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Foreign-Funded Firms and Stock Price Informativeness: Evidence from Chinese Capital Markets

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Abstract: This article aims to test whether and how foreign-funded firms can increase the stock price informativeness of China's capital market. It uses the data of China's A-share listed firms from 2011 to 2022. We found a significant positive relationship between foreign-funded firms and stock price informativeness. The study also found that compared with samples with a low level of social responsibility, the positive relationship between foreign-funded firms and stock price informativeness is more significant in samples with a higher level of social responsibility. Compared with samples with a low level of product market competition, the positive relationship between foreign-funded firms and stock price informativeness is more significant in samples with a higher level of product market competition. We found that foreign-invested firms increase the stock price informativeness by attracting media coverage and choosing the Big Four accounting firms. After alleviating the endogeneity problem in four ways, the conclusions still hold.

Keywords Foreign-funded firms, stock price informativeness, Social responsibility, Product market competition

Paper type Research paper

1. Introduction

Since joining the WTO, China's economy has maintained long-term high-speed growth and has achieved remarkable achievements. Foreign investment is an important part of China's economy. Foreign-funded firms have brought capital, technology, advanced management experience, and excellent talents to China, making important contributions to promoting China's economic development. A large number of literature focuses on and verifies the impact of foreign-funded firms on China's capital market, covering multiple macro and micro aspects, such as employment growth (Karlsson et al., 2009), green economic development (Kim et al., 2022), social responsibility (Kolk et al., 2010), innovation (Choi et al., 2011), export quality upgrading(Anwar and Sun, 2018), etc.

It is worth noting that the development of China's capital market lags far behind the development of China's economy. For example, according to statistics from "Investing.com", the world's fourth largest financial website, in the statistics of global stock market growth in 2023, mainland China ranked third from the bottom. The development of China's stock market has lagged behind developed countries for many years and behind many developing countries. China's capital market is often criticized for problems with investor protection, regulatory efficiency, and transparency (Swedlund, 2017; Sabbaghi, 2016; Naeem et al., 2024; Cao et al., 2019). Compared with developed capital markets, China's capital market is considered to be a market with low information efficiency (Kim and Shamsuddin, 2008; Yi et al., 2019), or a weak efficient market (Lim et al., 2013; Lima and Tabak, 2004). As China's level of opening up to the outside world gradually increases, more and more foreign capital is pouring into China. So, facing China's unique capital market environment, can foreign-funded firms improve their information efficiency? There is no literature research on the impact of foreign-funded firms on the efficiency of capital allocation in the Chinese market.

Given the lack of the above studies, this paper pays special attention to the key indicator of stock price informativeness. Stock price informativeness is an important indicator to measure the information efficiency of the capital market. Arbitrage activities in the capital market are trading activities based on private information, and information guides investors' decisions (Roll, 1988). When stock prices contain more firm-level idiosyncratic information, stock prices can better reflect the actual value of the firm, thereby guiding the direction of capital investment to achieve the optimal

allocation of social resources (Morck et al., 2000). On the contrary, it will not only increase the probability of investor decision failure but also lead to distortion of resource allocation. As an underdeveloped capital market, China's capital market has created a unique environment for testing the relationship between foreign-funded firms and stock price informativeness. Compared with the research on stock price informativeness that has been widely used in developed capital markets, our exploration of the impact of foreign-funded firms on the information efficiency of China's capital market will undoubtedly have a more far-reaching impact. This study not only reveals the uniqueness of China's capital market, but also highlights the important role played by foreign-funded firms in shaping the information efficiency of China's capital market, and can provide empirical evidence for the vast number of developing countries to learn how to absorb and utilize foreign capital.

Based on the above analysis, we use data from A-share listed firms in the Chinese capital market from 2011 to 2012 to empirically test the relationship between foreign-funded firms and stock price informativeness using the ordinary least squares method. For comparative analysis, we also examined the relationship between domestic-funded firms in the Chinese capital market and stock price informativeness, and the relationship between firms cross-listed in the Chinese and Hong Kong capital markets and stock price informativeness. Additionally, we conducted heterogeneity analysis to examine the impact of corporate social responsibility and product market competition, as important corporate governance mechanisms, on the relationship between foreign-funded firms and stock price informativeness. We also verified the mechanism through which foreign-funded firms influence stock price informativeness. Finally, we addressed potential endogeneity issues using four methods: instrumental variables, treatment effect models, fixed effects models, and propensity score matching.

Our results show that there is a significant positive relationship between foreign-funded firms and stock price informativeness, a significant negative relationship between domestic-funded firms and stock price informativeness, and a significant positive relationship between AH cross-listed firms and stock price informativeness. The positive relationship between foreign-funded firms and stock price informativeness is more significant in samples with higher levels of social responsibility than in samples with lower levels of product market competition. The positive relationship between foreign-funded firms and stock price informativeness is more significant in samples with higher levels of product market competition than in samples with lower levels of

product market competition. Foreign-funded firms mainly promote the improvement of stock price informativeness by attracting media coverage and selecting the Big Four accounting firms for audits. Finally, after addressing the endogeneity concern, the main conclusions of this paper still hold.

Our findings make two contributions to the literature. First, we extend the research on the economic consequences of foreign-funded firms in China's capital market and provide new evidence for the debate on whether foreign-funded firms can effectively improve the information efficiency of China's capital market. For a long time, a large number of studies have confirmed that the information efficiency of China's capital market is relatively low (Eun et al., 2015; Jin and Myers, 2006; Morck et al., 2000). However, the academic community currently knows little about the role of foreign-funded firms in the information efficiency of China's capital market. Through in-depth research, we find that there is a significant positive correlation between foreign-funded firms and stock price informativeness. This finding not only highlights the importance of foreign investors in China's capital market but also further emphasizes the positive impact of foreign investors in emerging markets.

