

# Exploring the Relationship between Foreign Ownership, Innovation and Firm Value: A Korean Perspective\*

JKT 25(7)

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Received 22 July 2021  
Revised 5 November 2021  
Accepted 9 November 2021

## Abstract

**Purpose** – This paper’s purpose is to investigate how foreign ownership and innovation affect firm value.

**Design/methodology** – Firm innovation is defined as operational efficiency, which is calculated by adopting data envelopment analysis (DEA). Additionally, R&D intensity is included as a measure of innovation in the analysis. We used firm-level data from manufacturing companies in Korea. The sample comprised 3,753 firm-year observations for every year in the period 2003–2017.

**Findings** – We found that foreign ownership and innovation are positively related to firm value (Tobin’s Q). Foreign ownership moderates innovation’s contribution to firm value, implying that foreign ownership may enhance the value relevance of firm innovation. In addition, we found that firm innovation partially mediates the relationship between foreign ownership and firm value.

**Originality/value** – This highlights the important role of foreign investors’ monitoring; wherein foreign investors enhance firm value by facilitating firm innovation. Our results suggest that foreign ownership can be crucial for innovation and may serve to address weak ownership structures.

**Keywords:** Data Envelopment Analysis, DEA, Foreign Ownership, Firm Value, Innovation, Operational Efficiency

**JEL Classifications:** D24, G34, M21, O30

## 1. Introduction

Firm innovation is essential to maintaining sustainable growth and establishing competitive advantages (Chen et al., 2014). Korea provides a suitable research setting in which to investigate the determinants of firm innovation. According to the 2017 Global Innovation Index (GII), Korea was ranked 11th among the 49 high-income economies and 2nd among the 17 economies in East Asia, Southeast Asia and Oceania. However, the GII stated that Korea had produced fewer innovation outputs, such as new knowledge creation and intellectual assets, relative to its level of investment in innovation. Innovation is an

\* This paper was supported by Konkuk University in 2018.

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unpredictable process and managers tend to underinvest in innovation-related activities (Tian and Wang, 2014). As researchers and practitioners increasingly acknowledge the importance of firm innovation, the need to understand how innovation improves firm performance has become critical.

Korea ranked 12th in the World Bank's gross domestic product (GDP) country ranking in 2017. In the same year, the Korean manufacturing industry generated about 30% of the country's GDP. However, since the 1997 Asian financial crisis, manufacturing firms in Korea have followed a similar trend to what other Asian countries have experienced. Subsequently, the manufacturing industry began losing its global competitiveness, which is likely to continue declining due to problems such as low productivity and high costs. Thus, the Korean government endeavoured to attract foreign investments, fully opening its financial markets to foreign investment in 1998.

Corporate ownership structure may affect management's resource-allocation decisions as well as incentives to invest in firm innovation (Aghion et al., 2009). There has been increasing literature focusing on the relationship between corporate ownership characteristics and innovation. As determinants of R&D investments that are one of the most used proxies for measuring innovation, earlier studies examined the following: individual chief executive officer (CEO) characteristics, ownership concentration, top management team and board outsider compositions, management compensation structure, the identity of ownership types, multiple shareholder-oriented governance practices, the ownership stake of CEO, institutional stock ownership, etc. (Barker and Mueller, 2002; Chi, Liao and Yang, 2019; Coles, Daniel and Naveen, 2006; Kor, 2006; Lee and O'Neill, 2003; Lhuillery, 2011; Loukil, Yousfi and Cheikh, 2020; Minetti, Murro and Paiella, 2015; Munari, Oriani and Sobrero, 2010). The results of these studies are mixed and controversial. For instance, while shareholder-oriented governance practice is better for R&D investment (Lhuillery, 2011), high levels of governance have negative effects on R&D (Driver and Guedes, 2012). Based on this literature, we explored the role of foreign investors and revisited the competing hypotheses regarding corporate governance and innovation. Specifically, we investigated the effect of foreign ownership on innovation and firm value in the Korean manufacturing sector.

Innovation is generated by a combination of human resources and capital inputs as well as an active learning process. We defined innovation as operational efficiency from a production perspective and measured it utilising data envelopment analysis (DEA). DEA evaluates a firm's performance compared to the best performance of its peers. In this study, we employed DEA to determine the relative innovation performance of the sample firms. We presumed that relatively higher innovation performance would increase firm value. Our results showed that foreign ownership has a significant positive relationship with innovation and firm value (Tobin's Q), supporting the view that ownership structure by foreign investors enhances innovation and firm value. Furthermore, foreign ownership moderates the positive link between innovation and firm value. Moreover, we found that firm innovation partially mediates the effect of foreign ownership on firm value. These results support the role of firm innovation as a mediator in the relationship between corporate ownership and firm value and provide insights into the potential mechanisms underlying this relationship.

Prior studies presented evidence that strong ownership structures lead to higher firm value (e.g., Cui and Mak 2002; Hu and Izumida 2008; Koji, Adhikary and Tram, 2020; Yuan, Xiao and Zou, 2008); however, there is little evidence regarding the specific channels through which ownership structure affects firm value. Additionally, firm innovation may play a mediating role in foreign ownership's contribution to firm value. From an empirical standpoint, this study contributes to literature by integrating innovation into the link between ownership structure and firm value.

This study makes several contributions to existing literature. First, this paper analysed the economic effects of foreign ownership. Consistent with the existing evidence, we showed that foreign ownership positively affects both innovation and firm value. Second, we demonstrated the critical role of foreign investors' monitoring in Korea, wherein foreign investors enhance firm value by promoting firm innovation. Third, the results suggest that foreign ownership is an integral part of firm innovation and may address the lack of good ownership structures. Fourth, our study has implications for the economic development of the countries where firms have more concentrated ownership structures.

The rest of this study is organised as follows: Section 2 briefly presents foreign investors in the Korean stock market and develops the research hypotheses. Section 3 details the research design and model specifications. Section 4 provides the sample data and empirical results. Section 5 concludes the paper with a summary and discussion of our results.

## 2. Literature Review and Hypotheses

### 2.1. Korean Stock Market and Foreign Investors in the Manufacturing Industry

Korean stock market, i.e., the Korea Exchange (KRX), consists of three divisions: the Korea Composite Stock Price Index (KOSPI), the Korea Securities Dealers Automated Quotations (KOSDAQ) and the Korea New Exchange (KONEX) markets. The KOSPI market has been the main board of the Korean stock market since its opening in 1956. As of the end of 2017, a total of 774 companies, including global companies such as Samsung, LG, Hyundai, and SK, were listed on the KOSPI. The KOSDAQ market was launched in 1996 to fund start-ups as well as small- and medium-sized enterprises (SMEs) in high-tech areas such as information technology, biotechnology and cultural technology. This market has 1,266 SMEs listed on it as of 2017. The KONEX market was established in 2013 exclusively for early-stage SMEs and venture start-ups. It has about 150 listed SMEs in 2017. The KOSDAQ and KONEX markets serve as listing platforms for SMEs and companies listed on the KONEX may move to the KOSDAQ or KOSPI when they become mature SMEs or blue-chip corporations.

