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Foreign institutional ownership externalities and supplier innovation

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内容摘要: Many emerging markets allow foreign investment as a way to reform domestic markets. Extant studies have found a positive externality on innovation brought forth by foreign direct investment (FDI); however, we know very little about the externality of another form of foreign investment, ownership by foreign institutional investors (FII), on innovation. In this paper, we document one form of FII externality by showing that foreign institutional ownership of the customer firm results in higher supplier innovation. We also show that the FII externality on supplier innovation is stronger when customers have more influence on the suppliers and when the FIIs can facilitate information flow better. Our findings suggest that the real impact of FII can go beyond the underlying firms, and promoting FII may benefit firms, especially smaller firms in emerging countries that do not directly have foreign ownership.

一、 Introduction

There has been ample evidence suggesting that foreign investment benefits the host countries due to its spillover benefits to local firms' technology and productivity (MacDougall, 1960; Buckley et al., 2002; Meyer and Sinani, 2009). This literature has focused mainly on the foreign direct investment (i.e., FDI, the direct investment made by the foreign enterprise on local firms) externality and consistently find FDI spillovers exist in vertical relationships between the foreign affiliates and the domestic suppliers (Javorcik and Spatareanu, 2011; Havranek and Irsova, 2011). Through competitive pressure and integration effort, the entry of foreign firms often forces local affiliates to upgrade their technologies, resulting in firms spending more effort and resources on innovative activities, which leads to higher innovation output.

Despite the enormous literature on FDI externality, the externality of another major form of cross-border capital flow --investments made by Foreign Institutional Investors (FII)-- is rarely studied. FII externality is the impact of foreign institutional ownership that extends beyond the underlying firm the FII invests in and accrues to local firms for which foreign investors are not directly compensated. While FDI is still a strategic focus of many developing economies, FII has started to attract more attention as more developing countries open their stock markets to foreign investors, and the role FII plays is increasingly important (Chen et al., 2021) ¹. Compared to FDI, FII mainly differs in two aspects: 1) FDI typically have more information about the firms they invest in due to its corporate control positions (Goldstein and Razin, 2006). FII, on the other hand, enters and exits the foreign market through its investment in the secondary market; its domestic presence and information access are much limited due to the lack of direct control (Kingsley and Graham, 2017). As such, compared to FDIs that can benefit the emerging market by bringing advanced technology directly from the developed countries, the benefit of the FII is often less direct, mostly through the disciplinary role the FII plays on the firms that they invest in (Guadalupe et al., 2012; Bena et al., 2017). 2) While FDI is required to comply with many local regulations due to their control positions, FII enters and exits the foreign market a lot easier. Due to its flexibility and liquidity, one often considers FII a less stable foreign investment source and is more prone to destabilize the economy rather than benefit it (e.g., Sarno and Taylor, 1999; Tong and Wei, 2009). Given the differences between those two forms of foreign ownership, a natural question is

whether FII exhibits a similar spillover effect in the vertical relationship with its affiliated domestic suppliers. For example, suppose FII promotes its underlying firm's innovation activities and increases its suppliers' incentive to innovate by exposing them to updated technology. In that case, one will expect a positive spillover effect. Alternatively, suppose FIIs have a short-term investment horizon and are only willing to make the minimum effort. In that case, one should expect the limited influence of the FIIs and no spillover benefits of FIIs beyond the underlying firms. Taken together, the existence of FII externalities becomes an empirical question.

In this paper, we examine the impact of FIIs on supplier innovation in China. We focus on innovation output because innovation is often considered the main driving force of a firm's long-term growth (Solow, 1957; Porter, 1992; Gu et al., 2017). The Chinese government has recently paid increasing attention to promoting innovation in China and has singled out innovation as the key to future economic development in its most recent Five Year Plan. The Chinese market is a great setting for examining FII externality because access to foreign institutional investors is extremely limited for many Chinese firms: First, even though China has opened the domestic stock market to Qualified Foreign Institutional Investors (QFIIs), the Chinese government still imposes substantial barriers to foreign investment. Due to these government restrictions on capital control and exchanges, foreign institutional ownership is still not prevalent in many Chinese firms.

Moreover, similar to many other developing markets, the Chinese market exhibits significant uncertainties for the FIIs due to challenges such as political risks and information asymmetries. To mitigate their risks, FIIs mostly buy securities of large and listed companies (Inderst, 2022), and only a small fraction of big firms attracts the attention of FIIs in China (Huang and Zhu, 2015; Wang, 2014). Under such circumstance, understanding the spillover effect of FIIs become extremely important because many firms, especially those without direct access to the FIIs, may benefit from reduced innovation costs if externalities exist. Hence, whether FII externalities exist in China, one of the largest emerging economies is a question of practical importance.

Using a sample of 1,762 suppliers from 2009 to 2018 in China, we explore the FII externality on supplier innovation by examining how the foreign institutional ownership of the customer firm impacts supplier innovation. Because the customer firm is the underlying firm that the FII invests in, the FII externality only exists when

a spillover effect extends beyond the customer firm to the suppliers. In our paper, we first document that foreign institutional ownership of customers is positively associated with the innovation outputs of suppliers. This finding is robust with different innovation specifications, and when we apply a difference-in-difference setting using the Shanghai/Shenzhen HongKong Stock Connect program as an exogenous shock to the foreign institutional ownership. Our primary finding shows that similar to FDI, FII spillovers exist along the vertical relationship, and local suppliers benefit from the FII-induced innovation spillovers.

We further show that the extent of FII externalities differs with supplier-customer relationships and FII characteristics. FII externality occurs when the influence of FIIs can extend along the supply chain; as such, one should expect the externalities to be stronger when customers have more influence on the suppliers and when the FIIs can facilitate innovative activities better. Our results show that customer FII is more likely to influence supplier innovation when the customer has a long relationship with the supplier and when the supplier belongs to the durable goods industry. We also find that our results are stronger when the foreign ownership is independent FII, comes from a common law legal origin, or a more innovative country. Those results support the idea that FII externalities are stronger when foreign investors can better facilitate customer innovation and innovation transfer.