Second, inspired by the research on the impact of firm‐level corporate governance on stock price informativeness (Yu, 2011), our study found that social responsibility, as an unconventional governance measure in the corporate governance system, can guide companies to improve the information environment, improve information quality, and ultimately improve the stock price informativeness, confirming the moral hypothesis of social responsibility. Furthermore, product market competition, as an external governance mechanism, can constrain the opportunistic behaviour of insiders, promote the improvement of the information environment, and ultimately improve stock price informativeness, confirming the external governance hypothesis of product market competition.

The rest of this paper is organized as follows: Section 2 is the literature review and research hypothesis. Section 3 is the research design. Section 4 is the empirical results and analysis. Section 5 is the mechanism test. Section 6 is the endogeneity. Section 7 is the conclusion.

2. Literature review and research hypotheses

2.1 Literature review

The stock price informativeness reflects the degree to which firm-specific

information is incorporated into the stock price (Roll, 1988). The more information about a firm's characteristics is contained in the stock price, the closer the stock price is to the firm's actual value, and the more effectively it can guide market resources to achieve optimal allocation (Morck et al., 2000).

By combing through the existing literature, the factors that affect the stock price informativeness can be summarized into two aspects.

First, external factors. For example, investor protection (Morck et al., 2000), product market competition (Wang et al., 2021), political uncertainty (Fulgence et al., 2023), media coverage(Kim et al., 2014; Tsang et al., 2024), analyst following(Bowen et al., 2008), institutional investors(Ding et al., 2013), etc. Specifically, some factors can serve as important external corporate governance mechanisms to constrain management's opportunistic manipulation of firm financial data, thereby reducing investors' information collection costs and ultimately attracting more investment to obtain firm information and integrate it into stock prices through transactions (e.g., investor protection). The above factors also include information intermediaries, which have the functions of information mining, transmission, and interpretation, allowing existing or potential investors to understand and master more firm-specific information (e.g., media coverage and analyst following). Overall, these factors affect the firm's information environment and investors' information collection costs. Other factors affect investors' information collection costs and willingness (e.g., political uncertainty). Morck et al. (2000) believe that higher information collection costs will lead to investors' unwillingness to participate in arbitrage activities, while the reduction of arbitrage activities will hinder the stock price from absorbing firm-specific information.

Second, internal factors. For example, cross-listing (Foucault and Gehrig, 2008), information transparency (Jin and Myers, 2006), corporate governance (Yu, 2011), firm disclosure characteristics (Goldstein and Yang, 2019; Roychowdhury and Sletten, 2012), earnings quality (Tiron-Tudor, 2019), gender (Gul et al., 2011), social responsibility (Chen et al., 2021), CEO overconfidence (Le et al., 2024), etc. These factors, interpreted from the perspective of the firm's basic characteristics, manager characteristics, or behavioral finance, often affect the firm's disclosure motivation, disclosure quality, and financial information quality, and are important factors in determining the firm's information environment and information asymmetry.

Summarizing the above literature, we can see that stock price informativeness is

closely related to the firm's information environment, information asymmetry, the amount of disclosed information, the quality of financial information, and other factors. The reason is that sufficient and effective financial information and an open and transparent information environment can reduce the information collection costs of investors, thereby attracting more investors to explore and use firm-specific information and integrate it into stock prices through transactions, ultimately increasing the stock price informativeness. On the contrary, it will reduce the stock price informativeness.

2.2 Foreign-funded firms and stock price informativeness

Foreign investment is an important means for local governments in China to achieve economic growth, and obtain funds and technology (Rochlitz et al., 2015). Therefore, local governments will pay close attention to the management and operation of foreign-funded firms in their jurisdiction. In an immature capital market, media reports become an important channel for supervising and reporting firm information (Cui et al., 2023). It can be inferred that as an underdeveloped capital market, China's media has played the role of paying attention to foreign-funded firms instead of the government. Media reports on foreign-funded firms can reduce investors' information collection costs (Kothari et al., 2009), disseminate more private information about companies, improve transparency and accounting information quality (Bushee et al., 2010), and the improvement of firm transparency and accounting quality will ultimately help to increase the information content of stock prices (Jin and Myers, 2006).

Shareholders of foreign-funded firms are usually at an information disadvantage due to their lack of expertise in host country laws, taxation, accounting, auditing, and risk management (Johanson et al., 2020). To protect their interests from loss, shareholders of foreign-funded firms tend to hire the Big Four accounting firms to carry out evaluation and attestation work (Guedhami et al., 2009). The Big Four accounting firms are more independent (DeAngelo, 1981) and pay more attention to maintaining their brand and reputation, which means higher audit quality (Carter and Spence, 2014; Che et al., 2020). As an external supervision mechanism, the Big Four accounting firms can effectively suppress the opportunistic behavior of insiders to manipulate information, reduce information asymmetry, and improve the quality and transparency of financial reports (Bushman et al., 2004; Chi et al., 2011). It can be inferred that the higher the audit quality, the easier it is for external investors to obtain reliable firm-level private

information, and promote their entry into stock prices, thereby increasing the information content of stock prices. Based on the above analysis, this paper proposes the first hypothesis:

H1: Foreign-funded firms are positively correlated with stock price informativeness

2.3 Foreign-funded firms, social responsibility and stock price informativeness

As early as the 1970s, Western scholars began to explore firm social responsibility and formed a mature corporate governance theory system. Therefore, foreign shareholders usually have more advanced social responsibility concepts and practical experience, and incorporate their social responsibility preferences into the process of corporate governance, guiding firms to assume more social responsibilities in the host country (Guo and Zheng, 2021; McGuinness et al., 2017). However, there are two completely different views on firm social responsibility. Therefore, in this section, we conduct heterogeneity analysis from the perspective of social responsibility.