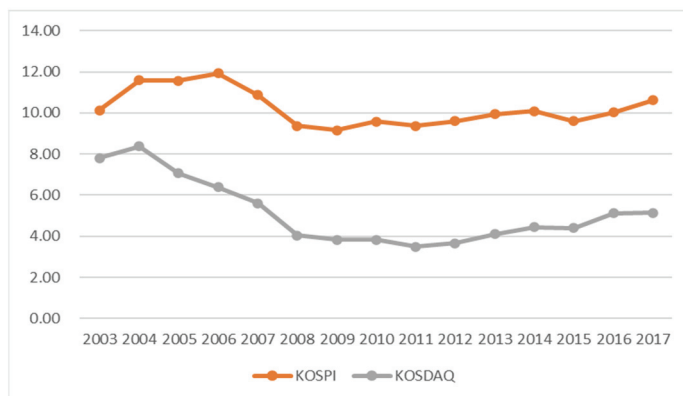
Korea was one of the countries hit hard by the Asian financial crisis. The crisis began with the devaluation of the Thai baht in 1997 and rapidly spread to Malaysia, Indonesia, the Philippines, Korea, and other countries far from Asia. The Korean government requested a bailout from the International Monetary Fund (IMF), which mandated the implementation of various financial restructuring measures to tackle the structural weakness of the Korean economy and restore foreign investors' confidence. The most important reform measure was the complete opening of the stock market to foreign investment. Before the crisis, individual foreigners were not permitted to own more than 7% of the shares of a Korean company and the collective share portion of foreign investors was limited to 26%. In May 1998, Korea repealed all ceilings on foreign investors' shareholdings, even permitting hostile takeovers, which was beyond the IMF's requirements. Consequently, the Korean stock market became one of the most open markets for foreign investment in the world (Kalinowski and Cho, 2009).

Fig. 1 depicts the percentage of equity held by foreign investors in Korean manufacturing firms from 2003 to 2017. In the KOSPI market, foreign ownership reached its highest at 11.94% in 2009, and in the KOSDAQ, it reached its highest at 8.37% in 2004. On average, the percentage of foreign equity holdings in the KOSPI and KOSDAQ markets were 10.24% and 5.16%, respectively. The difference in foreign ownership between the two stock markets

remained steady at around 5% after 2006.

Prior studies revealed that companies listed on the KOSDAQ and KONEX tend to manipulate their earnings more actively than KOSPI-listed companies (Kim Moontae and Ma Seung-Su, 2016; Yoon Soon-Suk, 2005). Manufacturing firms and service firms differ in their innovation processes because the ways by which firms in these two sectors formalise the development of their new offerings are different (Ettlie, 2011). Therefore, we use a sample of manufacturing firms listed on the KOSPI market and test our hypothesis.

**Fig. 1.** The Trend of Foreign Ownership in the Korean Manufacturing Industry



## 2.2. Literature Review and Hypothesis Development

This study aimed to investigate how foreign ownership affects innovation, firm value and the value relevance of innovation. The separation of ownership and control may result in agency costs, which may increase significantly due to conflicts of interest between firm owners and managers (Jensen and Meckling, 1976). The relationship between ownership structure and firm value is based on the optimal balance that exists between the ‘convergence of interests’ and ‘entrenchment’ hypotheses. A related strand of literature viewed corporate ownership structure as a major determinant of firm value. The ownership structure here includes large shareholders’ ownership, managerial ownership and institutional ownership, etc.

Morck, Shleifer and Vishny (1988) measured firm performance using Tobin’s Q for 371 Fortune 500 companies in 1980 and found support for the ‘convergence of interests’ hypothesis in the 0-10% range of management’s equity holdings. This hypothesis suggests that, as managerial ownership increases, agency costs should fall, and firm performance should improve. Furthermore, they found evidence for the ‘entrenchment’ hypothesis, which predicts lower performance levels for firms with very large management holdings. In other words, firm performance declines when managers are protected against market discipline and pursue their personal objectives instead of firm value maximisation. McConnell and Servaes (1990) observed a significant non-linear relationship between Tobin’s Q and managerial ownership for a sample of firms listed on U.S. stock exchanges in 1976 and 1986, respectively. They found that the curve sloped upward until managerial ownership reached approximately 40-50% and then sloped downward. From the analysis of manufacturing firms listed on the Tokyo Stock Exchange from 1980 through 2005, Hu and Izumida (2008) reported that

ownership concentration has a significant effect on current and subsequent corporate performance, and a U-shaped relation to performance, which is consistent with the expropriation and monitoring effects of large shareholders. Using data from 563 Chinese listed companies.

The empirical findings in previous literature on whether foreign ownership improves firm performance are quite consistent. Ferreira and Matos (2008) used comprehensive stockholding data, including ordinary shares, preferred shares and depositary receipts, from 27 countries and found that the higher the ownership of foreign investors and institutional investors, the better the firm valuation and operating performance. They provided evidence of the effective direct or indirect monitoring by foreign investors who have fewer potential business relationships with investee companies. Mishra (2014) found that foreign ownership had a direct and significant impact on the value of Australian companies during the sample period from 2001 to 2009. This finding indicates the effectiveness of corporate management's monitoring role, consistent with the agency theory. Rashid (2020) collected data from 2015–2017 annual reports of listed companies in Bangladesh, a developing economy, and demonstrated that foreign ownership is significantly positively related to firm performance, measured using Tobin's Q. Additionally, he found that board independence and size partially mediate the effect of foreign ownership on Tobin's Q. Based on the evidence provided in the literature, we posited that foreign equity holdings may enhance firm value in the context of the Korean manufacturing industry.