Our study contributes to the existing literature in several ways. First, our paper is related to the literature that shows foreign investment has a positive spillover effect on the domestic economy (MacDougall, 1960; Buckley et al., 2002). While it is widely acknowledged that foreign investments are both in the form of direct investment and institutional ownership, only the FDI externalities have been the attention of the literature, probably due to their controlling positions and long involvement with the underlying firms. Our paper documents that positive FII externalities can promote supplier innovation. We show that the real impact of foreign institutional ownership can extend along the supply chain. This finding is of practical importance because our finding suggests that firms that do not directly benefit from foreign institutions can still obtain an indirect boost in innovation.

Second, we add to the literature on the determinants of innovation. A large amount of literature has explored how to promote innovation from various theoretical and empirical perspectives, such as venture capital backing and ownership structures (Tian and Wang, 2014; Chemmanur et al., 2014), corporate governance (Ferreira et al.,

2014), compensation schemes (Manso, 2011), and product market competition (Thakor and Lo, 2016; Bloom et al., 2013). More recent literature has started to recognize the important role of stakeholders in innovation. They emphasize that stakeholders often offer valuable human knowledge and social capital in increasing innovation output and success (Smith and Lohrke, 2008; Leonidou et al., 2020). The role played by stakeholders is often more important in countries outside of the U.S. due to reduced shareholder engagement and increased government intervention. For example, some recent papers in China have found that employee protection (Tong et al., 2018), customer concentration (Pan et al., 2020), and stakeholder relationship capability (Jiang et al., 2020) can impact innovation. Our study enriches the literature on the determinants of innovation in Chinese enterprises from the supply chain perspective. Our findings that customer FII can positively impact innovation along the supply chain can be relevant for startups and small firms in China that are resource constrained.

The remainder of this paper is organized as follows. Section 2 discusses related literature and introduces our hypotheses. Section 3 presents our sample description, variable definitions, and descriptive statistics. Section 4 reports our empirical analysis and addresses endogeneity issues, and Section 5 conducts several additional tests. Section 6 concludes the paper.

2. Literature Review and Hypothesis Development

The role of foreign institutional investors has been long documented in the literature. Foreign institutional investors are sometimes referred to as fair-weather friends² and are sometimes blamed for causing the market crash³. Existing literature has found mixed results concerning the effect of allowing foreign investors to invest in the domestic market on stock market liquidity (Bekaert and Harvey, 1997; Kim and Singal, 2000; Bekaert and Harvey, 2000) and investment or growth (Henry, 2007; Bekaert et al., 2005; Bonfiglioli, 2008). Meanwhile, foreign institutional investors are also touted for improving firm innovation (Luong et al., 2017) and price efficiency (Kacperczyk et al., 2021). While all these studies focus on the direct effect of FIIs, whether externalities exist for FIIs remains unclear. When studying the FII's impact on voluntary disclosure, Tsang et al. (2019) suggest that "the presence of FIIs may generate positive externalities for a firm's other stakeholders, such as lenders, customers, and suppliers." This paper aims to study the FII externalities by focusing on one

particular stakeholder - the suppliers. We also focus on one important type of corporate activity - firm innovation because of its essential role in a corporation's long-term growth (Solow, 1957; Porter, 1992).

How can FIIs of the customer firm influence the suppliers? The first plausible channel of FII externality is knowledge spillover between the customers and the suppliers. Knowledge spillovers have always been an important mechanism to advance technological development (Griliches, 1998). Most spillover papers focus on spillovers across the geographical region or within the same industry (Jaffe et al., 1993; Hall et al., 2010) because technological innovations

often result from information sharing across similar proximity. However, in the recent literature, studies have highlighted another form of the economic link- the supplier-customer relationship - that is important for innovation. For example, Chu et al. (2019) document that supplier- customer geographic proximity increases supplier innovation. Li (2018) shows that positive innovation outputs of customer firms increase supplier profitability. Dasgupta et al. (2021) show higher innovation activities when there are closer social ties between the customer and supplier's board members and managers. These studies suggest that the interactions between customers and suppliers may allow a better flow of information and knowledge transfer; as such, suppliers can benefit from customers' innovative ideas.

Prior studies also show that foreign institutional investors increase customer firms' innovation activities. FIIs are relatively more independent from the management of the domestic investee firms (Davis and Kim, 2007), have relatively fewer conflicts of interest inside the investee country (Ferreira and Matos, 2008), and have more monitoring expertise (Gillan and Starks, 2003). Their portfolios are also more diversified through global holdings. Hence, Bena et al. (2017) suggest that foreign institutions promote riskier, innovative activities by reducing management shirking; simultaneously, they can tolerate higher risks associated with innovative activities because of their diversified international portfolios. Luong et al. (2017) also find higher innovative activities when more foreign institutional investors are present. Taken together, one potential channel of the FII externality is the spillover effect of the FII's impact from the customer firm to the supplier.

Another plausible channel of the FII externality is an improved information environment along the supply chain. Existing papers show that a firm's innovation is

often affected by various internal and external factors, such as ownership, product market competition, and other cultural and institutional factors (Aghion et al., 2013; Bloom et al., 2013; Fang et al., 2017; Luong et al., 2017). Interestingly, most of the obstacles to innovation are because of information transparency rather than scientific and technological in nature (e.g., Acharya et al., 2009; Brown et al., 2013; Hsu et al., 2014; Chang et al., 2018; Carayannis et al., 2015). Due to the risky nature of innovations, innovation decisions are often influenced by the information environment faced by the firm (Feldman, 1999; Audretsch and Feldman, 2004). Suppliers are more likely to engage in long-term technological innovations when the information uncertainties they face are lower.