One view emphasizes the moral attributes of social responsibility, arguing that firms should not only maximize profits but also take into account the interests of society and stakeholders and that owners are willing to sacrifice economic interests to pursue social welfare (Hoi et al., 2013). To a certain extent, high-level information disclosure and provision of reliable financial data are not only the firm's obligations but also a manifestation of the firm's social responsibility (Martínez et al., 2015). Firms that assume social responsibility tend to show higher earnings quality (Kim et al., 2012), disclose more information (Gelb and Strawser, 2001), have higher transparency (Qian et al., 2015), and have higher audit quality and financial reporting quality (Saeed et al., 2022). This means that foreign-funded firms with higher levels of social responsibility have higher profit quality and transparency, and a better information environment, which is conducive to the integration of firm-specific information into stock prices.

Other scholars have put forward different views based on agency theory. They believe that the only goal of a firm is to maximize profits and that taking on social responsibility is a way for management to seek rent (Carroll, 1979; Jensen and Meckling, 1976). Foreign-funded firms tend to take on social responsibility in the host country to alleviate institutional and non-institutional pressures to gain legitimacy (Cordeiro et al., 2018). Management takes on social responsibility to serve its interests, and often takes on social responsibility to cover up earnings manipulation and other opportunistic behaviors (Hemingway and Maclagan, 2004) or evade supervision

(Alberici and Querci, 2016). Firms that take on social responsibility are more likely to manipulate financial data (Petrovits, 2006; Prior et al., 2008). This means that foreign-funded firms with higher levels of social responsibility have worse earnings quality and transparency, and a worse information environment, which is not conducive to the integration of firm-specific information into stock prices. Based on the above analysis, this paper proposes the following competing hypotheses:

H2a: The positive relationship between foreign-funded firms and stock price informativeness is more significant in firms with higher social responsibility levels than in firms with lower social responsibility levels.

H2b: The positive relationship between foreign-funded firms and stock price informativeness is more significant in firms with lower social responsibility levels than in firms with higher social responsibility levels.

2.4 Foreign-funded firms, product market competition, and stock price informati veness

Because foreign-funded firms face a completely different institutional and non-institutional environment in the host country than in the home country, their shareholders are at an information disadvantage (Kang and Kim, 2010), making it easier for management to use information advantages to infringe on the interests of shareholders (Jensen and Meckling, 1976). Therefore, compared with the home country, the agency problems faced by foreign-funded firms in the host country may be more serious. Foreign shareholders can use advanced corporate governance concepts and practices to alleviate agency conflicts (Boubakri et al., 2013). However, when the internal governance mechanism fails, rent-seeking by management will become easier, eventually leading to severe insider control (Graf-Vlachy et al., 2020), which will undoubtedly increase the firm's information asymmetry and opacity. Some scholars believe that product market competition can serve as a substitute and supplement to the internal governance mechanism (Anuja and Thenmozhi, 2022; Babar and Habib, 2021; Chan et al., 2007). Therefore, in this section, we conduct heterogeneity analysis from the perspective of product market competition.

In addition to the corporate governance mechanism, competitive pressure from the product market plays a positive role in constraining management (Alchian, 1950). Product market competition is the most powerful force for obtaining economic efficiency. Under the pressure of the external environment, firms will consciously improve production and operation to solve possible information and incentive problems

(Stigler, 1958). As a strong external governance mechanism, product market competition transmits operating pressure to firm management through product market competition when other internal and external governance mechanisms are relatively weak, plays its external supervision and constraint role, and forces management to reduce slackness, thereby reducing agency costs (Chen et al., 2020). Some literature studies have found that product market competition can reduce financial restatements and insider trading (Ammann et al., 2013), improve earnings quality (Iqbal et al., 2017), and improve the comparability of financial information (Majeed et al., 2018), which is ultimately conducive to improving information quality and information environment, attracting arbitrageurs to participate in research and trading activities on firms, and increasing the stock price informativeness.

However, there is no consensus on product market competition as an external governance mechanism. Another view is that competitive pressure in the product market will increase the risk of business operations and performance fluctuations, and management will engage in more opportunistic or short-sighted behavior based on private compensation, avoiding reporting losses or achieving performance targets, and considering their careers (Hermalin and Weisbach, 2012). Some literature studies have found that the more intense the product market competition, the higher the level of earnings manipulation of the firm (Markarian and Santalo, 2014; Shi et al., 2018) and the lower the willingness to disclose information (Ali et al., 2014), which ultimately deteriorates the information quality and information environment, hinders arbitrageurs from participating in research and trading activities on firms, and reduces stock price informativeness. Based on the above analysis, this paper proposes the following competitive hypotheses:

H3a: The positive relationship between foreign-funded firms and stock price informativeness is more significant in industries with higher product market competition levels than in industries with lower product market competition levels.

H3b: The positive relationship between foreign-funded firms and stock price informativeness is more significant in industries with lower product market competition levels than in industries with higher product market competition levels.

3. Research Design

3.1 Sample and data source

This paper uses A-share listed firms from 2011 to 2022 as the research sample, and

all data are from the CSAMR database. Finally, the data is processed according to the following principles: (1) Delete the samples of financial companies; (2) Delete the ST samples; (3) Delete the samples with missing values; (4) Perform tail-shrinking on continuous variables at the 1% level.