*H1: Foreign ownership is positively related to firm value.*

Foreign investors have features that differ from those of domestic investors. Specifically, foreign investors operate independent of local management and possess expertise in the monitoring of firms (Gillan and Starks, 2003). Luong et al. (2017) suggested there are three channels through which foreign investors promote firm innovation: monitoring, insurance, and knowledge spillovers. If a market is unable to fully observe the actions of managers, moral hazard could induce managers not to invest in risky and costly innovative investments. Foreign investors could act as corporate monitors to reduce the moral hazard problem and actively intervene in capital allocation decisions. The existence of this monitoring channel is further supported by Aggarwal et al. (2011), who analysed portfolio holdings of foreign institutions in firms from 23 countries during the period 2003–2008 and found that foreign investors more actively monitor the companies they have invested in around the world. From an insurance channel perspective, foreign investors tend to have portfolios that are more diversified internationally than their domestic peers and may thus be able to withstand the failure risk associated with investing in R&D activities. Consequently, foreign investors are more likely to encourage managers to invest in innovative activities. Knowledge spillover denotes the transference of knowledge or ideas among organizations (e.g., from foreign firms to local ones) without any contract or compensation (Meyer, 2004; Chang and Xu, 2008). Foreign investors can facilitate knowledge spillover across firms through business networks, which could help investee companies achieve the success of innovative activities. Therefore, we hypothesised that foreign ownership may promote firm innovation activities.

*H1-1: Foreign ownership is positively related to firm innovation.*

It is an axiomatic fact that a firm's innovation is indicative of its long-term economic growth. According to Jovanovic's (1982), firm growth is regarded as a learning process, wherein firms identify their true efficiency levels in the industry, adjust their size accordingly

and expand to larger-scale firms with more efficiency. This learning theory explains why younger and smaller firms grow faster than large firms. Building on Jovanovic's (1982) findings, Pakes and Ericson (1998) developed an active learning model, wherein a firm can be more efficient by idiosyncratic (firm-specific) investments in innovation. Therefore, firm innovation may lead to firm growth and subsequently, increase firm performance. This is one of the reasons why we defined firm innovation as its level of operational efficiency. After conducting a meta-analysis of 62 studies over a period of 20 years, Rousseau et al. (2016) confirmed a strong relationship between innovation and firm value. Thus, we formulated the following hypothesis regarding the relationship between innovation and firm value in Korean manufacturing firms.

*H1-2: Firm innovation is positively related to firm value.*

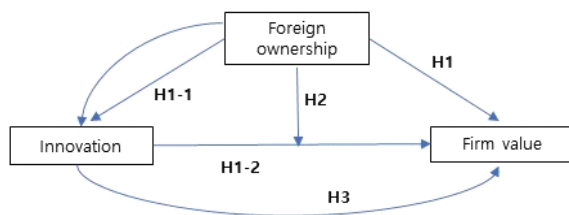
As discussed above, prior research has addressed the relationships between foreign investors and firm value, foreign ownership and firm innovation, and innovation and firm value, separately. The preceding hypotheses simultaneously link these relationships among foreign ownership, innovation and firm value. Foreign ownership implicitly affects firm value by promoting innovation. In other words, ownership structure facilitates managers' propensity to innovate, which subsequently enhances firm value. Following this line of reasoning, we posited that foreign ownership moderates the value relevance of innovation, and innovation plays a mediating role in the relationship between foreign ownership and firm value. Therefore, this study formed the following hypotheses:

*H2: Foreign ownership moderates the relationship between innovation and firm value.*

*H3: Firm innovation mediates the relationship between foreign ownership and firm value.*

The proposed research model is illustrated in Fig. 2. First, by testing H1, 1-2 and 2, we confirmed the results of prior research regarding the impact of foreign ownership and innovation on firm value and obtained empirical evidence for the moderating role of foreign ownership in the value relevance of innovation. Second, we tested H1-1 and 3, examining the mediating effect of innovation on the relationship between foreign ownership and firm value.

**Fig. 2.** Research Model and Hypothesis



### 3. Research Design

#### 3.1. Measurement of Innovation

Previous studies typically measured innovation as R&D intensity, i.e., the ratio of total R&D expenditures to total sales revenues, and the number of patent applications (e.g., Ahuja and

Lampert, 2001; Driver and Guedes, 2012; Munari, Oriani and Sobrero, 2010) to measure firms' innovation performance. While R&D expenditure is used as an input variable for innovation and may drive innovation, it may not in itself be a good proxy for innovation. The innovation process can be divided into four steps: [Step 1] inputs to R&D, [Step 2] throughputs, [Step 3] output and [Step 4] outcomes (Chaney and Deviney, 1992). R&D expenditure forms part of [Step 1] and is inherently risky as it creates greater uncertainty of the outcomes. Moreover, Lee and Stone (1994) stated that R&D expenditure merely represents the activities that lead to innovation but not the realisation of innovation. Furthermore, the number of patent applications is typically used to capture the output of innovation. However, Feldman and Lemley (2015) found that very few patent licensing demands lead to innovation. Patents are not the only way to promote innovation nor are they necessary for innovation to occur in most cases.

Schumpeter (1942) suggested that innovation involves the introduction of efficient production methods, the transition to highly productive organisations, the acquisition of new resources, the invention or development of new products, and the creation of new markets. Drucker (2015) defined innovation as changing the yield of resources in supply terms or changing customer value attained from resources in demand terms. Horngren, Datar and Rajan (2012) defined innovation as the performance that creates value by supplying products through more efficient and improved production technologies or processes. Guadalupe, Kuzmina and Thomas (2012) defined innovation as the evolution of productivity distribution and stated that foreign investors tend to acquire the most productive firms within an industry.

Most firms innovate through R&D, which involves activities, such as developing new technologies and improving manufacturing processes, that ultimately lead to increased operational efficiency. Accordingly, we defined innovation as 'operational efficiency' based on Drucker's (2015) definition of innovation in supply terms. The innovation-productivity link has been scrutinised since the pioneering studies of Griliches (1958) and Mansfield (1965). Previous literature has reached the general conclusion that company's productivity has a strong positive relationship with its innovation (Griliches and Mairesse, 1984). In this study, operational efficiency is viewed as a function of product and/or process improvements. Moreover, this definition is consistent with the Step 4 outcomes of innovation, as described by Chaney and Deviney (1992).

We introduced two measures of innovation: R&D intensity, largely used in prior research, and operational efficiency, calculated using DEA. DEA uses actual input and output data to identify the efficient frontier and estimates a firm's relative efficiency by measuring the distance function between the frontier and the firm. Chen, Podolski and Veeraraghavan (2015) argued that DEA is appropriate to assess the relative performance of a firm's innovative activities. The DEA model has two orientations: input orientation and output orientation. The output-oriented model is used to determine a firm's ability to increase outputs while maintaining its current input levels (Cooper, Seiford and Tone, 2007). Our sample comprised manufacturing firms that typically try to increase their total sales utilising their current resource levels. Thus, we chose the output-oriented DEA model for our study.

