The Impact of Industrial Network Structure on Insider Trading

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Abstract. Opportunistic share reduction by executives is an insider trading behavior reflecting short-termism, influenced by trade information within industrial networks of the real economy. How to effectively prevent such practices to maintain market fairness and stability warrants exploration. Using social network analysis methods and data from Chinese A-share listed companies, this study investigates whether opportunistic share reduction by executives is affected by the position of their industry within industrial networks. Findings reveal that companies located at the center of industrial networks are more prone to opportunistic share reduction by executives. This study not only offers an industrial network perspective for examining the motivations behind insider trading behaviors like opportunistic share sales by executives but also delves into the mechanisms of information asymmetry within industrial networks. It provides valuable practical insights for preventing and governing insider trading, protecting the interests of investors, and promoting the healthy and stable development of China's capital markets.

Keywords: Supply chain, Insider trading, Corporate governance.

1 Introduction

Executive share sales are a common occurrence in China's capital markets, with a wave of sell-offs often following sharp stock market rallies. For instance, after the rapid and sustained rise in A-shares toward the end of September 2024, numerous listed companies announced plans to reduce their holdings, including large-scale sell-offs and full liquidation sales. While research suggests insider trading carries signaling effects that enhance capital market information efficiency, opportunistic share reduction carries more profound negative consequences. It not only undermines corporate long-term development but also erodes investor confidence and may even disrupt the healthy functioning of capital markets. Regulatory oversight of share reduction has gradually tightened in recent years, from the introduction of reduction rules in 2017 to the issuance of the strictest, ever share reduction regulations in 2024, yet the practice remains widespread. While existing research often explains share reduction through firm-specific characteristics and macro-policy influences, it fails to account for the distinct industry

J. Rak et al. (eds.), *Proceedings of the 2026 11th International Conference on Social Sciences and Economic Development (ICSSED 2026)*, Advances in Economics, Business and Management Research 391,
https://doi.org/10.2991/978-94-6239-701-9_45

patterns observed in corporate share reductions. This paper attempts to explore the industry-level inducing factors of opportunistic share reduction by executives within the research framework of industrial network relationships.

In the real economy, industries are interconnected through economic activities, forming industrial networks based on input-output relationships. When shocks propagate between industries, relevant information spreads along industrial chains within these networks (Aobdia et al., 2014)[1]. When an industry exhibits high centrality within the industrial network, its linkage to the broader economy intensifies, making it more susceptible to shocks originating from other sectors. This complexity amplifies the transmission pathways of shock information. However, the costs associated with gathering and interpreting information about shifts in the fundamentals of central industries vary, potentially creating information asymmetry between corporate management and external investors. On one hand, corporate managers possess inherent advantages in interpreting complex information about shocks from related industries to the central industry and their impact on corporate fundamentals, leveraging their grasp of actual operational conditions and extensive industry experience (Ben-David et al., 2019; Goergen et al., 2019)[2,5]. On the other hand, investors are often constrained by limited attention spans, making it difficult for them to effectively process complex information involving multi-industry linkages. This hinders their ability to promptly or accurately grasp the impact of multiple shocks on the operational status and fundamentals of firms within the central industry (Evgeniou et al., 2022; Noh, 2014; Yu et al., 2024)[4,10,11].

Industrial network relationships reflect the genuine economic connections between industries through inputs and outputs. Industries at the center of industrial networks engage in transactional ties with a greater number of other industries (Menzly and Ozbas, 2010)[9], leading to the aggregation of more complex information toward these central industries (Noh, 2014)[10]. Industry-level information reflects inter-industry dynamics relevant to actual production and operations, such as cooperative interactions involving the flow of physical materials and price transfers, as well as shocks like demand fluctuations, technological change, and industrial policy shifts (Aobdia et al., 2014)[1]. Drawing on their understanding of actual business operations and accumulated industry expertise, corporate managers are often better equipped to interpret the implications of industry-level information (Ben-David et al., 2019;Goergen et al., 2019)[2,5]. This enables them to identify opportune moments to leverage their information advantage for profit. However, industry-level information presents a double-edged sword for outsiders. Industry-level information holds significant value, and experienced analysts tend to prioritize its acquisition. On one hand, they can leverage economies of scale from similar industry information to reduce marginal costs of information acquisition. On the other hand, they can enhance the accuracy of information gathering by utilizing the complementary nature of multi-dimensional cross-industry information (Guan et al., 2015; Huang et al., 2022; Kini et al., 2009)[8,6,7]. Yet for retail investors, deciphering complex industry-level information proves challenging. Core industries often involve more intricate data, imposing higher information processing costs on investors constrained by limited attention—thereby deepening their information disadvantage (Evgeniou et al., 2022; Noh, 2014; Yu et al., 2024)[4,10,11]. Therefore, this paper argues that a firm's position within an industrial network influences how executives and

investors interpret complex industry-level information, thereby affecting the degree of information asymmetry between them and potentially inducing opportunistic selling by executives.