3.2 Model design and variable definition

To examine the relationship between foreign-funded firms and stock price informativeness, referring to Lanis and Richardson (2012) and Chen et al. (2021), this paper constructs Eq. (1):

$$INFOR = \alpha_0 + \alpha_1 FOREIGN + \alpha_2 SIZE + \alpha_3 LEV + \alpha_4 ROA + \alpha_5 TOP1 + \alpha_6 INP + \alpha_7 BOARD + \alpha_8 DUAL + \alpha_9 TOVER + YEARDUM + INDDUM + \varepsilon \quad (1)$$

Dependent Variable: stock price informativeness (INFOR). Following the approach of Durnev et al. (2003), the fitting coefficient of Eq. (2) is used to estimate the R^2 of individual stocks, and Eq. (3) is used to calculate the stock price informativeness.

$$r_{i,t} = \beta_0 + \beta_1 r_{m,t} + \beta_2 r_{I,t} + \varepsilon_{i,t} \quad (2)$$

$$INFOR_{i,t} = LN(\frac{1 - R_i^2}{R_i^2}) \quad (3)$$

In Eq. (2), $r_{i,t}$ is the stock returns in the t week, $r_{m,t}$ is the market returns in the t week, and $r_{I,t}$ is the industry returns in the t week. $r_{I,t}$ is according to the industry classification standard of the China Securities Regulatory Commission (CSRC), based on the firm's market capitalization, calculated using the weighted average of $r_{i,t}$. R_i^2 is the fitting degree of the Eq. (3). Considering that the value of R^2 is between [0,1], which does not meet the regression requirements of the least squares method in econometrics, we refer to the approach of Durnev et al. (2003) and use Eq. (3) to perform a logarithmic transformation on R^2 to make it normally distributed. The final indicator is the measure of the stock price informativeness.

Independent Variable. Foreign-funded firms (FOREIGN), a dummy variable, refer to firms that are completely owned and controlled by foreign firms or individuals in China. If this condition is met, FOREIGN is assigned a value of 1, otherwise it is 0.

To comprehensively analyze the differences in stock price informativeness between foreign-funded firms and Chinese companies, we also set the following two variables, namely domestic-funded firms and AH cross-listed firms.

Domestic-funded firms (DOMESTIC), a dummy variable, refer to firms established in China that are owned and controlled by Chinese firms or individuals and listed in

mainland China. If this condition is met, DOMESTIC is assigned a value of 1, otherwise, it is 0.

AH cross-listed firms (AH), a dummy variable, refer to firms established in China that are owned and controlled by Chinese firms or individuals and listed in mainland China and Hong Kong at the same time. If this condition is met, AH is assigned a value of 1, otherwise it is 0.

Heterogeneity test variables. (1) Social responsibility (CSRSCORE). Drawing on the practice of Lanis and Richardson (2012), we divide a firm's social responsibility into six categories: social responsibility strategy, environment, employees, social investment, customers, and suppliers. We analyze the social responsibility reports disclosed by the firm. If the firm has invested in and built on the above six aspects and disclosed one of the above contents in the social responsibility report, it is assigned a value of 1, otherwise, it is assigned a value of 0. Then, by adding up the values of all items, we get a comprehensive evaluation index of the firm's social responsibility, expressed as CSRSCORE, with a value between 0 and 6.

(2) Product market competition (HHI) is measured by the Herfinndahl-Hirschman concentration Index, following the approach of Markarian and Santalo (2014). The calculation formula is as follows:

$$HHI = \sum_{i}^{N} \left(\frac{X_i}{X}\right)^2 \quad (4)$$

Where N represents the number of firms in the industry, Xi represents the main business income of firm i in the industry. $X = \Sigma Xi$. When the number of firms in the industry is constant, the smaller the HHI index is, the more firms of the same size there are in the industry, and the more intense the competition is. Since HHI is a reverse indicator, to increase the intuitiveness of understanding, we refer to the practice of Markarian and Santalo (2014) to multiply the index by -1 to convert it into a positive indicator.

Control variables. Referring to Lanis and Richardson (2012) and Chen et al. (2021), the control variables of this paper are as follows. In terms of firm characteristics, we select total asset size (SIZE) to measure the size of the firm, financial leverage (LEV) to measure the firm's debt repayment ability, return on total assets (ROA) to measure the firm's profitability. In terms of corporate governance variables, we select four board characteristics variables to measure corporate governance efficiency: the shareholding ratio of the largest shareholder (TOP1), the proportion of independent directors (INP),

the size of the board of directors (BOARD), whether Chairman cum General Manager (DUAL).The firm's activeness in capital market transactions is measured by the firm's annual average daily turnover rate (TOVER). In the meantime, taking the potential impact of the year and industry on stock price informativeness into account, we also control for the year and industry fixed effects. The names and definitions of the variables are shown in Table I.

Insert Table I here

3.3 Descriptive statistics of variables

Table II reports the descriptive statistics of the variables. From the results, the minimum value of the stock price informativeness (INFOR) is -1.2556, the maximum value is 4.2769, and the standard deviation is 1.0905, indicating that this indicator value has large differences among the sample firms and is unbalanced. The minimum value of foreign-funded firms (FOREIGN) is 0, the maximum value is 1, and the mean value is 0.0547, indicating that foreign-funded firms account for 5% of the total sample, and the proportion of foreign-funded firms in China's capital market is relatively low. The minimum value of firm size (SIZE) is 19.8657, the maximum value is 26.2494, and the standard deviation is 1.2958, indicating that this indicator has large differences among the sample firms. The minimum value of the shareholding ratio of the largest shareholder (TOP1) is 8.41, the maximum value is 74.3, and the standard deviation is 14.8195, indicating that this indicator has large differences among the sample firms and is unbalanced.

Insert Table II here

3.4 Correlation coefficient analysis

Table III is the Pearson correlation coefficient table. It can be seen from the table that the correlation coefficient between foreign-funded firms and stock price informativeness is significantly positively correlated at the 1% level, which preliminarily shows that foreign-funded firms can increase stock price informativeness and improve information efficiency. The maximum correlation coefficient is 0.5517, indicating that the multicollinearity problem between variables is not serious and can be further analyzed through regression.

Insert Table Ⅲ here

4. Empirical Results and Analysis

4.1 Regression results of hypothesis 1

Table IV is a multivariate regression analysis, using least squares regression (OLS Regression), controlling for the fixed effects of year and industry, and using robust standard errors for estimation. Column (1) is the regression result of foreign-funded firms and stock price informativeness. The results show that the regression coefficient of foreign-funded firms and stock price informativeness is significantly positive and significant at the 1% level, indicating that foreign-funded firms can increase stock price informativeness, significantly improve the information efficiency of China's capital market, and play a positive role in promoting the healthy development of China's capital market.