The first DEA model was presented in Charnes, Cooper and Rhodes (1978), which assumed that an increase in input levels leads to an equivalent increase in output levels, i.e., constant returns-to-scale (CCR model). Let us consider firms that produce multiple outputs using multiple inputs. For firm  $j=1, \dots, J$ , if  $x_j$  is the vector of  $I$  inputs and  $y_j$  is the vector of  $R$  outputs, and there is an  $I \times J$  input matrix,  $X$ , and an  $R \times J$  output matrix,  $Y$ , for the firms, then the CCR-efficiency of each firm is the reciprocal of the inefficiency measure  $\Phi$ , which can be calculated using the following linear programme:



$$\begin{aligned} \Phi_j &= \text{Max } \Phi \\ \text{subject to } x_o &\geq X\lambda, \Phi y_o \leq Y\lambda, \lambda \geq 0 \end{aligned} \quad (1)$$

In Equation (1),  $x_o$  and  $y_o$  are the input and output vectors of a firm to be evaluated, respectively.  $X$  and  $Y$  are multiplied by the same real number  $\lambda$  ( $\geq 0$ ) to form a production possibility set (PPS). A firm with  $\lambda > 1$  indicates that it is on the boundary of the PPS, which is an efficient frontier. The inequality of the constraint signifies that even if a firm increases its outputs, it should still belong to the PPS. When outputs are maximised, the ratio of the increased output levels to the original output levels is measured as the firm's inefficiency ( $\Phi_j$ ). We will take the reciprocal of  $\Phi_j$  ( $0 < 1/\Phi_j \leq 1$ );  $1/\Phi_j = 1$  indicates a fully efficient firm on the frontier, and  $1/\Phi_j < 1$  indicates an inefficient firm. Equation (1) calculates the CCR-efficiency, which combines technical efficiency and scale effect into a single value. Hence, the CCR score is also known as the *aggregate* technical efficiency. Banker, Charnes and Cooper (1984) constructed the variable returns-to-scale DEA model by adding  $\lambda I=1$  to the constraints of Equation (1). The BCC-efficiency score is known as *pure* technical efficiency because it considers the scale effect (BCC model). If a firm is fully efficient in terms of both the CCR- and BCC- efficiency, i.e., the efficiency score is one for both, the firm operates at the most productive scale. If a firm has full BCC-efficiency but a low CCR-efficiency score, then the firm's operation is *pure* technically efficient, but not efficient for the scale of the firm (Cooper, Seiford and Tone, 2007).

To apply the DEA model, we determined the input and output variables. Based on Banker, Chang and Cunningham (2003), this study measured the output of each firm in terms of the revenue obtained from selling goods to customers. To consider both the resources consumed in operating activities and the capital stock used in operations, we chose three input variables: (1) cost of goods sold (COGS), (2) other operating costs (OPEX) and (3) operating assets including net property, plant and equipment (NPPE). The CCR and BCC scores were logarithmically transformed following the work of Banker and Natarajan (2008), who developed a theoretical framework to evaluate the contextual variables that affect the DEA efficiency score.

### 3.2. Firm Value

Our primary valuation measure was a firm's Tobin's Q, defined as the ratio of an asset's market value to its replacement cost. Since it is difficult to evaluate the replacement cost of a firm's assets, prior studies in finance literature calculated this ratio by comparing the market value of equity and liabilities with their corresponding book values (Ravid and Sekerci, 2020). If a firm's Tobin's Q is greater than one, it indicates that the market value reflects the firm's unrecorded assets such as goodwill, technology, innovation and other intangible assets. This study uses Tobin's Q as a proxy for firm value because we were interested in the effects of innovation on firm value in the long-term. Specifically, we calculated Tobin's Q for each manufacturing firm as shown in Equation (2).

$$\begin{aligned} \text{Tobin's Q} &= (\text{Market value of common stocks and preferred stocks} \\ &+ \text{Book value of liabilities}) / \text{Book value of assets} \end{aligned} \quad (2)$$

where assets = equity + liabilities



### 3.3. Foreign Ownership

Corporate ownership is one of the most important factors that affect firm valuation. The ownership structure comes in various forms, such as family-owned firms, institutional investor-owned firms, or limited partnerships (Pierce and Snyder, 2020). We focused on the ownership structure of firms invested by foreigners. Following the literature regarding foreign investors, we considered foreign ownership at the end of the fiscal year (Luong et al., 2017). Foreign ownership (FOREIGN) refers to the sum of shares held by individual or institutional investors domiciled in countries other than Korea, expressed as a percentage of a company's total shares outstanding.

### 3.4. Control Variables

This paper employed a regression equation with several control variables that were plausibly related to the differences in value across firms. Based on literature on innovation, we selected return on assets (ROA), firm size (SIZE), leverage (LEV) and operating cash flows (OCF) as control variables at the firm level (Chi et al., 2019). Big audit firms (Big4) tend to provide higher quality audits than non-Big4 firms because the former has stronger incentives and monitoring that enhance the quality of their audits (Che, Hope and Langli, 2020). During the sample period, the Big 4 audit firms were Samil-PwC, EY-Hanyoung, Deloitte-Anjin, and Samjong-KPMG in the Korean audit market. We measured the research variables using financial data audited by Big4 or non-Big4 firms. The relationship between the dependent and independent variables may have been affected by whether the companies' financial statements were audited by the Big4 or not. Thus, BIG4 was included in our regression model as a control variable and measured as a dummy variable that equals one if the audit firm is one of the Big4. We also included year dummies in the regression to control for any time-series trends. Table 1 presents the variable definitions and measurements.

**Table 1.** Variable Definitions

Variable		Definitions
Firm value	Tobin's Q	= (Market value of common stocks and preferred stocks + Book value of liabilities)/ Book value of assets
Foreign ownership	FOREIGN	= Sum of shares held by foreign investors/ Total number of shares outstanding
Innovation (INNOV)	CCR	= Natural logarithm of CCR score
	BCC	= Natural logarithm of BCC score
	R&D	= R&D expenditures/ Sales
Controls	ROA	= Earnings before income tax/ Total assets
	SIZE	= Natural logarithm of total assets
	LEV	= Total liabilities/ Total assets
	OCF	= Operating cash flows/ Total assets
	BIG4	= Dummy variable that equals 1 if the external auditor is one of the Big4 firms, and 0, otherwise

### 3.5. Research Model

This study utilised a regression model to examine the relationship between foreign investors, operational efficiency and firm value. We employed an ordinary least squares (OLS) model and included 14-year dummies (Greene, 2000).

$$\begin{aligned} \text{Tobin's } Q = & \alpha_0 + \alpha_1 \text{FOREIGN} + \alpha_2 \text{INNOV} + \alpha_3 \text{FOREIGN} \cdot \text{INNOV} \\ & + \sum_{n=4}^8 \alpha_n \text{Controls} + \text{Year} + \varepsilon \end{aligned} \quad (3)$$

where FOREIGN = foreign ownership; INNOV = the natural logarithm of the CCR and BCC scores or R&D intensity; Controls = control variables including ROA, SIZE, LEV, OCF and BIG4; Year = dummies to capture the influence of time-series trends. For simplicity, the subscripts *i* and *t* referring to firm and year were omitted. Since Equation (3) includes a product term, we used mean-centred variables to alleviate a possible multicollinearity problem (Iacobucci et al., 2016).