This study examines the impact of industrial network centrality on opportunistic share sales by corporate executives. Based on data from Chinese A-share listed companies from 2009 to 2019, an industrial network is constructed using inter-industry input-output data. Empirical results reveal that firms located at the center of the industry are more prone to opportunistic share sales by executives, with higher amounts and frequencies of sales. The main contribution lies in expanding the perspective of industrial information within research on factors influencing executive share sales. Existing research primarily addresses two levels: the firm level and the macro level. Firm-level characteristics may serve as triggers for selling behavior, while macro-level information functions as external oversight. However, the influence of industry-level information is often overlooked. Differences in how investors and corporate insiders interpret industry-level information deepen information asymmetry, potentially inducing opportunistic selling by executives. This paper constructs a logical chain linking "industry network position, degree of information asymmetry, executive share reduction behavior," offering a theoretical perspective for understanding the interaction between the real economy and capital markets. Industry network relationships reflect trade dynamics within the real economy. Firms within these networks are invariably affected by industry-level developments, though the magnitude of impact varies based on their position within the network. Central industries are more susceptible to information shocks, exhibit greater information asymmetry, and are thus more prone to executive share sales. This framework also offers a new perspective for monitoring and preventing opportunistic executive share sales. Regulatory authorities can focus their oversight on companies within industry hubs, implementing targeted supervision. This approach holds practical significance for protecting external investors' interests, enhancing investor confidence, standardizing stock market trading practices, and promoting the healthy and stable development of China's capital markets.

2 Data, Variables and Research Design

2.1 Data and Sample

This study utilizes annual data from A-share listed companies between 2009 and 2019 as its sample, matching the annual intervals of China's Input-Output Tables. Transaction data regarding senior executives of Chinese A-share listed companies reducing their holdings of company stock in the secondary market, along with other firm-level data, are sourced from the CSMAR database. Inter-industry input-output data are derived from the China Input-Output Tables published by the National Bureau of Statistics. Since the China Input-Output Tables only released data for selected years, interpolation was employed to fill gaps in missing annual data. The initial sample data underwent the following processing: (1) Exclusion of financial sector samples; (2) Exclusion of samples from companies under special treatment (ST); (3) Samples with missing key variable data were excluded; (4) To mitigate the impact of extreme values on

results, all continuous variables underwent winsorization at the upper and lower 1% thresholds. This process yielded a final dataset of 24,267 firm-year observations.

2.2 Dependent Variables

This paper employs industrial eigenvector centrality to measure the position of a firm's industry within the industrial network. Centrality encompasses various measures such as degree centrality, closeness centrality, betweenness centrality, and eigenvector centrality, each carrying distinct economic implications. Among these, eigenvector centrality comprehensively considers both the network status and connection strength of directly and indirectly adjacent nodes, thereby fully reflecting economic indicators within industrial networks such as the intensity of economic ties, the centrality of business partners, and the number of business partners. Regarding the calculation method for eigenvector centrality, this paper adopts Bonacich (1972)[3] iterative approach and its classical formula. The weight assignment method follows the methodology proposed by Aobdia et al. (2014)[1], utilizing direct flow data from China's Input-Output Tables for iterative computation. Here, s_{ij} and s_{ji} represent the intermediate inputs and intermediate uses data in Quadrant I of the input-output tables, respectively. while s_{ik}, s_{kj}, s_{jk}, s_{ki} represent the total intermediate inputs and total intermediate uses data for Quadrant I. s_{ij} denotes the value of products directly consumed by industry j in its production process that originate from industry i. This process ultimately yields the variable data for industrial feature vector centrality.

$$Eigenvector_i = \frac{1}{\lambda} * \sum_j \left[\frac{1}{4} * \left(\frac{s_{ij}}{\sum_k s_{ik}} + \frac{s_{ij}}{\sum_k s_{kj}} + \frac{s_{ji}}{\sum_k s_{jk}} + \frac{s_{ji}}{\sum_k s_{ki}} \right) Eigenvector_j \right] \quad (1)$$

2.3 Independent Variables

To measure opportunistic share sales by executives, first, determine whether such sales constitute opportunistic behavior by examining abnormal returns following the transactions. If an executive's share sale predicts negative stock returns within one month, the transaction is classified as opportunistic. Second, each opportunistic sell-off transaction by listed company executives is aggregated at the corporate annual level. The total sell amount (*Sell)* and number of sell-offs (*SellTimes*) are calculated and log-transformed. Corporate annual values are set to zero for years with no sell-off activity.