Column (2) is the regression result of domestic-funded firms and stock price informativeness. Replacing the explanatory variables of Eq. (1) with domestic-funded firms. The results show that the regression coefficient of domestic-funded firms and stock price informativeness is significantly negative and significant at the 1% level, indicating that domestic-funded firms are negatively correlated with stock price informativeness, which means that the cost for investors to collect specific information about domestic-funded firms is high, which hinders the stock price from absorbing firm-specific information and ultimately reduces the information efficiency of China's capital market.

Column (3) is the regression result of AH cross-listed firms and stock price informativeness. Replacing the explanatory variables of Eq. (1) with AH cross-listed companies. The results show that the regression coefficient of AH cross-listed firms and stock price informativeness is significantly positive and significant at the 5% level, indicating that AH cross-listed firms can improve stock price informativeness. The regression results of the third column are consistent with the research conclusions of Foucault and Gehrig (2008). There are two main reasons why cross-listing can improve stock price informativeness. First, the location of cross-listing has stricter regulatory systems and information disclosure standards than the home country, so firms disclose higher quality and more comprehensive accounting information than in the home country's capital market. From the actual situation, the Hong Kong capital market is superior to the mainland China capital market in terms of transparency, regulatory efficiency, and investor protection, and the disclosure standards are stricter. Second, cross-listing means that a firm faces two or more different capital markets, which increases the number of firm stock price signals, thereby stimulating investors to obtain

information and make decisions. From the actual situation, cross-listing of mainland China-listed firms in Hong Kong can attract more investors, increase stock price signals, and incorporate more firm-specific information into stock prices, ultimately increasing stock price informativeness.

Insert Table IV here

4.2 Regression results of hypothesis 2

Table V shows the regression results of foreign-funded firms, social responsibility, and stock price informativeness. Taking the industry-year average of social responsibility level as the demarcation value, the total sample is divided into samples with higher social responsibility levels and samples with lower social responsibility levels. Column (1) shows the regression results of samples with higher social responsibility levels. The regression coefficient of foreign-funded firms and stock price informativeness is positive and significant at the 1% level, indicating that in samples with higher social responsibility levels, foreign-funded firms play a positive role in increasing stock price informativeness. Column (2) shows the regression results of samples with lower social responsibility levels. The regression coefficient of foreign-funded firms and stock price informativeness is positive but not significant, indicating that in samples with lower social responsibility levels, foreign-funded firms do not play a positive role in increasing stock price informativeness.

The Fisher combination test is used to distinguish the difference between the two groups of coefficients. Random sampling is performed 1,000 times. The results show that the difference is significant at the 5% level, indicating that there is a significant difference between the two groups. The above results show that the role of foreign-funded firms in increasing stock price informativeness and information efficiency is more obvious in samples with higher social responsibility levels. This confirms the moral hypothesis of social responsibility, that is, a firm's assumption of social responsibility is not rent-seeking behavior, but a manifestation of the firm sacrificing economic interests to pursue social welfare, which is consistent with H2a.

Insert Table V here

4.3 Regression results of hypothesis 3

Table VI shows the regression results of foreign-funded firms, product market competition, and stock price informativeness. Taking the industry-year average of

product market competition level as the demarcation value, the total sample is divided into samples with higher product market competition levels and samples with lower product market competition levels. Column (1) shows the regression results of samples with higher product market competition levels. The regression coefficient of foreign-funded firms and stock price informativeness is positive and significant at the 1% level, indicating that in samples with higher product market competition levels, foreign-funded firms play a positive role in increasing stock price informativeness. Column (2) shows the regression results of samples with lower product market competition levels. The regression coefficient of foreign-funded firms and stock price informativeness is positive but not significant, indicating that in samples with lower product market competition levels, foreign-funded firms do not play a positive role in increasing stock price informativeness.

The Fisher combination test is used to distinguish the difference between the two groups of coefficients. Random sampling is performed 1,000 times. The results show that they are significant at the 1% level, indicating that there are significant differences between the two groups. The above results show that the role of foreign-funded firms in increasing stock price informativeness and improving information efficiency is more obvious in samples with higher product market competition levels. This confirms the external governance hypothesis of product market competition, that is, product market competition can serve as a substitute or supplement to the internal governance mechanism and play a role in constraining insiders, which is consistent with H3a.

Insert Table VI here

5. Mechanism Test

Our main hypothesis is that foreign-funded firms increase the stock price informativeness mainly through two mechanisms: first, foreign-funded firms can attract more media attention. The media, as an information intermediary, can mine, transmit, and interpret firm-specific information, which improves the information environment and allows existing or potential investors to better understand and grasp the firm-specific information and integrate it into the stock price through transactions, ultimately increasing the stock price informativeness; second, To alleviate agency conflicts and reduce information asymmetry, foreign-funded firms tend to choose the Big Four international accounting firms to carry out evaluation and certification services. The Big Four international accounting firms can inhibit management's manipulation of firm

financial data, reduce information asymmetry, and improve the quality and transparency of financial reports. They also play a role in improving the information environment and reducing investors' information collection costs, ultimately increasing the stock price informativeness.

To verify the above mechanism, we construct the following Eq. (5):

$$MEDIA/BIG4 = \alpha_0 + \alpha_1 FOREIGN + \alpha_2 SIZE + \alpha_3 LEV + \alpha_4 ROA + \alpha_5 TOP1 + \alpha_6 INP + \alpha_7 BOARD + \alpha_8 DUAL + \alpha_9 TOVER + YEARDUM + INDDUM + \varepsilon \quad (5)$$

The explained variables in Eq. (5) are media coverage (MEDIA) and the Big Four accounting firms (BIG4). The explanatory variables and control variables are consistent with those in Eq. (1). All data are from the CSMAR database.