In Equation (3), the CCR- and BCC-efficiencies measured the realisation of firms' innovative activities; thus, there was no need to consider time-lag effects. Many empirical studies have examined the time-lag effects between R&D expenditures and their realisations (e.g., Cameron, Proudman and Redding, 2005; Loch and Tapper, 2002). However, models with time-lag variables may face the following problems (Gujarati and Porter, 2009): First, they require a priori information regarding the maximum length of time-lag. Second, estimating the regression equation by adding time-lag variables results in the loss of degrees of freedom and hence, a deterioration in the stability of statistical inference. Third, since time-lag variables tend to be highly correlated, they are likely to cause multicollinearity problems. Hall, Griliches and Hausman (1986) observed that the contribution of historical R&D activities to the current year's patent application was quite small, about 5%. Hence, we did not include any time-lag variables in our research model to focus on the economic effects of firm innovation from a short-term perspective.

The coefficient of FOREIGN (or INNOV) captures the effect of foreign ownership (or innovation) on Tobin's *Q*. If foreign ownership (or innovation) caused an increase in firm value, the estimate of  $\alpha_1$  (or  $\alpha_2$ ) would be significantly positive. Equation (3) included an interaction term, FOREIGN\*INNOV, to test the conditional effect of foreign ownership on the value relevance of innovation. If the  $\alpha_3$  estimate was significantly positive, the effect of innovation on firm value would become higher as foreign ownership increased.

To explore whether foreign ownership affects firm value through the channels of innovation, i.e., whether innovation has a mediating effect, we employed the causal steps approach of Baron and Kenny (1986), which requires meeting four statistical conditions by applying four regression models.

$$\begin{aligned} [1] \text{ Tobin's } Q &= i_1 + c \cdot \text{FOREIGN} + \sum_{n=2}^6 \lambda_n \cdot \text{Controls} + \text{Year} + e_1 \\ [2] \text{ INNOV} &= i_2 + a \cdot \text{FOREIGN} + \sum_{n=2}^6 \lambda_n \cdot \text{Controls} + \text{Year} + e_2 \\ [3] \text{ Tobin's } Q &= i_3 + b \cdot \text{INNOV} + \sum_{n=2}^6 \lambda_n \cdot \text{Controls} + \text{Year} + e_3 \\ [4] \text{ Tobin's } Q &= i_4 + c \cdot \text{FOREIGN} + b \cdot \text{INNOV} + \sum_{n=3}^7 \lambda_n \cdot \text{Controls} + \text{Year} + e_4 \end{aligned} \quad (4)$$

In Equation (4), the first model tests whether foreign ownership significantly predicts firm value. The second model tests whether foreign ownership significantly predicts innovation, which is the mediator in this study. In the third model, innovation must significantly predict the majority of variance in the dependent variable, i.e., firm value. In the final model, the

relationship between foreign ownership and firm value requires controlling for innovation. When the mediator variable innovation is added to the final model, the estimate of  $c'$  is not statistically significant, while that of  $b'$  is significant in the case of full mediation. If there is partial mediation, the estimated  $c'$  and  $b'$  are all significant and  $c'$  is estimated to be less than the  $c$  used as a parameter in the first model (Mount, Iliès and Johnson, 2006). We evaluated the magnitude of innovation's mediating effect by multiplying the estimated  $a$  and  $b'$  and determining the statistical significance of  $a*b'$  using the Sobel test (Sobel, 1982). The Sobel test statistic, z-value, was calculated using the following formula.

$$z\text{-value} = \frac{\mu\nu}{\sqrt{\mu^2 SE_\nu^2 + \nu^2 SE_\mu^2}}, \quad \text{where } \mu=a, \nu=b', \text{ SE: standard error.} \quad (5)$$

## 4. Data and Empirical Results

### 4.1. The Sample

Our data were obtained from the KISVALUE database of NICE Information Service Co., Ltd. in Korea. This database provides not only financial but also non-financial information for companies listed on the KRX. As mentioned in Section 1.1, this study used the data for companies listed on the KOSPI market every year during the period 2003–2017.

Table 2 describes the sample selection procedure. The initial sample comprised all the firms in the manufacturing sector. We excluded companies whose fiscal closing date was not the end of December to ensure the homogeneity of the sample. To mitigate survivorship bias, we retained firms that were de-listed during the analysis period in the sample. R&D expenditures include both R&D expenses reported in the income statement and capitalised as intangible assets in the balance sheet. Moreover, missing R&D information does not necessarily mean that firms are not involved in innovation activities (Koh and Reeb, 2015). Accordingly, we did not drop firms with no R&D expenditures from the sample. After excluding unqualified data, our final sample comprised 3,753 firm-year observations.

**Table 2.** The Sample (2003–2017)

Sample selection procedure		Number of firm-year observations
Initial sample		5,777
Less	Firms whose fiscal closing date is not the end of December	183
	Missing financial or foreign ownership variables	1,841
Final sample		3,753

### 4.2. Descriptive Statistics

Table 3 presents the descriptive statistics of the variables. All monetary amounts were expressed in billions of the Korean won and were deflated by the Korean Consumer Price Index using 2010 as a base year.

The mean value of Tobin's Q was 1.068, indicating that, on average, the market value of equity and liabilities was greater than the book value of the total assets. The mean value of

FOREIGN was 0.108, which was slightly higher than 10.24% in Fig. 1. This is because we removed unqualified and incomplete observations from the initial sample. We adopted the DEA model to estimate the operational efficiency for each firm-year observation. The high standard deviations of the output and input variables suggest that the sample firms varied greatly in size and input mix. The respective means of the CCR and BCC were 0.849 and 0.881. Both efficiency scores were less than one, implying that manufacturing firms still have room for improvement in terms of technology and scale to achieve full efficiency. The mean of R&D was 0.018, suggesting that manufacturing firms spend 1.8% of their sales revenue, on average, on R&D activities.