Moreover, if successful, at least some innovations are specific to the supplier-customer relationship and may not have alternative uses with or without costly adjustments. Thus, suppliers invest less in innovation when the supply chain information environment is poor (i.e., customer opportunism is uncontained). Put differently, given the heavy dependence of the supplier on the customer along the supply chain, problems generated by information asymmetry may be one of the significant non-technological, non-scientific reasons which adversely affect the innovation decisions made by outsider suppliers (Chen et al., 2018)⁴. A better flow of overall information from customers (public and private, formal and informal), in turn, induces more innovation on the part of suppliers.

FIIIs can significantly influence the firms' information environment (Tsang et al., 2019). To guarantee optimal portfolio selection and effective corporate governance, FIIIs are incentivized to monitor customers' information disclosure and improve information transparency. FIIIs lack close business ties with local firms and are more independent than domestic shareholders. At the same time, because FIIIs are less familiar with local firms, industries, and economic conditions, they have fewer social connections to obtain and verify the information. As such, they may have a strong incentive to urge firms to provide more voluntary disclosure through formal channels and improve the information environment.

Consequently, FIIIs will mitigate the information asymmetry of customers. A more transparent information environment generated by the customer for its supplier will mitigate the information asymmetry along the supply chain (Chen et al., 2018; Radhakrishnan et al., 2014; Patatoukas, 2012; Ozer et al., 2011; Cachon and Lariviere, 2001). Specifically, Radhakrishnan et al. (2014) indicate that greater

numerical transparency by a customer results in better operating performance of its supplier; Chen et al. (2018) find that greater textual transparency by a customer brings about better investment quality of its supplier. These findings suggest that customer information transparency can significantly influence the supplier's operating and investment decisions. The relationship between foreign institutional investors, improved environment, and the importance of better information for supplier innovation results in higher suppliers' innovation outputs.

In sum, to the extent that foreign institutional ownership in customers improves customers' transparency and knowledge spillover, we conjecture that it will induce a material improvement along the supply chain, with one important consequence being more supplier innovation. We have the following hypothesis:

H1: Foreign institutional ownership in a customer firm yields a positive externality on its supplier innovation.

3. Sample Description, Variable Definitions, and Empirical Models

3.1. Sample Description

Our sample comes from China Stock Market & Accounting Research (CSMAR) and covers firm years from 2009 to 2018. China Securities Regulatory Commission (CSRC) adopted new financial accounting standards in 2007 whereby firms must disclose the identities of the top five customers ranked by their total sales. A revised version of financial accounting standards in 2011 further strengthened this requirement⁵. We require the customer and its supplier to be listed to obtain firm-level financial information. We follow the method adopted in Fee and Thomas (2004) and Fee, Hadlock, and Thomas (2006) and match the disclosed customer names or their abbreviations with those of all listed firms in CSMAR. The matching process produced 3,116 supplier-customer-year pairs after dropping pairs in which the supplier or the reported customer is in the financial and utility firms⁶. Our sample is reduced to 2,287 unique supplier-years and 2,778 supplier-customer-years pairs. After including firm-level patent, financial, and ownership data, our final sample consists of 2,128 supplier-customer-year pairs over 10 years from 2009 to 2018, representing 1,762 unique supplier-years with at least one identified customer and 783 unique suppliers.

3.2. Variables

3.2.1. Innovation

Our study focuses on the outputs of the suppliers' innovation activities. Following previous literature, we use patent data to construct the output measures of firm-level innovation. Despite limitations, registered patents remain standard and important measures of innovation outputs (e.g., Jaffe and Lerner, 2004; Cohen et al., 2016). Our patent data are obtained from the Chinese State Intellectual Property Office (CSIPO). Generally speaking, the patent application procedures in China are similar to those of the U.S. and Europe. CSIPO grants three types of patent: invention patent (Type 1, similar to US utility patent granted for a new technological solution to a product or process), utility model patent (Type 2, function-specific but less innovative than Type 1), and design patent (Type 3, related to designs of new shape, color, pattern or their combination that are aesthetically pleasing and industrially applicable). Following Tan et al. (2015) and Chu et al. (2019), we use the natural logarithms of one plus the number of invention patent applications filed with CSIPO in each firm-year to measure firm innovation outputs denoting it as *InvApply*. We also use the natural logarithms of one plus the sum of invention patents and utility patents applications (*IuApply*) and the total number of invention, utility, and design patent applications (*TotalApply*) to ensure the robustness of our measure. We winsorize all variables at the 99th percentile due to the right skewness of the distribution of patent applications.

3.2.2. Foreign Institutional Ownership

Because of capital control, the convertibility of the Chinese currency (RMB) is restricted, and foreign investors cannot freely invest in firms listed in China's stock markets except for large and highly reputable institutional investors who can do so through the Qualified Foreign Institutional Investors (QFII) program. A Qualified Foreign Institutional Investor is a foreign institutional investor listed on the Qualified Foreign Institutional Investors List published by CSRC⁷. The QFII quota has expanded yearly from the initial \$4 billion in investments and was

eventually canceled in 2019. By 2022, CSRC has approved about 740 foreign institutional investors, which signals that the QFII program has an increasing impact on Chinese capital market liberalization.

We obtain information on listed firms' top 10 shareholders' names and their equity ownership percentages from CSMAR. Following the literature (Aggarwal et al., 2011; Luong et al., 2017), we obtain foreign ownership information to construct relevant ownership variables as follows. We identify a firm's top 10 largest shareholders in our sample by manually searching their background information through annual reports, public press, or official websites.⁸ We construct two ownership variables for a customer firm: *DumFrg* and *FrgShr*. *DumFrg* is a dummy variable that equals 1 (and zero otherwise) if a customer firm has at least one QFII shareholder among its top 10 largest shareholders. The second variable, *FrgShr*, is a continuous variable that captures the percentage of QFII ownership.

