamin Investment corporation
National Investment	National Investment	National Investment	National Investment	National Investment
Tamin Petroleum & Petrochemical Investment Co.	Tamin Petroleum & Petrochemical Investment Co.	Tamin Petroleum & Petrochemical Investment Co.	Tamin Petroleum & Petrochemical Investment Co.	Tamin Petroleum & Petrochemical Investment Co.
	Mostazafan Foundation	Mostazafan Foundation		

In the following table, descriptive statistics for centrality degree renders:

Table 5. Descriptive statistics of degree centrality

	2013	2014	2015	2016	2017
Mean	7.33	7.43	7.47	6.46	6.22
Standard deviation	9.24	9.58	9.65	7.68	7.14
Minimum	0.00	0.00	0.00	0.00	0.00
Maximum	140	156	149	123	115
Total	9282	8932	9282	10018	9740
Number of observation	1134	1201	1242	1549	1564

Due to the large volume and number of outputs, descriptive statistics of the degree centrality presented to show the overall picture of this index among shareholders. The highest degree from 2013 to 2017 belongs to Saba Tamin Investment.

6. Closeness

The closeness centrality implies that a node or entity (here the individual) can quickly access more nodes or entities in the network. The shorter the path a node has to access to all the nodes, the closest node to all the other nodes, the higher the closeness centrality is. This indicator reflects the ability to obtain information through the cluster of network members. In general, an entity with higher closeness centrality has quick access to the other entities on the network through a shorter path to the other entities, and high visibility on what's going on in the network (Borgatti: 2005, Worrell et al: 2013). Figure 5 represents the network based on the closeness centrality.

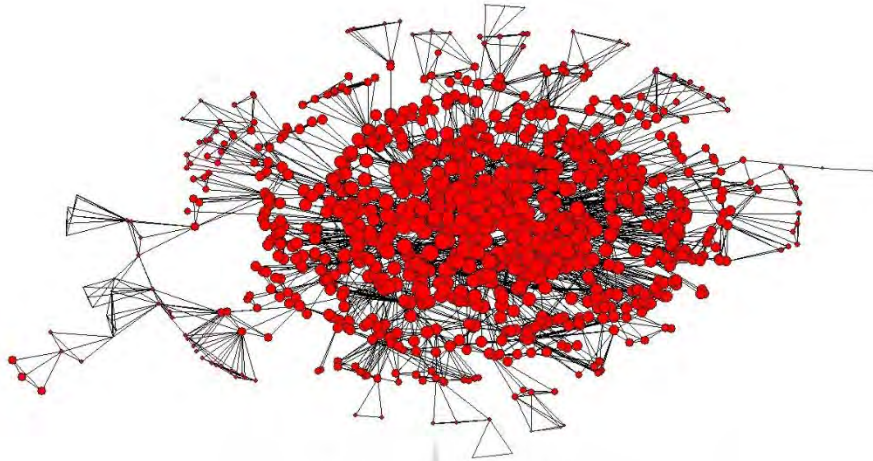


Figure 4. network related to closeness (year: 2017)

As shown in figure 4, despite the fact that there are shareholders with high and very low closeness and the difference between three levels of core, semi-periphery and periphery is high, there is not much difference among the units at each level. There is not a large gap between each level and the next one and there is a relation among levels and the structure is more open (i.e. the amount and density of relation are lower than the previous level). As the distance from the center of the network increases, the closeness of the units decreases. This indicator represents that shareholders in the center communicate with fewer mediators and there is relatively fast accessibility to them. And, the access is provided for peripheral shareholders with more mediators which might lead to monopoly economic rent among the units of high levels and would impose more cost on peripheral units.

Table 6 posits the descriptive statistics of closeness.

Table 6. descriptive statistics of closeness

	2013	2014	2015	2016	2017
Mean	0.14	0.14	0.13	0.09	0.10
Standard deviation	0.03	0.03	0.03	0.07	0.02
Minimum	0.1	0.09	0.09	0.00	0.07
Maximum	0.20	0.19	0.19	0.23	0.13
Total	168.88	170.52	169.23	154.41	158.76
Number of observation	1134	1201	1242	1549	1564

Due to the large volume and number of outputs, descriptive statistics of the closeness presented to show the overall picture of this index among shareholders.