**Table 3.** Descriptive Statistics (2003–2017, N=3,753)

Variable		Mean	Std dev.	25%	Median	75%
Firm value	Tobin's Q	1.068	0.648	0.742	0.911	1.167
Foreign ownership	FOREIGN	0.108	0.145	0.008	0.042	0.154
Innovation (INNOV)	CCR	0.849	0.089	0.795	0.851	0.914
	BCC	0.881	0.088	0.823	0.883	0.948
	R&D	0.018	0.082	0.001	0.007	0.023
Output Input	Sales	1,729	8,088	117	239	645
	COGS	1,372	5,994	87	192	523
	OPEX	213	1,274	11	26	79
	NPPE	602	2,659	35	78	216
Controls	ROA	0.053	0.082	0.021	0.053	0.092
	SIZE	26.537	1.568	25.561	26.272	27.197
	LEV	0.407	0.181	0.262	0.404	0.545
	OCF	0.058	0.072	0.021	0.057	0.098
	BIG4	0.625	0.484	0.000	1.000	1.000

**Notes:** 1. Sales, COGS, OPEX and NPPE are expressed in billions of the Korean won.

2. All monetary variables were adjusted for inflation using the 2010 Consumer Price Index as a base year.

The results for the control variables were comparable to descriptive statistics in prior research. The mean of ROA was 0.053, which means that manufacturing firms, on average, had pre-tax earnings of 5.3% of the total assets. The average total asset size measured in the natural logarithm was 26.537, equal to 334 billion Korean won. The mean leverage was 0.407, indicating that the average manufacturing firm borrowed approximately 40.7% of its total assets. The mean of OCF was 0.058, signifying that the operating cash flow of manufacturing firms was 5.8% of the total assets. The mean of BIG4 indicates that 62.5% of the sample firms were audited by the Big4.

### 4.3. Empirical Results

#### 4.3.1. Correlations

Table 4 presents the Pearson and Spearman correlations between firm value, foreign ownership, and innovation measures. We examined the linear relationships between two variables using the Pearson correlation coefficients. Predictably, Tobin's Q was positively related to FOREIGN, CCR, BCC, and R&D. Additionally, FOREIGN exhibited a positive relationship with CCR, BCC and R&D. The results in Table 4 are partially consistent with our hypotheses.

**Table 4.** Correlations for Data Pooled Over the Period 2003–2017

Variable	Tobin's Q	FOREIGN	CCR	INNOV		
				BCC	R&D	
Tobin's Q	1	0.262 ***	0.128 ***	0.181 ***	0.256 ***	
FOREIGN	0.232 ***	1	0.127 ***	0.182 ***	0.215 ***	
INNOV	CCR	0.089 ***	0.130 ***	1	0.852 ***	-0.245 ***
	BCC	0.106 ***	0.182 ***	0.869 ***	1	-0.183 ***
	R&D	0.171 ***	0.034 ***	-0.176 ***	-0.159 ***	1

**Notes:** 1. Pearson correlation coefficients are below the diagonal and Spearman's rho values are above the diagonal.

2. Refer to Table 1 for variable definitions.

3. \*:  $p < 10\%$ , \*\*:  $p < 5\%$ , \*\*\*:  $p < 1\%$

#### 4.3.2. Innovation and Firm Value: The Moderating Role of Foreign Ownership

Table 5 presents the empirical findings for H1, 1-2, and 2. We estimated Equation (3) employing the OLS model. Since multicollinearity between independent variables leads to biased results, we estimated the variance inflation factor (VIF) of the variables in the regression. The maximum VIF values for all models were lower than 10, signifying the lack of a significant multicollinearity problem in our analysis.

**Table 5.** The Effect of Foreign Ownership and Innovation on Firm Value

Variable	CCR		INNOV BCC		R&D	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
FOREIGN	0.767 ***	0.081	0.708 ***	0.083	0.856 ***	0.083
INNOV	0.851 ***	0.108	0.973 ***	0.110	1.791 ***	0.233
FOREIGN *INNOV	11.082 ***	0.706	10.154 ***	0.763	8.011 ***	2.193
ROA	0.354 **	0.155	0.378 **	0.151	0.726 ***	0.148
SIZE	-0.005	0.008	-0.023 ***	0.008	-0.008	0.007
LEV	0.589 **	0.059	0.617 ***	0.059	0.654 ***	0.061
OCF	0.478 ***	0.158	0.502 ***	0.158	0.718 ***	0.159
BIG4	0.018	0.021	0.016	0.021	0.009	0.021
Year	Included		Included		Included	
Adj. R <sup>2</sup>	0.233		0.222		0.198	
F-stat.	32.669***		30.802***		26.869***	
VIF (Max)	1.885		1.752		4.104	

**Notes:** 1. Variable definitions are provided in Table 1.

2. \*:  $p < 10\%$ , \*\*:  $p < 5\%$ , \*\*\*:  $p < 1\%$

As shown in Table 5, the coefficients of FOREIGN were all positive and statistically significant, indicating that foreign ownership is positively related to firm value. The first four columns of Table 5 present the results where INNOV was measured as DEA efficiency scores. When INNOV was measured as the CCR- and BCC- efficiencies, the coefficients of INNOV were 0.851 and 0.973, respectively, both of which were statistically significant. Moreover, we tested our hypotheses using R&D intensity, which was a popular innovation measure in previous studies. When INNOV was R&D, the coefficient of INNOV was 1.791 and statistically significant. This implies that firms' innovation is positively related to firm value, and the CCR- and BCC- efficiency scores can also be used as the measures of innovation along with R&D.

We added the interaction term 'FOREIGN\*INNOV' to Equation (3) and tested whether FOREIGN had a moderating effect on the relationship between innovation and firm value. In Table 5, the coefficients of FOREIGN\*INNOV were all positive and statistically significant for all innovation measures. This suggests that the effects of innovation on firm value increase as foreign ownership increases.

#### 4.3.3. Foreign Ownership and Firm Value: The Mediating Role of Innovation

This section examines how innovation mediates the firm value implications of foreign ownership. We tested the proposed mediating effect by adopting Baron & Kenny's approach (1986), as described in Section 2.5, since it satisfies four statistical conditions. The first condition is that FOREIGN significantly predicts firm value, i.e., Tobin's Q. The second condition is that FOREIGN significantly predicts the mediators, i.e., the innovation measures CCR-efficiency, BCC-efficiency and R&D. The third condition is that the innovation significantly predicts firm value. The final condition is that, when the mediator variable, innovation, is included in the model to test the first condition, the effect of the FOREIGN should decrease if there is partial mediation or become statistically insignificant when there is full mediation. Table 6 reports the empirical results regarding H1-1 and 3.

