OWNERSHIP AND CONTROL IN SHAREHOLDING NETWORKS

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This paper aims to provide an analysis the structure of ownership and control of firms whose shares are traded on the Italian Stock Market. The work is relevant for adding knowledge on the diversification of risk and ultimately to work for the development of risk indicators beyond the standard approaches most based on the time series analysis of raw price time series. The dataset reports the shareholdings of 247 companies traded on the Italian stock market. Data, adjourned at May 2008, were retrieved through the AIDA database, integrated by the Bureau van Dijk databases BANKSCOPE, ISIS, and cross-validated through CONSOB and MEDIOBANCA reports. Therefore, this dataset allows to consider a sampling larger than the one examined in [2], even considering the difference in the companies traded in the Italian stock market due to the different sampling date. Fig. 1 shows the most connected nodes of the shareholding network. We are most interested in understanding the role of portfolio diversification and portfolio size in the structure of ownership and control.

Methods used in the present analysis involve statistical analyses most proper of the field of complex networks [3] and graph flow analysis typical of operations research approach [1, 4].

We start our analysis building a network from data. Each company corresponds to a node and a link from node i to node j exists if i owns shares of j. Therefore, we obtain a directed graph and the direction of our links is the opposite of the ones of [2], but the same used in [4].

Therefore, in our network construction, the number of links exiting from a node, k_{out}, measures portfolio diversification. The number of links entering in a node, k_{in}, shows the number of shareholders, but this data is biased due to the sample, like it happens in [2].

We are most interested in outlining the difference between ownership, control, and the overlap between ownership and control paths and portfolio diversification. Portfolio diversification is measured through mere statistical analysis, assortativity, and hierarchical paths estimate, in accord with the measure introduced in [5]. We both estimate the probability distribution and the relationship between k_{out} of network nodes. We remark the absence of power laws, although a comparison with the results of [2] allows to detect the tendency to lower the diversification.

We consider also the correlation of k_{out} between different nodes. Having detected a low positive degree of assortativity (0.17), we deepen the analysis by estimating the percentage of hierarchical paths. Two nodes i and j are in a hierarchical path if an "up" path exists from node i through nodes with higher k_{out}, followed by a "down" path where nodes on the path have a decreasing k_{out}. Therefore, a hierarchical path exists if node i is in the portfolio of a larger investor, in which also the smaller j is investing.

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Capitalization is introduced and the analysis is carried on the portfolio size as well. This allows to measure the overlap between portfolio diversification and capitalization, and to answer to questions on the possibility to diversify portfolios for companies having a smaller capitalization. Given the distribution of nodes, we determine its distance form the maximum (minimum) hierarchical ones, and provide ranges for possible scenarios.
We compare this data with the results of the analysis of ownership/control, based on techniques of operational research [1, 4]. The method shown in [4] deals with directed acyclic graph (DAG), whilst [1] considers connected components. The entire network becomes DAG only whether links corresponding to more 10% share ownerships are considered. Hence, cycles cannot be eliminated without cutting relevant information. The results emphasize that companies traded on the Italian stock market most use direct control.

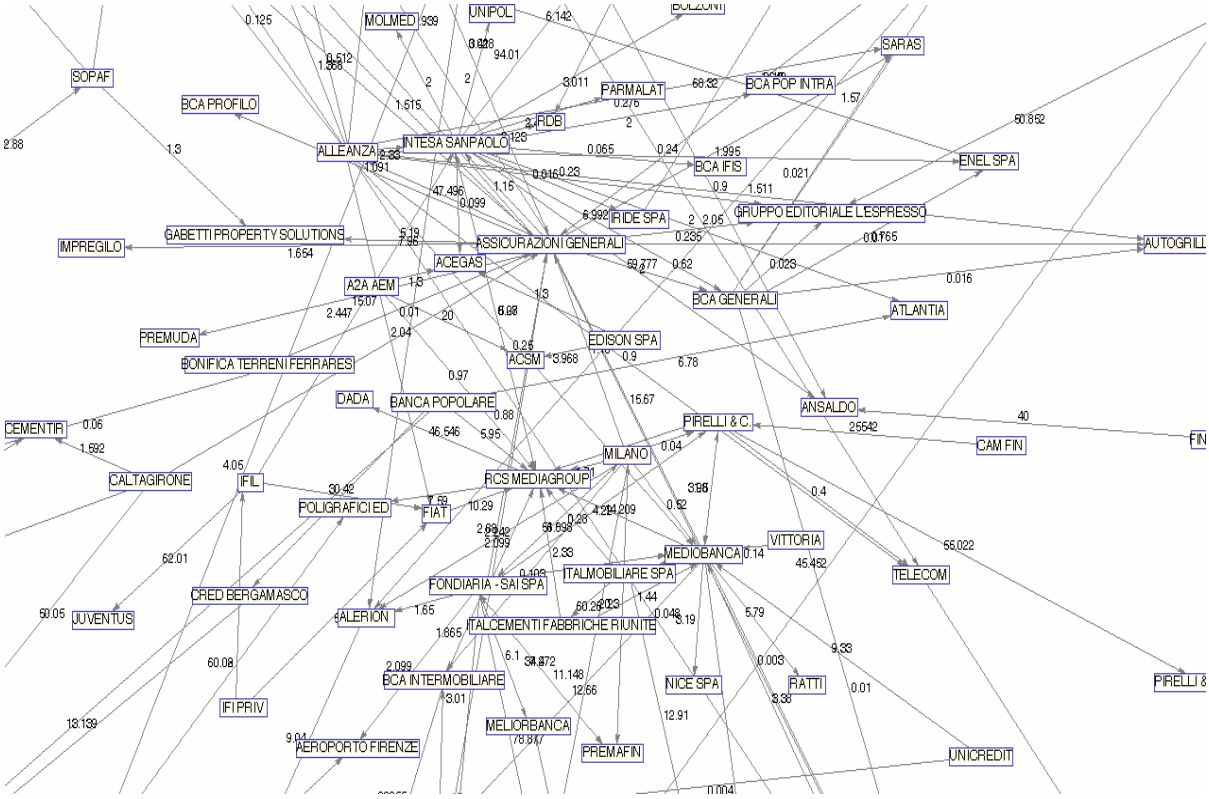

Fig. 1: Shareholding network: the highest connected nodes.

Keywords
Stock market, complex network analysis, shareholdings, firms ownership, control paths.

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