Among them, media coverage (MEDIA) is the natural logarithm of the number of times a listed firm is reported by the media plus 1. The Big Four accounting firms (BIG4) is 1 when the firm hires the Big Four accounting firms for auditing, otherwise, it is 0.

Table VII shows the regression results of the mechanism test. Column (1) uses least squares regression (OLS Regression) to test the relationship between foreign-funded firms and media coverage. From the results, it can be seen that the regression coefficient between foreign-funded firms and media coverage is significantly positively correlated at the 1% level, indicating that foreign-funded firms can attract more media coverage, verifying the rationality of this mechanism.

Column (2) uses probit regression analysis（Probit Regression Analysis） to test the relationship between foreign-funded firms and the choice of the Big Four accounting firms. From the results, it can be seen that the regression coefficient between foreign-funded firms and the Big Four accounting firms is significantly positively correlated at the 1% level, indicating that foreign-funded firms are more likely to choose the Big Four accounting firms, verifying the rationality of this mechanism.

Insert Table VII here

6. Endogeneity

The conclusions of this paper may be troubled by endogeneity concern. Four methods will be used to address the endogeneity concern.

6.1 Instrumental variable method and treatment effect model

To address the endogeneity concern caused by omitted variables and reverse causality, the instrumental variable method is used to retest, the results are shown in Table VIII.

The terrain relief (IV1) and the number of people with junior high school education or above (IV2) are used as instrumental variables. The reason for using terrain relief as an instrumental variable is that geographical information variables such as terrain relief have natural exogenous properties. It determines the difficulty of infrastructure construction and social governance in the jurisdiction (Lv et al., 2024), and often determines whether foreign-funded firms establish factories and offices in the area. The reason for using the number of people with junior high school education or above as an instrumental variable is that the investment scale of foreign-funded firms is often closely related to the scale and level of human capital in the host country (Azam and Ahmed, 2015).

Corr (e. FOREIGN, e. INFOR) is significant at the 1% level, indicating that the instrumental variable satisfies exogeneity. Column (1) is the regression result of the instrumental variable method. The regression coefficient of foreign-funded firms and stock price informativeness is significantly positively correlated at the 1% level, indicating that after using instrumental variables to alleviate endogeneity, the positive relationship between foreign-funded firms and stock price informativeness still holds.

To alleviate the endogeneity concern caused by sample self-selection, the treatment effect model is used for retesting, the results are shown in Table VIII.

The treatment effect model still uses terrain relief (IV1) and the number of people with junior high school education or above (IV2) as instrumental variables. Column (2) is the regression result of the treatment effect model. The regression coefficient of foreign-funded firms and stock price informativeness is significantly positively correlated at the 1% level, indicating that after using the treatment effect model to alleviate the sample self-selection problem, the positive relationship between foreign-funded firms and stock price informativeness still holds.

Insert Table VIII here

6.2 Fixed Effects Model and Propensity Score Matching

To address the endogeneity concern caused by factors that do not change over time or factors that change individually, the fixed effect model is used to retest, the results are shown in Table IX.

Column (1) is the regression result of the fixed effect model. The regression coefficient of foreign-funded firms and stock price informativeness is significantly positively correlated at the 1% level, indicating that after using the fixed effect model

to alleviate the endogeneity problem, the positive relationship between foreign-funded firms and stock price informativeness still holds.

To alleviate the endogeneity concern caused by model setting errors, the propensity score matching model is used to retest, the results are shown in Table IX.

Column (2) is the regression result of the propensity score matching model. The regression coefficient of foreign-funded firms and stock price informativeness is significantly positively correlated at the 5% level, indicating that after using the propensity score matching model to alleviate the endogeneity problem, the positive relationship between foreign-funded firms and stock price informativeness still holds.

Insert Table IX here

7. Conclusion

China's capital market has been criticized for issues such as investor protection, regulatory efficiency, and transparency, which often determine the information efficiency of the capital market. Compared with developed capital markets, China's capital market is not efficient. As China's opening-up continues to increase, more and more foreign capital is entering China. So, whether foreign-funded firms can improve the information efficiency of China's capital market is a very worthy question. This paper uses stock price information content as a proxy variable for information efficiency and examines the relationship between foreign-funded firms and stock price information content for the first time.

First, this study finds that in China's capital market, foreign-funded firms have a positive relationship with stock price informativeness, indicating that foreign-funded firms have improved the information efficiency of China's capital market. Second, from the perspective of heterogeneity, this study finds that the positive relationship between foreign-funded firms and stock price informativeness is more significant in samples with higher levels of social responsibility than in samples with lower levels of social responsibility, confirming the moral hypothesis of social responsibility, that is, firm' social responsibility is an important sign that owners sacrifice economic interests for social welfare. Third, from the perspective of heterogeneity, this study found that the positive relationship between foreign-funded firms and stock price informativeness is more significant in samples with a higher level of product market competition than in samples with a lower level of product market competition, which confirms the external governance hypothesis of product market competition, that is, product market

competition can serve as an important external governance mechanism to suppress the opportunistic behavior of insiders. Fourth, this paper also reveals the mechanism by which foreign-funded firms increase the stock price informativeness. Foreign-funded firms increase stock price informativeness by attracting media coverage and choosing the Big Four accounting firms. Finally, after mitigating endogeneity through the instrumental variable method, treatment effect model, fixed effect model, and propensity score matching, the research results of this paper still hold.

Our research conclusions supplement the research on the economic consequences of foreign-funded firms in China's capital market and the research on the factors affecting stock price informativeness. Our research conclusions show that foreign-funded firms not only bring excellent talents, technology, and funds to China's capital market but also have a positive role in improving the transparency of China's capital market, improving market liquidity, and improving information efficiency. At the same time, foreign-funded firms can provide examples for domestic-funded firms in China's capital market, and have an important enlightenment role for Chinese listed firms to learn from the corporate governance model and management methods of foreign-funded firms and standardize their information disclosure. Finally, our research conclusions are instructive for the vast developing countries and regions with underdeveloped capital markets and can serve as a reference for them to think about how to design reasonable investment promotion policies and promote the healthy development of the economy and capital markets.