In Panel A of Table 6, the first three conditions were satisfied, i.e., the relationships between FOREIGN, INNOV (= CCR-efficiency) and Tobin's Q were all positive and significant. When both FOREIGN and INNOV were included in the regression, the effect of FOREIGN was significant and the absolute value of its coefficient (0.867) was smaller than in the first condition (0.882) without INNOV. This indicates that the effect of foreign ownership on firm value was partially transmitted through the channel of innovation measured as CCR-efficiency.

Similarly, from Panel B of Table 6, FOREIGN was positively related to INNOV (= BCC-efficiency); the INNOV was positively associated with Tobin's Q. When both the FOREIGN and INNOV were included in the final condition, the effect of the FOREIGN on Tobin's Q remained significant, but the absolute value of the coefficient decreased. This implies that innovation, when measured as BCC-efficiency, mediates the relationship between foreign ownership and firm value. In contrast, when we measured innovation as R&D intensity, the second condition was not satisfied, i.e., the effect of FOREIGN on innovation (= R&D intensity) was not significant. Accordingly, while the mediation effect of innovation was estimated to be 0.011, it was not statistically significant.

To sum up, when we measure innovation as CCR- and BCC-efficiencies, our results showed that both foreign ownership and innovation incrementally and significantly affected firm value, and innovation partially mediated the effect of foreign ownership on firm value.

**Table 6.** Mediating Role of Innovation in the Relationship between Foreign Ownership and Firm Value

Panel A: Innovation = CCR

Variable	<u>[1] Tobin's Q</u>		<u>[2] INNOV</u>		<u>[3] Tobin's Q</u>		<u>[4] Tobin's Q</u>	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
FOREIGN	0.882***	0.082	0.032**	0.013	n/a		0.867***	0.082
INNOV	n/a		n/a		0.516***	0.107	0.471***	0.106
Adj. R <sup>2</sup>	0.215		0.403		0.195		0.219	
F-stat.	29.470***		71.377***		26.293***		29.353***	
VIF (Max)	1.861		1.861		1.889		1.892	
Mediation	0.015							
Sobel test	Z-value = 2.153**							

Panel B: Innovation = BCC

Variable	<u>[1] Tobin's Q</u>		<u>[2] INNOV</u>		<u>[3] Tobin's Q</u>		<u>[4] Tobin's Q</u>	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
FOREIGN	0.882***	0.082	0.048***	0.013	n/a		0.851***	0.082
INNOV	n/a		n/a		0.722***	0.108	0.652***	0.107
Adj. R <sup>2</sup>	0.215		0.361		0.200		0.222	
F-stat.	29.470***		59.709***		27.031***		29.959***	
VIF (Max)	1.861		1.861		1.861		1.861	
Mediation	0.031							
Sobel test	Z-value = 3.158***							

Panel C: Innovation = R&amp;D

Variable	<u>[1] Tobin's Q</u>		<u>[2] INNOV</u>		<u>[3] Tobin's Q</u>		<u>[4] Tobin's Q</u>	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
FOREIGN	0.882***	0.082	0.010	0.011	n/a		0.872***	0.082
INNOV	n/a		n/a		1.042***	0.119	1.024***	0.117
Adj. R <sup>2</sup>	0.215		0.063		0.207		0.230	
F-stat.	29.470***		7.951***		28.162***		31.330***	
VIF (Max)	1.861		1.861		1.861		1.861	
Mediation	0.011							
Sobel test	Z-value = 0.904							

**Notes:** 1. Variable definitions are provided in Table 1.

2. The control variables and year dummies are included in the regression, but the estimated coefficients of these variables are not reported here.

3. \*: p &lt; 10%, \*\*: p &lt; 5%, \*\*\*: p &lt; 1%

#### 4.3.4. Additional Analysis: Firm Innovation as Productivity Change, Efficiency Growth and Technical Progress

In the previous Sections, we measured innovation as CCR- and BCC-efficiency scores for a specific period by adopting DEA. Firm innovation refers to a significant technological improvement in existing products or operating processes. Since innovation is a radical change



for a firm, we measured the extent of the change in innovation with productivity growth over two periods.

Caves, Christensen and Diewert (1982a/1982b) introduced the Malmquist productivity index that measures total factor productivity using distance functions. Fare et al. (1994) specified the output-based productivity change as the geometric mean of efficiency growth and technical progress, which relationship can be summarised as follows:

$$\text{Productivity change (PC)} = \text{Efficiency growth (EG)} * \text{Technical progress (TP)} \quad (6)$$

In Equation (6), EG captures the changes in the relative efficiency between two periods. TP measures technological shifts between the two periods. If there has been no change in the input and output between the two periods, the PC equals one. If productivity has improved (or deteriorated) over the two periods, the PC is greater (or less) than one. The same interpretation is applied to the components of the PC, i.e., the EG and TP.

We calculated the PC as well as the EG and TP for each firm in the sample. Table 7 provides a summary description of the Malmquist productivity index over the sample period 2003–2017. On average, productivity for our sample firms increased slightly over the period: the average change in the PC was less than 1% (about 0.32%) per year. The PC (1.0032) was due to the TP (1.0042) rather than improvements in the EG (0.9991).

**Table 7.** Malmquist Productivity Index (2003–2017, N=3,753)

Variable	Mean	Std dev.	25%	Median	75%
Productivity change (PC)	1.0032	0.0711	0.9700	1.0000	1.0281
Efficiency growth (EG)	0.9991	0.0627	0.9760	1.0000	1.0181
Technical progress (TP)	1.0042	0.0614	0.9760	1.0000	1.0300

**Note:** Descriptive statistics of the output and inputs for the productivity index are presented in Table 3.

**Table 8.** Moderating Role of Foreign Ownership: Malmquist Productivity Index

Variable	INNOV					
	Productivity change (PC)		Efficiency growth (EG)		Technical progress (TP)	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
FOREIGN	0.904***	0.084	0.902***	0.084	0.905***	0.084
INNOV	0.357***	0.137	-0.076	0.161	0.587***	0.159
FOREIGN *INNOV	0.598	0.998	1.265	1.237	-1.095	0.992
ROA	0.573***	0.149	0.591***	0.149	0.567***	0.149
SIZE	-0.002	0.008	-0.002	0.008	-0.002	0.008
LEV	0.592***	0.061	0.604***	0.061	0.596***	0.061
OCF	0.665***	0.165	0.711***	0.162	0.702***	0.161
BIG4	0.008	0.022	0.008	0.022	0.007	0.022
Year	Included		Included		Included	
Adj. R <sup>2</sup>	0.181		0.179		0.182	
F-stat.	23.953***		23.772***		24.206***	
VIF (Max)	1.656		1.656		1.655	

**Notes:** 1. Variable definitions are provided in Table 1.

2. \*: p < 10%, \*\*: p < 5%, \*\*\*: p < 1%

Next, we estimated Equation (3), replacing INNOV with the Malmquist productivity index. The results, presented in Table 8, showed that foreign ownership is positively related to firm value. When INNOV represented the PC and TC, the coefficients of INNOV were 0.357 and 0.587, and both were statistically significant. This means that firms' productivity growth and technical progress are positively related to firm value. However, the coefficient of EG was -0.076 but not significant. The coefficients of the cross term FOREIGN\*INNOV were all statistically insignificant, implying that FOREIGN did not have moderating effect on the relationship between the Malmquist productivity index and firm value.