7. Betweenness

The centrality of betweenness refers to the position of a node or entity (here the individual) within the network in terms of its ability to link other pairs, colonies or Cliques. Also, it shows how far the node is in the relational path of the other nodes and the communication is made through it. As the network nodes depend on a node to communicate with others, that node will have more power on the network. If a node that is the only connector between two nodes or Cliques is lost for any reason, the exchange of information and knowledge between these two nodes or Cliques is disrupted (Borgatti: 2005, Worrell et al: 2013). Figure 6 represents the network based on the centrality of betweenness.

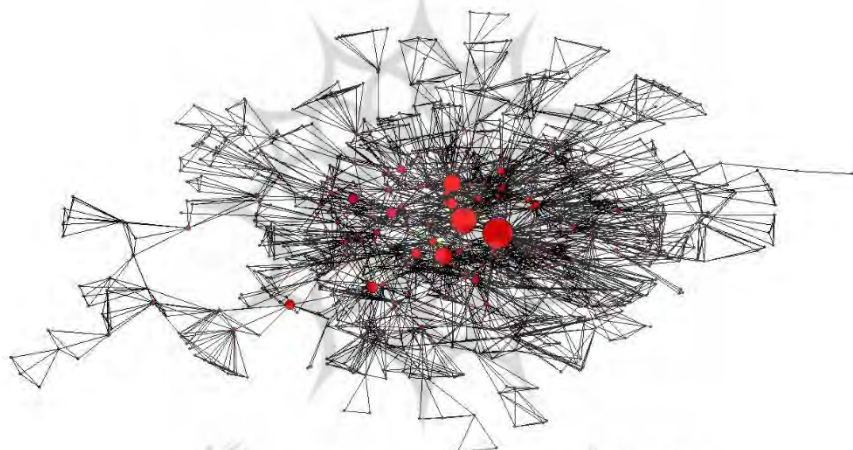


Figure 5. network related to Betweenness (year: 2017)

As shown in figure 5, there are more units with higher betweenness within the network (points shown by large circles). In fact, there are units that the communication ways of other units pass through them. These units can isolate or enhance communication. On the other hand, units with high betweenness have an impact on the joint action of other units. It means that if the given unit does not exist, that common behavior will not occur. In fact, each of these units has a common behavior, since they act according to the given (main) unit's behavior. Overall, the betweenness feature can be seen with a high difference among units. In addition, the number of units with high betweenness is fewer over the entire network. This indicates that there are units

in the network that have more access to the information stream and have higher influencing power which can lead to a proper decision on one hand, and on the other hand it may lead to economic rent. Later, shareholders with the highest betweenness and significant difference with other shareholders are presented (shareholders shown by large red circles).

Table 7. shareholders related to the maximum betweenness

2013	2014	2015	2016	2017
National Investment	National Investment	National Investment	National Investment	National Investment
Saba Tamin Investment corporation	Saba Tamin Investment corporation	Saba Tamin Investment corporation	Saba Tamin Investment corporation	Saba Tamin Investment corporation
Ghadir Investment	Tadbir Investment Co.	Tamin Petroleum & Petrochemical Investment Co.	Tadbir Investment Co.	Tadbir Investment Co.
Tosee Melli Investment Group Company	Tosee Melli Investment Group Company	Tadbir Investment Co.	Tamin Petroleum & Petrochemical Investment Co.	Tamin Petroleum & Petrochemical Investment Co.

Table 8 posits the descriptive statistics of betweenness centrality.

Table 8. Descriptive statistics of betweenness

	2013	2014	2015	2016	2017
Mean	928.28	1049.23	870.77	500.49	1086.44
Standard deviation	4157.04	4757.70	4749.47	1467.24	5886.94
Minimum	0.00	0.00	0.00	0.00	0.00
Maximum	79595.31	103968.78	122437.25	9840.99	126517.87
Total	1052673	1260128	1081507	775271	1699194
Number of observation	1134	1201	1242	1549	1564

Due to the large volume and number of outputs, descriptive statistics of the betweenness presented to show the overall picture of this index among shareholders. The highest degree from 2013 to 2017 belongs to National Investment.

8. Pareto distribution

The Pareto distribution shows the distribution of power among the managerial shareholders (in terms of the number of assigned CEOs or board of directors) is 25/75, it means that 75 per cent of power belongs to the 25 per cent of units.