Finally, because one supplier can have multiple customers, we use two methods to calculate customer FII for each supplier in a given year: 1) *CDumFrg* is a dummy variable that equals 1 if at least one customer firm has *DumFrg* equals 1, and 2) because the supplier's innovation will likely be driven by its major customers rather than only one specific customer, we also calculate a measure called *CFrgShr*, which is the sales weighted-average of QFII ownership of the supplier's customers (Chen et al., 2018)⁹.

3.3. Descriptive Statistics

Table 1 reports the distribution of countries or regions of FIIs. Our sample has 19 unique countries or regions from 2009 to 2018. Column (1) reports the number of customers with FIIs from each country or region. Overall, we have 462 unique customers invested by FIIs. Column (2) reports each country's or region's sample size as a percentage of the total sample size (462). Hong Kong accounts for about 40% of the total sample¹⁰, followed by the United States (12.77%), the United Kingdom (9.74%), Switzerland (8.01%), and France (7.79%). Column (3) reports the foreign institutional ownership *FrgShr* in percentages. We show that the average foreign institutional ownership is 1.85%. This number is similar to Huang and Zhu (2015), that also reports that the average FII is 1% in China, and they show that despite this small percentage of ownership, foreign institutional ownership still plays a governance role and is effective in limiting expropriation by controlling shareholders as well as their agents in China.

In Panel A of Table 2, we provide descriptive statistics of suppliers and their corresponding sales-weighted customers. The mean (median) number of major customers for a supplier (*NUMCUST*) is 1.449 (1) in our sample, and the mean (median)

number of major suppliers for a customer (*NUMSUPP*) is 2.795 (2). This difference between customers' and suppliers' major partners suggests that a supplier is in a weaker and more reliant position in the Chinese supply chain than its customer. The mean of *CDumFrg* is 0.259, indicating that 25.9% of the suppliers in our sample have customers with foreign institutional investors. The mean of *CFrgShr* is 0.397%, with the maximum value at 5.87%.

Panel B of Table 2 provides the Pearson correlation statistics of the key variables used in our baseline model. We note that *CDumFrg* is significantly and positively correlated with variable *CFrgShr*, as is expected. Second, *CDumFrg* or *CFrgShr* is significantly and positively correlated with *InvApply*, suggesting that FIIs of customers are more likely to promote suppliers' innovation in the univariate setting.

4. Empirical Analysis

This section tests various regression models to analyze whether and how customer FII influences supplier innovation.

4.1. Baseline Model Specification and Empirical Results

4.1.1. Baseline Model Specification

Following Chu et al. (2019) and Luong et al. (2017), we investigate our main hypothesis using the following model:

$$\begin{aligned}
 SINVT_{i,t+1} = & a_1 + F_1X_{i,t} + F_2SQFII_{i,t} + F_3SMB_{i,t} + F_4SHHI_{i,t} + F_5CRD_{i,t} + \\
 & F_6CLEV_{i,t} + F_7CSIZE_{i,t} + F_8CROA_{i,t} + F_9CAGE_{i,t} + F_{10} \\
 & CMB_{i,t} + F_{11}SSGRT_{i,t} + F_{12}SCSHLD_{i,t} + F_{13}SSIZE_{i,t} + \\
 & F_{14}SPPE_{i,t} + F_{15}SCAPEX_{i,t} + YEAR + FIRM + e_{i,t}
 \end{aligned}
 \tag{1}$$

where we let $X_{i,t} = CDumFrg_{i,t}$ or $CFrgShr_{i,t}$, representing customer foreign institutional ownership in year t . In this model, the dependent variable *SINVT* is the proxy for supplier innovation in year $t+1$, measured by *InvApply*, *IuApply*, or *TotalApply*. The one-year lag accounts for the fact that the effect of customers' foreign institutional ownership on supplier innovation is unlikely to be instantaneous.

Following existing papers on innovation and supply chain, we control the

characteristics of suppliers and customers that may affect our empirical results in the model (1). Following Chu et al. (2019) and Luong et al. (2017), we control for suppliers' characteristics by including the market-book ratio (*SMB*), the growth ability (*SSGRT*), the level of cash holding (*SCSHLD*), firm size (*SSIZE*), asset tangibility (*SPPE*), capital expenditures (*SCAPEX*), the industry concentration (the Herfindahl index, *SHHI*), and a dummy variable that measures whether suppliers are invested by FIIs (*SQFII*). In addition, we also control for the customers' characteristics, such as the investments in intangible assets (*CRD*), leverage (*CLEV*), firm size (*CSIZE*), profitability (*CROA*), firm age (*CAGE*), and market-book ratio (*CMB*). As previously noted, the customer characteristics are calculated using a sales-weighted average of the supplier's customers. We include firm¹¹ and year-fixed effects in our models. We winsorize all continuous variables at the 1st and 99th percentiles to eliminate the effects of outliers. Appendix A provides detailed variable definitions. We use the prefix "S-/C-" to indicate suppliers' or customer characteristics variables in the model for convenience and readability.

After controlling for suppliers' and customers' characteristics, our baseline hypothesis is supported if the coefficient F_1 is positive and statistically significant, suggesting that customers' foreign institutional ownership is positively associated with suppliers' innovation.