This study further investigated whether the PC mediates the relationship between foreign ownership and firm value. To test this hypothesised mediating relationship, we repeated Baron and Kenny's (1986) approach, as described in Sections 3.5.

**Table 9.** Mediating Role of Innovation: Malmquist Productivity Index

Panel A: Innovation = Productivity Change (PC)

Variable	[1] Tobin's Q		[2] INNOV		[3] Tobin's Q		[4] Tobin's Q	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
FOREIGN	0.882***	0.082	-0.009	0.011	n/a		0.885***	0.082
INNOV	n/a		n/a		0.282**	0.136	0.303**	0.134
Adj. R <sup>2</sup>	0.215		0.022		0.191		0.215	
F-stat.	29.471***		3.296***		25.642***		28.844***	
VIF (Max)	1.861		1.861		1.861		1.862	
Mediation					-0.003			
Sobel test					Z-value = -0.769			

Panel B: Innovation = Efficiency Growth (EG)

Variable	[1] Tobin's Q		[2] INNOV		[3] Tobin's Q		[4] Tobin's Q	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
FOREIGN	0.882***	0.082	-0.005	0.009	n/a		0.882***	0.082
INNOV	n/a		n/a		-0.061	0.155	-0.045	0.153
Adj. R <sup>2</sup>	0.215		0.032		0.191		0.214	
F-stat.	29.471***		4.492***		25.497***		28.669***	
VIF (Max)	1.861		1.861		1.861		1.861	
Mediation					0.0002			
Sobel test					Z-value = 0.259			

Panel C: Innovation = Technical Progress (TP)

Variable	[1] Tobin's Q		[2] INNOV		[3] Tobin's Q		[4] Tobin's Q	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
FOREIGN	0.882***	0.082	-0.003	0.009	n/a		0.884***	0.082
INNOV	n/a		n/a		0.425***	0.159	0.436***	0.157
Adj. R <sup>2</sup>	0.215		0.042		0.192		0.216	
F-stat.	29.471***		5.607***		25.739***		28.935***	
VIF (Max)	1.861		1.861		1.862		1.863	
Mediation					-0.001			
Sobel test					Z-value = -0.331			

**Notes:** 1. Variable definitions are provided in Table 1.

2. The control variables and year dummies are included in the regression, but the estimated coefficients of these variables are not reported here.

3. \*:  $p < 10\%$ , \*\*:  $p < 5\%$ , \*\*\*:  $p < 1\%$

Table 9 displays the empirical results. In Panels A, B and C of Table 9, the relationships between FOREIGN and INNOV (i.e., the PC, EG and TP) were all statistically insignificant. This implies that the effect of foreign ownership on firm value may not be transmitted through changes in innovation, measured as productivity change.

To summarise, when we measured innovation as the Malmquist productivity index, the results showed that both PC and TP incrementally and significantly affected firm value; however, these innovation-change measures did not mediate the relationship between foreign ownership and firm value.

## 5. Summary and Conclusions

This study investigated the effects of foreign ownership and innovation on firm value. Firm innovation measures the performance of R&D activities, such as developing new products or services and improving operational processes, which can be the indicator of firms' competitive advantages. However, R&D investments can generate very high agency costs and are innately uncertain in terms of contributing to innovation progress and being converted into firm value. If appropriate corporate governance mechanisms are in place to monitor managerial decision making, then R&D activities may contribute more to firm value. Foreign investors serve as active monitors and promote knowledge spillover from highly innovative economies. However, there is little research on how foreign investors affect firm value through innovation at the firm level. If a firm succeeds in its innovation activities, then it can improve the yield of its resources, satisfy customers, and differentiate itself from competitors, thus exploiting operational efficiency gains. In this study, we defined innovation as firms' operational efficiency, which was measured using the DEA model that can suitably characterise the relationships between multiple inputs and outputs without any functional form.

Like other countries, the Korean manufacturing industry has faced challenges such as the short lifecycles of technological products, rapid shifts in customer needs, fierce competition, high labour costs and low productivity. Thus, the industry requires innovation to ensure strong and sustainable economic growth. Additionally, Korea abolished all limits on foreign shareholdings in listed companies to restore the confidence of foreign investors. Accordingly, we utilised data regarding Korean manufacturing firms in our analysis. We found that foreign ownership can enhance a firm's Tobin's Q, i.e., firm value, by promoting innovation. Moreover, foreign ownership moderates the relationship between innovation and firm value. In summary, higher foreign ownership can promote firm innovation, thus increasing a firm's market value. Furthermore, we observed that, while productivity change and technical progress between the two periods had a positive effect on firm value, they did not mediate the relationship between foreign ownership and firm value.

This study is subject to some limitations in terms of research methodologies. First, we did not document the empirical evidence on the moderating and mediating effects of productivity change on firm innovation. In future, researchers could develop more accurate innovation-change variables to test the hypothesis of this study. Second, some studies indicated endogeneity between ownership structure and firm performance (e.g., Black et al., 2015; Mishra et al., 2017). The possibility of the existence of endogeneity could have been investigated using difference-in-differences regressions, Heckman's two-step selection analysis or propensity score matching. In future, researchers might try to explore the relationship between ownership structure, innovation and firm value using various methodologies that can mitigate endogeneity bias.

Despite these limitations, the findings of this study have several implications for policy and practice. First, in Korea, a common criticism of foreign investors is that they tend to indulge in rampant short selling, which increases stock market volatility. However, banning short selling is not an appropriate solution since it does not necessarily help to boost the stock market. If regulators motivate foreign investors to make long-term investments, then foreign ownership could help domestic companies to increase their firm value through innovation. Second, our results suggest that, for firms with weak ownership structures, foreign ownership can be crucial for promoting firm innovation and may serve as a substitute for the lack of good ownership structures. Third, since Korean manufacturing firms have more concentrated ownership structures, like most companies in other countries, our study has implications for the economic development of these countries as well. It would be interesting to explore the relationships documented in our analysis in the context of corporate ownership structures in other countries.

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