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Table file

Table 1 Names and definitions of variables

Variable	Symbol	Names and Definition
Dependent variable	INFOR	Stock price informativeness, see above
Independent variable	FOREIGN	Foreign-funded firms, see above
Heterogeneity test variables	CSRSCORE	Social responsibility, see above
	HHI	Product market competition, see above
Control variables	SIZE	Asset size, natural logarithm of total assets
	LEV	Debt-to-asset ratio, total liabilities divided by total assets
	ROA	Return on total assets, total profit divided by total assets
	TOP1	The proportion of shares held by the largest shareholder, the ratio of the number of shares held by the largest shareholder to the total share capital
	INP	The proportion of independent directors, the number of independent directors divided by the total number of board members
	BOARD	Size of the board of directors, taking the natural logarithm of the total number of board members
	DUAL	Whether the Chairman cum General Manager, take 1 if the Chairman cum General Manager, otherwise, take 0
	TOVER	Market trading activity, annual average daily stock turnover rate
	IND	Industry dummy variable
	YEAR	Annual dummy variable

Table 2 Descriptive statistics of the variables

Variable	N	Mean	SD	Min	Max
INFOR	34616	0.7667	1.0905	-1.2556	4.2769
FOREIGN	34616	0.0547	0.2273	0.0000	1.0000
SIZE	34616	22.2204	1.2958	19.8657	26.2494
LEV	34616	0.4223	0.2071	0.0535	0.9073
ROA	34616	0.0432	0.0724	-0.2814	0.2343
TOP1	34616	33.8909	14.8195	8.4100	74.3000
INP	34616	0.3762	0.0531	0.3333	0.5714
BOARD	34616	2.1188	0.1968	1.6094	2.6391
DUAL	34616	0.2971	0.4570	0.0000	1.0000
TOVER	34616	1.7392	1.2590	0.1774	6.3145
CSRSCORE	34616	3.4834	1.8680	0.0000	6.0000
HHI	34616	-0.0885	0.0943	-0.5821	-0.0129
MEDIA	34409	3.4308	0.9364	0.6931	7.7668
BIG4	34616	0.0586	0.2350	0.0000	1.0000

Table 3 Pearson correlation coefficient matrix

	INFOR	FOREIGN	SIZE	LEV	ROA	TOP1	INP	BOARD	DUAL	TOVER
INFOR	1									
FOREIGN	0.0467	1								
	(0.0000)									
SIZE	-0.1701	-0.0444	1							
	(0.0000)	(0.0000)								
LEV	-0.0505	-0.0536	0.5014	1						
	(0.0000)	(0.0000)	(0.0000)							
ROA	-0.0038	0.0433	0.0197	-0.3639	1					
	(0.4815)	(0.0000)	(0.0002)	(0.0000)						
TOP1	-0.0431	0.0571	0.1884	0.0392	0.1585	1				
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)					
INP	0.0285	0.0052	-0.0049	-0.0087	-0.0196	0.0366	1			
	(0.0000)	(0.3319)	(0.3630)	(0.1040)	(0.0003)	(0.0000)				
BOARD	-0.1123	-0.0332	0.2617	0.1425	0.0229	0.0229	-0.5517	1		
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)			
DUAL	0.0782	0.0353	-0.1792	-0.1362	0.0212	-0.0566	0.1190	-0.1863	1	
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0000)		
TOVER	0.13333	-0.0295	-0.2654	0.0096	-0.1689	-0.2759	0.0320	-0.1217	0.0443	1
	(0.0000)	(0.0000)	(0.0000)	(0.0742)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	

Note: P-values are in the parentheses.

Table 4 Regression results for hypothesis 1

VARIABLES	INFOR		
	(1)	(2)	(3)
FOREIGN	0.0986***		
	(0.0289)		
DOMESTIC		-0.0725***	
		(0.0220)	
AH			0.0994**
			(0.0488)
SIZE	-0.1661***	-0.1669***	-0.1711***
	(0.0071)	(0.0071)	(0.0073)
LEV	0.3789***	0.3795***	0.3824***
	(0.0390)	(0.0390)	(0.0391)
ROA	0.5180***	0.5220***	0.5351***
	(0.0877)	(0.0877)	(0.0876)
TOP1	0.0037***	0.0039***	0.0038***
	(0.0004)	(0.0004)	(0.0004)
INP	-0.0316	-0.0393	-0.0585
	(0.1348)	(0.1350)	(0.1350)
BOARD	-0.0860**	-0.0873**	-0.0914**
	(0.0390)	(0.0390)	(0.0391)
DUAL	0.0359***	0.0359***	0.0363***
	(0.0125)	(0.0125)	(0.0125)
TOVER	0.1219***	0.1219***	0.1214***
	(0.0054)	(0.0054)	(0.0054)
CONSTANT	3.4589***	3.5474***	3.5822***
	(0.1804)	(0.1825)	(0.1839)
IND	YES	YES	YES
YEAR	YES	YES	YES
N	34616	34616	34616
R^2	0.3841	0.3841	0.3839

Note: ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are robust standard errors adjusted for White heteroskedasticity.