4.1.2. Baseline Results

Table 3 provides regression results based on model (1) using *InvApply*, *IuApply*, and *TotalApply* to measure supplier innovation in year $t+1$ and *CDumFrg* (or *CFrgShr*) to measure customers' foreign institutional ownership in year t . As shown in columns (1) to (3) of Table 3, the coefficients of *CDumFrg* (0.188, 0.158, and 0.145) are positive and significant. It suggests that having customers with foreign institutional ownership is associated with an 0.188 (0.158 and 0.145) increase in suppliers' patents compared to suppliers without FIIs among their customers. Moreover, the regression results in columns (4) to (6) also suggest that higher levels of foreign institutional ownership are associated with higher levels of supplier innovation. In terms of economic significance, a coefficient estimate of 0.077 (0.066 and 0.061) in model (1) suggests that an increase in foreign institutional ownership ratio from the 25th percentile to the 75th percentile of its distribution is associated with a 16.5% (14.1% and 13.1%) increase in the suppliers' innovation in the following year. These findings support our first hypothesis that FIIs in

customers are positively associated with supplier innovation output.

The coefficients for other control variables are also consistent with findings in the extant literature. First, the coefficients for variables *SQFII*, *CAGE*, and *SSIZE* are significantly positive. Supplier innovation is higher if suppliers are also invested by FIIs, if suppliers are larger, and if customers have a longer relationship with suppliers. Second, all columns in Table 3 show that the variable *CRD* is significantly positive, suggesting that the customer's R&D expenses are positively and significantly associated with supplier innovation activities.

4.2. Endogeneity & the SSHSC Policy Shock

Our evidence supports a positive relationship between customers' foreign institutional ownership and supplier innovation. However, many suppliers engage customers in innovation (e.g., Prahalad and Ramaswamy, 2013). Hence, the endogeneity problem may arise if more innovative suppliers self-select more innovative customers with more foreign institutional investors.

We address the endogeneity concern using a DiD approach utilizing the SSHSC Policy. SSHSC stands for the Shanghai (Shenzhen)-Hong Kong Connect program and aims to open the domestic Chinese equity market to foreign investors. The Chinese premier Keqiang Li announced the program on April 10, 2014, as the "first of a new round" of liberalizations. Following the announcement on November 17, 2014, the Shanghai-Hong Kong Connect program was initiated, allowing foreign investors to invest in a list of 568 stocks on the Shanghai Stock Exchange. On December 5, 2016, the Shenzhen-Hong Kong Connect program was introduced, allowing foreign investors to invest in 881 stocks on the Shenzhen Stock Exchange. The stock list of the Shanghai-Hong Kong Connect program includes constituent stocks in the Shanghai Stock Exchange (SSE) 180 Index and SSE 380 index and SSE-listed A-shares with corresponding H-shares listed in Hong Kong; and is chosen based on a combination of market capital, turnover, industry characteristics, sales growth, and return on assets. The stock list of the Shenzhen-Hong Kong Connect program includes constituent stocks in the Shenzhen Stock Exchange Component Index and Shenzhen Stock Exchange Small/Mid Capital Innovation Index and Shenzhen-listed A-shares with corresponding H-shares listed in Hong Kong, whose market value is beyond 6 billion RMB. Overall, the list of investible stocks constitutes more than half of the total stocks listed on the Shanghai stock exchange and more than 40% of the stocks listed on the

Shenzhen stock exchange.

SSHSC effectively opened the domestic Chinese equity market to foreign investors. Before SSHSC, FIIs could invest in Chinese companies by acquiring QFII licenses. However, the QFII program is quite restricted with a quota limit. Only selected FIIs with many years of experience and a large amount of assets under management can trade under the program. The SSHSC program offers much greater freedom for FIIs by allowing foreign investors to invest in listed firms directly through a centralized platform set up by the Shanghai (Shenzhen) Stock Exchange and the Hong Kong Stock Exchange. This policy also has no minimum requirement on the years of operation and assets under management, which opens the Chinese market to many smaller-scale foreign institutional investors.

The adoption of the SSHSC program provides a quasi-natural experiment to our study because the implementation of the SSHSC program allows an exogenous entry of foreign investors to trade shares of SSHSC stocks. Because the motivation of the SSHSC program is to open the domestic Chinese equity market to foreign investors, the policy is unlikely to influence a firm's innovation output directly. Under the policy, foreign investors can only trade the list of stocks on the SSHSC program. The program does not impact the stocks not on the SSHSC list. Furthermore, the adoption of the SSHSC program is not anticipated ex-ante. According to the assistant director of the Stock Exchange's Capital Markets Institute: "the list of eligible firms and size of the liberalization was a surprise. Even our team that oversaw the facilitation of SSHSC was notified of the regulation details on the day of Premier Li's speech (May 15, 2017)".

Because there are two event years (i.e., 2014 for the Shanghai-Hongkong Connect Program and 2016 for the Shenzhen-Hongkong Connect Program), we adopt the multi-period Difference in Difference (DiD) analysis, following Bertrand and Mullainathan (2003). One key advantage of a multiperiod DiD model is that by having multiple shocks, the model removes potential omitted variables corresponding to a single shock that may coincide with changes in innovation output. Our regression model is as follows:

$$\begin{aligned} \text{SINVT}_{i,t+1} = & F_0 + F_1 \text{C_SSHSC_POST}_{i,t} + F_2 \text{SQFII}_{i,t} + F_3 \text{SMB}_{i,t} + F_4 \text{SHHI}_{i,t} + \\ & F_5 \text{CRD}_{i,t} + F_6 \text{CLEV}_{i,t} + F_7 \text{CSIZE}_{i,t} + F_8 \text{CROA}_{i,t} + F_9 \text{CAGE}_{i,t} + \end{aligned}$$

$$F_{10} \text{CMB}_{i,t} + F_{11} \text{SSGRT}_{i,t} + F_{12} \text{SCHSLD}_{i,t} + F_{13} \text{SSIZE}_{i,t} + \\ F_{14} \text{SPPE}_{i,t} + F_{15} \text{SCAPEX}_{i,t} + \text{YEAR} + \text{FIRM} + e_{i,t}$$

(2)

Where C_SSHSC_POST is a dummy variable that equals 1 if the customer belongs to the Shanghai- or Shenzhen-Hongkong Stock Connect program after the implementation of the SSHSC in year t ; otherwise, C_SSHSC_POST equals 0. All other variables are defined in the Appendix, and standard errors are clustered at the firm level. F_1 captures the within-firm differences between supplier innovations before and after the SSHSC program. A positive F_1 means that supplier innovation increases significantly afterward for suppliers with customers belonging to the SSHSC program.