2.4 Methodology

$$InsiderTrading_{i,t} = \alpha + \beta * Eigenvector_{j,t} + \gamma X_{i,t} + \sigma_i + \delta_t + \varepsilon_{i,t} \quad (2)$$

The subscripts i, j, and t denote firm, industry, and year, respectively, while ε represents the residual term. The explanatory variable is the industry characteristic eigenvector centrality (Eigenvector), and the dependent variable is firm opportunistic selling behavior (*InsiderTrading*), comprising two indicators: the amount of opportunistic selling (*Sell*) and the number of selling instances (*SellTimes*). Additionally, the regression

controls for time fixed effects δ_t and firm fixed effects σ_i with standard errors adjusted for firm-level clustering.

3 Empirical Results

Table 1 presents the results of the benchmark regression for Model (2) across the entire sample. The regression controls for year and firm-level fixed effects, with standard errors adjusted for firm-level clustering. Column (1) and Column (3) use the amount of opportunistic share sales (Sell) as the dependent variable, while Column (2) and Column (4) use the number of share sales (*SellTimes*). Columns (1) and (2) do not include control variables, whereas Columns (3) and (4) control for governance and firm-level characteristics to account for other factors influencing executive share sales. The regression results show that the regression coefficients for industry characteristic eigenvector centrality (*Eigenvector*) are 12.427, 1.473, 12.293, and 1.488, respectively, all significant at the 1% level. This indicates that companies with higher industry centrality are more prone to opportunistic selling by executives.

Table 1. Supply Chain Structure and opportunistic share sales by senior executives

	(1)	(2)	(3)	(4)
	Sell	*SellTimes*	*Sell*	*SellTimes*
Eigenvector	12.427***	1.473***	12.293***	1.488***
	(2.73)	(2.66)	(2.72)	(2.71)
Constant	3.215***	0.307***	-6.188**	-0.412
	(24.11)	(18.95)	(-2.40)	(-1.45)
Controls	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	24,267	24,267	24,267	24,267
Adj R^2	0.314	0.312	0.320	0.318

Notes. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively; values in parentheses denote t-statistics; standard errors are adjusted for clustering at the firm level.

4 Conclusion

This study utilizes China's input-output tables from 2009 to 2019 and data from A-share listed companies to examine how a firm's position within an industrial network influences opportunistic share reduction by executives. Findings reveal that firms located at the core of industrial networks are more prone to such opportunistic reductions. Based on these conclusions, the following practical implications emerge: establish a differentiated industrial network regulatory framework and implement targeted share reduction oversight strategies. Given that executives at firms in the network center are more prone to opportunistic selling, regulators should establish a classification-based oversight mechanism guided by industrial network position. This would impose stricter share-

reduction restrictions on key industries at the network center. Such an approach not only enhances the efficiency of regulatory resource allocation but also targets systemic risk prevention, fostering a more robust capital market ecosystem. Simultaneously, establishing an industrial network risk early-warning system to prioritize monitoring executive trading activities in central industries could facilitate a shift from blanket regulation to targeted interventions. Guiding listed companies to embrace long-term value creation principles and strengthen internal governance mechanisms is essential. Companies should be encouraged to develop more robust long-term incentive structures that tightly align management interests with sustainable corporate development. Regulators should also intensify penalties for non-compliant share reductions, using high-profile cases to create effective deterrence and purify the market environment. We should promote the development of diversified information dissemination channels, strengthen coordination among regulators, industry organizations, and market intermediaries, and establish industrial information-sharing platforms to reduce investors' costs in accessing and processing information. Furthermore, the introduction of new technologies such as artificial intelligence could be considered to enhance the intelligence of information disclosure, uphold market fairness and trading order, strengthen the intrinsic stability of capital markets, and promote the high-quality development of China's capital markets.

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