Table 5 Regression results for hypothesis 2

VARIABLES	INFOR	
	(1)	(2)
FOREIGN	0.1373***	0.0447
	(0.0345)	(0.0431)
SIZE	-0.1519***	-0.1734***
	(0.0087)	(0.0114)
LEV	0.3873***	0.3511***
	(0.0507)	(0.0558)
ROA	0.6702***	0.3718***
	(0.1208)	(0.1204)
TOP1	0.0037***	0.0038***
	(0.0006)	(0.0006)
INP	-0.0680	0.0278
	(0.1634)	(0.2087)

Table 5 Regression results for hypothesis 2

VARIABLES	INFOR	
	(1)	(2)
BOARD	-0.0890*	-0.0789
	(0.0469)	(0.0619)
DUAL	0.0295*	0.0458**
	(0.0162)	(0.0178)
TOVER	0.1185***	0.1261***
	(0.0071)	(0.0079)
CONSTANT	3.0997***	3.6257***
	(0.2232)	(0.2877)
INTER-GROUP DIFFERENCES	-0.093**	
(P-VALUE)	(0.022)	
IND	YES	YES
YEAR	YES	YES
N	19801	14815
R^2	0.3951	0.3745

Note: ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are robust standard errors adjusted for White heteroskedasticity.

Table 6 Regression results for hypothesis 3

VARIABLES	INFOR	
	(1)	(2)
FOREIGN	0.1300***	0.0159
	(0.0357)	(0.0450)
SIZE	-0.1726***	-0.1616***
	(0.0082)	(0.0122)
LEV	0.3223***	0.5160***
	(0.0450)	(0.0703)
ROA	0.4714***	0.7583***
	(0.1011)	(0.1617)
TOP1	0.0034***	0.0042***
	(0.0005)	(0.0008)
INP	-0.0527	0.0440
	(0.1531)	(0.2394)
BOARD	-0.0366	-0.1723**
	(0.0443)	(0.0674)
DUAL	0.0353**	0.0336
	(0.0146)	(0.0227)
TOVER	0.1185***	0.1299***
	(0.0063)	(0.0100)
CONSTANT	3.5691***	3.3425***
	(0.2069)	(0.2967)
INTER-GROUP DIFFERENCES	-0.114***	
(P-VALUE)	(0.007)	
IND	YES	YES
YEAR	YES	YES
N	24695	9921

Table 6 Regression results for hypothesis 3

VARIABLES	INFOR	
	(1)	(2)
R^2	0.3965	0.3692

Note: ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are robust standard errors adjusted for White heteroskedasticity.

Table 7 Mechanism test

VARIABLES	MEDIA	BIG4
	(1)	(2)
FOREIGN	0.1166***	0.7817***
	(0.0237)	(0.1054)
SIZE	0.2555***	0.5242***
	(0.0078)	(0.0339)
LEV	-0.0322	-0.8510***
	(0.0349)	(0.1956)
ROA	0.3022***	0.0419
	(0.0796)	(0.3945)
TOP1	-0.0047***	0.0061***
	(0.0004)	(0.0020)
INP	0.162	0.398
	(0.1270)	(0.6035)
BOARD	-0.0932**	0.0995
	(0.0375)	(0.1893)
DUAL	0.0779***	-0.0550
	(0.0115)	(0.0611)
TOVER	0.1174***	-0.1175***
	(0.0040)	(0.0280)
CONSTANT	-0.8957***	-13.7013***
	(0.1913)	(0.9794)
IND	YES	YES
YEAR	YES	YES
N	34409	34616
R^2/ Pseudo R^2	0.6114	0.2666

Note: ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are robust standard errors adjusted for White heteroskedasticity.

Table 8 Instrumental variables approach and treatment effect model regressions

VARIABLES	INFOR	
FOREIGN	1.4211***	1.6912***
	(0.0355)	(0.5235)
SIZE	-0.1652***	-0.1661***
	(0.0051)	(0.0049)
LEV	0.3766***	0.3808***
	(0.0309)	(0.0304)
ROA	0.5048***	0.5196***
	(0.0762)	(0.0722)
TOP1	0.0037***	0.0037***
	(0.0003)	(0.0003)
INP	-0.0383	-0.0302

Table 8 Instrumental variables approach and treatment effect model regressions

VARIABLES	INFOR	
	(0.1059)	(0.1061)
BOARD	-0.0856***	-0.0836***
	(0.0298)	(0.0303)
DUAL	0.0337***	0.0342***
	(0.0104)	(0.0104)
TOVER	0.1201***	0.1222***
	(0.0047)	(0.0045)
CONSTANT	3.3956***	3.3697***
	(0.1315)	(0.1333)
IND	YES	YES
YEAR	YES	YES
N	34616	34616
Wald chi^2	22110.74	21449.77
(P-value)	0.0000	0.0000
	Two-stage instrumental variables method's instrumental variable coefficient estimates	Two-stage consistent Estimation of Instrumental variable coefficients
IV1	-0.0819***	-0.0898***
	(0.0141)	(0.0159)
IV2	0.0146***	0.0132***
	(0.0043)	(0.0046)
Corr(e.Foreign,e.INFRO)	-0.6904***	
	(0.0174)	

Note: ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are robust standard errors adjusted for White heteroskedasticity.

Table 9 Fixed effects model and propensity score matching model regressions

VARIABLES	INFOR	
FOREIGN	0.0812***	0.0763**
	(0.0289)	(0.0325)
SIZE	-0.1703***	-0.1599***
	(0.0070)	(0.0172)
LEV	0.3211***	0.3720***
	(0.0385)	(0.0995)
ROA	0.6143***	0.6079***
	(0.0822)	(0.2181)
TOP1	0.0044***	0.0040***
	(0.0005)	(0.0010)
INP	-0.0699	0.3120
	(0.1327)	(0.3155)
BOARD	-0.0454	-0.1020
	(0.0386)	(0.0862)
DUAL	0.0251**	0.0370
	(0.0124)	(0.0280)
TOVER	0.1559***	0.1405***
	(0.0053)	(0.0142)
CONSTANT	3.4103***	3.2865***

Table 9 Fixed effects model and propensity score matching model regressions

VARIABLES	INFOR	
	(0.1773)	(0.4259)
IND	YES	YES
YEAR	YES	YES
N	34616	5360
R^2	0.3824	0.3755

Note: ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are robust standard errors adjusted for White heteroskedasticity