One concern of utilizing the SSHSC program as an identification strategy is that the selection process of the SSHSC stock list is not random. According to the filtering criterion of the SSHSC program, factors such as the firm size, industry characteristics, and ROA can determine whether to include a stock in the SSHSC program. As such, the supply chain relationship between an SSHSC customer-supplier and a non-SSHSC customer-supplier might be different. To deal with the issue, we use the propensity score matching method to match each supplier that has at least one SSHSC customer (treatment group) with a supplier that does not have an SSHSC customer (control group) to ensure the fundamentals of the two groups are similar in year $t-1$. To ensure that we can observe the customer firm characteristics before the SSHSC, we require that an SSHSC customer stays with the same supplier for at least two consecutive years before the event. We estimate the propensity score using a logit model that regresses a treatment dummy ($IF_TREATMENT$) that equals one if the supplier has at least one customer belonging to the SSHSC program in year t , on a list of supplier and customer characteristics¹². Our specific regression model is as follows:

$$IF_TREATMENT_{i,t} \\ = F_0 + F_1 \text{SQFII}_{i,t-1} + F_2 \text{SMB}_{i,t-1} + F_3 \text{SHHI}_{i,t-1} + F_4 \text{CRD}_{i,t-1} \\ + F_5 \text{CLEV}_{i,t-1} + F_6 \text{CSIZE}_{i,t-1} + F_7 \text{CROA}_{i,t-1} + F_8 \text{CAGE}_{i,t-1} +$$

$$\begin{aligned}
& F_9 \text{CMB}_{i,t-1} + F_{10} \text{SSGRT}_{i,t-1} + F_{11} \text{SCHSLD}_{i,t-1} + F_{12} \text{SSIZE}_{i,t-1} \\
& + F_{13} \text{SPPE}_{i,t-1} + F_{14} \text{SCAPEX}_{i,t-1} + \text{YEAR} + \text{INDUSTRY} + e_{i,t}
\end{aligned}
\tag{3}$$

The logit model results are reported in Table 4 Panel A. We then use the predicted propensity scores from the logit regression and identify the nearest supplier-customer relationship without an SSHSC customer but with similar firm characteristics. We ended up with 133 matched treatment-control pairs¹³ (266 observations).

To check the validity of the DiD estimate, we implement a balance test to ensure all covariates are well balanced. Panel B of Table 4 shows that none of the observed differences between the treatment and control groups is statistically significant. This suggests that the distribution of the covariates between the two groups is reasonably balanced. The matching pair indeed has similar characteristics for both the supplier and the customer. Our results are less likely to be biased by the fundamental differences between the supplier-SSHSC customer pair and the supplier-non SSHSC customer pair.

Table 4 Panel C reports the DiD test results with the PSM matched sample. The DiD results in Panel C show that C_SSHSC_POST are significantly positive in both the univariate regressions (columns 1, 4 & 7) and when the controls are included (columns 2, 5 & 8). This suggests that the exogenous entry of foreign institutional investors in customer firms that belongs to the SSHSC list significantly increases the innovation output of its suppliers and is consistent with our main hypothesis.

Parallel trend assumption states that in the absence of the SSHSC program, there should be a similar pre-event trend between the treatment and the control. To ensure that the parallel trend assumption holds in our DiD test, in Columns 3, 6 & 9 of Table 4 Panel C, we re-run our regressions by including three pre-event dummies C_SSHSC_3 , C_SSHSC_2 , and C_SSHSC_1 . C_SSHSC_3 , C_SSHSC_2 , and C_SSHSC_1 are dummy variables equal to 1 for 3-, 2-, or 1- year before the customer firm is included in the Shanghai- or Shenzhen- Hongkong Stock Connect program. We show C_SSHSC_3 , C_SSHSC_2 , and C_SSHSC_1 are all insignificant in parallel trend tests. The insignificance of the pre-treatment trend suggests that the significant increase in differences only happens after the event occurs.

In addition to the PSM method, we follow Yoon (2021) to implement the Entropy Balancing Matching (EBM) strategy to ensure the robustness of our results. Compared to the PSM method, EBM does not require a propensity score and directly aims to balance the moments of covariates between the treatment and the control group by constructing a set of matching weights (Hainmueller, 2012). Hence, EBM is often used when the treatment and control groups are unbalanced, which is ideal for our setting. In Table 5 Panel A, we use the variables in our baseline regression as the matching variables (Ferri et al. 2018) and show that the covariates match post matching. In Panel B, we report the DiD results based on the EBM matching method, and *C_SSHSC_POST* remains significantly positive in all regressions.

Lastly, one possible concern is that there could still be unobservable omitted variables exist between the treatment and control, and matching based on existing covariates cannot control for those unobservable differences. As such, our final strategy is to conduct a placebo test using the fictional adoption of the SSHSC program to make sure that the inherent differences between the treatment and control groups do not drive our results. Specifically, we follow Chen et al. (2021) to create a frictional inclusion of the customer firm into the SSHSC program THREE YEARS before the actual inclusion and rerun the DiD test based on this frictional event year. If the fundamental, unobservable differences between the treatment and control groups drive our results, the results should still be there when we use a fictional SSHSC year. We define a dummy variable, *C_FICSSHSC_POST*, that equals 1 for customers that belong to the frictional SSHSC program and 0 otherwise. In Table 6, we show that *C_FICSSHSC_POST* is insignificant in almost all regressions (except for one place, it is significant but of the wrong sign). This suggests that the unobservable differences between the treatment and control groups do not drive our results.