Indeed, it indicates that 25 per cent of people in the first class have 75 per cent of power and 75 per cent of people in the second class has 25 per cent of power. Therefore, 75 per cent of managerial shareholding power belongs to 25 per cent of them. In other words, 75 per cent of CEOs or board of directors have been assigned by 25 per cent of shareholders and the rest 25 per cent have been appointed by 75 per cent of shareholders. The result of this classification can be expressed in two ways: a) feature abundance which is the same as wealth in Pareto theory (here, CEOs or board members), and b) entity abundance which is the same as the population in Pareto theory (here, the managerial shareholders). If it is shown as figure 1, the value of the first class is 75 per cent and the value of the second class is 25 per cent of the total abundance (fig. 6). However, in figure 2, the value of the first class is 25 per cent and the value of the second class is 75 per cent of total abundance (fig. 7).



Figure 6. frequency of features in Pareto distribution



Figure 7. frequency of objectives in Pareto distribution

Conclusion and Discussion

This research aims to study the structure of the relations' network among those shareholders who have assigned a member of the board of directors or CEO in the involved networks in Tehran Stock Exchange. In this regard, the network analysis method and ownership concept of the managerial shareholders of the involved companies in the stock market are used during 2013-2017. In fact, this research tries to answer three key questions: a) which pattern is followed by the shareholding relations in Tehran stock Exchange? b) Which shareholders are the key actors in this structure? c) How is the power distributed among different shareholders?

In general, research findings show that the shareholder's network usually consists of three main, margin and isolated parts. Also, the number of isolated units is low in the shareholder's network. The main part of the network is composed of a dense structure with a high-level relation and centralized power. Also, in the main part, three levels of core, semi-periphery and periphery can be seen where relations are dense, semi-dense and scattered at these levels, respectively. There is a high difference among levels, but it is lower at each level; however, the power among different layers is in progress. On the other hand, Pareto distribution shows that the distribution of power between owners and managerial shareholders almost has 30/70 (25/75) skewness.

The results of the indicators related to position, significance and influence (centrality indicators: degree, closeness and betweenness) of the involved shareholders within the network represent that those shareholders usually located at the center of the network have the highest relation in the network and have a significant difference with other units. These extended relations can lead to appropriate communication and work opportunity for the central units, and on the other hand, may result in monopoly economic rent opportunity for those units. Besides, the shareholders of the central layers communicate with fewer mediators and there is relatively fast accessibility for them while the access provided for peripheral shareholders communicate with more mediators. In fact, high-level shareholders are more able than peripheral shareholders to acquire information through the cluster of network members. This can lead to monopoly economic rent opportunity among high-level units and will impose more cost to the peripheral units.

On the other hand, units are playing a key role in communicating among shareholders and in influencing the joint action of other units. Indeed, the communication ways of other units pass through their path which indicates the higher impressive power of these units over others. They also have more and

easier access to the information stream. Therefore, these shareholders can play the role of key actors in the governor structure. Overall, in the network of relations among shareholders, the betweenness feature is more tangible and visible than the degree. Moreover, the degree's is more tangible than closeness. In fact, network outputs, which indicate the different positions of shareholders in the network, as well as the Pareto ratio, which indicates the existence of a 75-25 inequality in the appointment of board members, can create a kind of monopoly in appointing board members. In addition to the obtained benefits from using network analysis method, the above method also includes some constraints so that the improvement and elimination of these constraints can be the starting point for future research. The present research has only been limited to the usage of widely used criteria of network analysis, while other criteria relating to the network analysis can be used. Furthermore, other methods related to the network analysis or a combination of this method with other methods such as graph theory can be employed. In future studies, the investment strategies in stocks and also the communication networks among companies can be studied. Considering the importance of the relation models in decision making of individuals and institutions associated with the stock market and in accordance with the obtained results, the following recommendations are presented:

- It is recommended to investors and other users to use network analysis method in making investment decisions based on stocks trading, which reduces the risk of the portfolio, evaluates risk and other decisions.
- It is recommended to supervisory and legislative institutions in the stock market to use the network analysis method to evaluate the market structure.
- It is recommended to legislative institutions in the stock market to pay attention to the relationship structure of shareholders in the stock market.
- According to this fact that there are shareholders in the communication network that are in a particular position over other units. It is recommended to pay more attention to the role, position and influencing power of these units for all individuals, organizations and institutions with a connection to the stock market.

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