5. Additional Tests

In this section of the paper, we conduct additional tests to examine the conditions under which the FII externality is stronger and ensure the robustness of our results.

5.1. Cross-Sectional Differences

This section explores how FII externality can vary with supplier-customer

relations and FII characteristics.

5.1.1. Supplier-Customer Relationship

Because customer FIIs likely influence supplier innovation through the knowledge spillovers of the customer firm, one should expect the FII externality to be stronger when

customers have more influence on the suppliers. We capture customer influence using the length of the supplier-customer relationship and define *CLongDur* equals 1 if the length of the supplier and customer relationship (in years) is greater than the sample mean, and 0 otherwise. We use model (4) below and report the results in Table 7.

$$\begin{aligned}
 \text{SINVT}_{i,t+1} = & F_0 + F_1 X_{i,t} + F_2 \text{CLongDuT}_{i,t} + F_3 X_{i,t} \times \text{CLongDuT}_{i,t} + \\
 & F_4 \text{SQFII}_{i,t} + F_5 \text{SMB}_{i,t} + F_6 \text{SHHI}_{i,t} + F_7 \text{CRD}_{i,t} + F_8 \text{CLEV}_{i,t} + \\
 & F_9 \text{CSIZE}_{i,t} + F_{10} \text{CROA}_{i,t} + F_{11} \text{CAGE}_{i,t} + F_{12} \text{CMB}_{i,t} + \\
 & F_{13} \text{SSGRT}_{i,t} + F_{14} \text{SCHSLD}_{i,t} + F_{15} \text{SSIZE}_{i,t} + F_{16} \text{SPPE}_{i,t} + \\
 & F_{17} \text{SCAPEX}_{i,t} + \text{YEAR} + \text{FIRM} + c_{i,t}
 \end{aligned}
 \tag{4}$$

where $X_{i,t} = \text{CDumFrg}_{i,t}$ or $\text{CFrgShr}_{i,t}$, representing customer foreign institutional ownership in year t . Table 7 Column 1-6 show positive and significant interaction terms between FII and the length of the supplier-customer relationship, which suggest that a longer and more stable relationship between supplier and customer is more beneficial for FIIs to promote suppliers' innovation.

We also use an alternative measure to capture the customer's influence on suppliers. According to Banerjee et al. (2008), a supplier depends on the customer more if the supplier belongs to the durable goods industry. Such a supplier needs to invest more relationship-specific assets to maintain the transaction relationship. Hence, we expect FIIs to promote suppliers' innovation more when suppliers belong to the durable goods sectors. We use model (5) to test this hypothesis:

$$\begin{aligned}
 \text{SINVT}_{i,t+1} = & F_0 + F_1 X_{i,t} + F_2 \text{SDurGoods}_{i,t} + F_3 X_{i,t} \times \text{SDurGoods}_{i,t} + \\
 & F_4 \text{SQFII}_{i,t} + F_5 \text{SMB}_{i,t} + F_6 \text{SHHI}_{i,t} + F_7 \text{CRD}_{i,t} + F_8 \text{CLEV}_{i,t} +
 \end{aligned}$$

$$\begin{aligned}
& F_9 \text{CSIZE}_{i,t} + F_{10} \text{CROA}_{i,t} + F_{11} \text{CAGE}_{i,t} + F_{12} \text{CMB}_{i,t} + \\
& F_{13} \text{SSGRT}_{i,t} + F_{14} \text{SCHSLD}_{i,t} + F_{15} \text{SSIZE}_{i,t} + F_{16} \text{SPPE}_{i,t} + \\
& F_{17} \text{SCAPEX}_{i,t} + \text{YEAR} + \text{FIRM} + e_{i,t}
\end{aligned}
\tag{5}$$

where *SDurGoods* is a dummy variable that measures whether the supplier belongs to the durable goods industries. Variable $X_{i,t}$ denotes *CDumFrg_{i,t}* or *CFrgShr_{i,t}*. We show in Table 7, columns 7- 12 that the interaction term is positive and significant. That is, FIIs of customers promote supplier innovation more if the suppliers belong to the durable goods sector when customers have more bargaining power over suppliers.

5.1.2. FII characteristics

The degree of FII externality may also vary by FII characteristics. If FII externalities occur through the knowledge spillover and the improved information environment faced by the supplier, we expect our results to be stronger for FIIs that facilitate innovation and information flow better.

First, we partition FIIs into gray and independent foreign institutions because the latter group facilitates information flow better. Independent foreign institutions are mutual fund managers and investment advisors, whereas gray foreign institutions are bank trusts, insurance companies, pension funds, and endowments. Chen et al. (2007) hold that independent foreign institutions are more inclined to gather information and get actively involved in the corporate decisions of firms where they invest, which then improves the information environment better; while gray foreign institutions are more likely to hold shares without intervening in firms'

business. Hence, we first separate foreign institutional ownership into 2 types: ownership by independent foreign institutions or gray foreign institutions. Following Luong et al.(2017), we then calculate the percentage of shares held by customers' FIIs from independent foreign institutions (*CIndShr*) and gray foreign institutions (*CGrayShr*) and add *CIndShr* and *CGrayShr* to model (1). As Table 8 Columns 1-3 show, the coefficients of *CIndShr* are all significantly positive, whereas the variable *CGrayShr* are all insignificant. The empirical results imply that the positive effect of FIIs on firm innovation is mostly driven by independent foreign institutions.

We also examine whether FII externality varies by the FIIs' legal origin. La Porta et al.(1998) suggest that common law countries have stronger investor protection than civil law countries. Aggarwal et al. (2011) and Bena et al. (2017) partition foreign institutional ownership into common foreign institutional ownership and civil foreign institutional ownership and find that FIIs from common law countries exert a more significant impact on invested firms. Hence, we expect FIIs from common law countries to have a stronger monitoring role on the customer firms, improving the information environment and customer innovation. We divide FIIs in our sample into two types based on the legal origin of the foreign institution's home country: common foreign institutional ownership and civil foreign institutional ownership. We then calculate the total percentage of shares held by FIIs from common law countries (*CCmnShr*) or civil law countries (*CCivilShr*) and test if *CCmnShr* is significantly positive by including *CCmnShr* and *CCivilShr* in the model (1). The empirical results in Columns 4-6 in Table 8 suggest that only *CCmnShr* is a positive and significant predictor of supplier innovation.

Lastly, we expect FIIs from more innovative countries to promote supplier innovation more. FIIs from countries with more and better innovative practices may act as catalysts for domestic suppliers to improve quality or time efficiency by demanding higher standards. At the same time, foreign institutional ownership may facilitate vertical spillovers between suppliers and customers more through its knowledge transfer to domestic firms. We use *PatGdp* to measure the level of innovation of each country of FIIs' origin in our sample. *PatGdp* equals the number of patents of each country divided by its GDP each year. If the *PatGdp* of one country is higher than the median of our sample, we define this country as high-innovation. We then calculate the percentage of shares held by customers' FIIs from high-innovation countries (*CHinnShr*) or low-innovation countries (*CLinnShr*) and test if *CHinnShr* is significantly positive in the model (1). As columns 7-9 in Table 8 show, the coefficients of *CHinnShr* are positive and significant in two of the three regressions, suggesting that FIIs from more innovative countries promote supplier innovation better.

5.2 Channels

We further explore how customer FII might influence supplier innovation by

considering two mechanisms through which FIIs impact supplier innovations. First, the FII externality may result from the spillover effects of the FII-induced better customer innovations. Prior papers show that foreign investors exert a disciplinary role, foster long-term investment in tangible and intangible human capital, and lead to innovation output (Bena et al., 2017). Such positive innovation outputs of customer firms can increase supplier innovation and profitability due to the supplier's knowledge of the customer's innovative activities (Li, 2018; Hsu et al., 2021). As such, the suppliers indirectly benefit from the foreign institutional ownership in their customer firm. Second, the FII externality may also arise due to the improved information environment faced by suppliers. Since foreign institutional ownership improves corporate disclosures (Tsang et al., 2019), it will allow better feedback from customers to suppliers. Manso (2011) shows timely and accurate feedback is crucial to supplier innovation. Chu et al.(2019) also find that suppliers innovate more when they can easily obtain and verify customer information. Hence, suppliers may benefit from the FII through an improved customer information environment. In the internet appendix ¹⁴, we find some supporting evidence that the spillover effect from customer innovation and the information effect from improved disclosure jointly result in the FII externalities.

5.3. Robustness

We conduct a series of additional tests to ensure the robustness of our results.

One concern about the documented customer FII-supplier innovation relationship is that the variation in the independent variable, *CDumFrg*, and *CFrgShr*, can be driven by both the changes of foreign institutional ownership in the customer firms and the changes in the supplier-customer relationship. In the latter case, the confounding effect from the supply chain disruption may result in a change in the supplier innovation output. To ensure that our results are not entirely driven by the supplier-customer relationship changes, we construct a subsample of suppliers with no major customer changes during the sample period. In Table 9 Panel A, we show that foreign institutional ownership of the customer firms still has a positive and significant coefficient in this restricted sample. This indicates that our results are not entirely

driven by the confounding effect, and changes in the foreign institutional holding of the customer firms matter¹⁵.

We also ensure the robustness of our results by using alternative measures for our dependent variable. Because innovation takes time, in Table 9 Panel B, columns 1 and 2, we use the natural logarithm of the number of patent applications in year $t+2$ (and in untabulated tests year $t+3$, as well as for *IuApply* and *TotalApply*) to ensure robustness. Similar to our main results, we find a positive relation between FIIs of customers and supplier innovation. We also use the number of patent applications filed and eventually granted by the patenting office as an alternative proxy for the supplier's innovation (Chu et al., 2019). In columns 3 and 4, we report our empirical results using the patent granted as the dependent variable. Our main results remain qualitatively similar to those shown earlier. Lastly, we use the total number of citations of the supplier's patents (*STACITE*) as an alternative innovation indicator. This additional variable allows us to understand the role of customer FII on the quality of the patent filed. We show that having a customer with significant foreign institutional ownership increases the number of patents and quality. The average citation number is significantly higher when customer FII exists.

Conclusion

In this paper, we study the FII externality along the supply chain. We find that FII ownership of customers is positively and significantly associated with the suppliers' innovation

outputs. To mitigate endogeneity concerns, we conduct a DiD analysis that takes advantage of the exogenous shock to foreign institutional ownership generated by the quasi-natural experiment, the Shanghai (or Shenzhen)-Hongkong Stock Connect Policy. Our findings suggest that the role of FII might be greater than previously perceived. Its positive impact on innovation might also produce positive externalities along the supply chain.

Innovation is critical to a firm's survival and future growth. Many micro and macro factors would affect corporate innovation. Extant literature has shown how FIIs might promote innovation in an economy, and we argue that this effect does not reside merely in firms receiving FII investments. Suppliers of firms with high FII investment also obtain indirect benefits and experience a higher level of innovation. Our study is also important in showing that despite the relatively smaller investment sizes of the foreign institutional investors compared to the foreign direct investments, the FII externality exists and can go beyond the firms in which it invests. Policymakers,

financial analysts, and various stakeholders should also consider such spillover effects when evaluating the impact of FII in the market.

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