ISSN: 2288-2766 © 2018 EABEA. http://eajbe.jams.or.kr
doi: http://dx.doi.org/10.20498/eajbe.2018.6.4.1

MNE's Ability to Mitigate the FX Exposure: Subsidiary Network and Pass-through Ability*

Hyejin Cho

Research Professor, Business School, Korea University, Seoul, Korea
E-mail: hyejinstory@korea.ac.kr

Received: November 12, 2018. Revised: December 5, 2018. Accepted: December 11, 2018.

Abstract

Purpose – This paper tests the effect of the structure of manufacturing and marketing subsidiary network on FX exposure of Korean MNEs. Furthermore, the moderating effect of pass-through ability on the relationship between the subsidiary network and FX exposure is explored.

Research design and methodology – This study utilizes a sample of 309 Korean MNEs constructed from database offered by KOTRA and KIS-VALUE.

Results – As operational flexibility arising from having operations in multiple locations provides an option for firms to tackle FX exposure, greater breadth of manufacturing subsidiary network reduces FX exposure, and greater depth increases FX exposure. However, both the breadth and depth of marketing subsidiary network decrease FX exposure due to the firm's higher level of market presence and knowledge to devise an appropriate marketing strategy that can buffer adverse exchange rate movement. Such an effect is intensified when MNE's have FX exposure pass-through ability stemming from differentiated good.

Conclusions – Empirical findings suggest that types and structure of Korean MNEs' foreign subsidiary network are closely related to the level of FX exposure they are experiencing. Also, they can utilize marketing subsidiary network more efficiently when having a higher R&D intensity.

Keywords: Foreign Exchange Exposure Hedge, Subsidiary Network, Operational Hedge, Pass-through Ability.

JEL Classification Code: F23, G32.

* This research was supported by Korea University Research Grant

1. Introduction

Globalization gives opportunities for firms to do business with a bigger market by nurturing trade and investment flows among countries all around the world. While enlarged business chance enables firms to realize more profits, firms face intense competition with foreign competitors and different external environments. One of the most influential factors affecting all the operating firms in the globalized market is exchange rate fluctuation (Allayannis & Ofek, 2001). After the Bretton Woods system collapsed, most of the countries changed their exchange rate system from fixed to flexible. Afterward, the international economic environment is significantly exposed to exchange rate fluctuation (Bartov, Bodnar, & Kaul, 1996; Williamson, 2001). Foreign exchange rate exposure (FX exposure) has an impact on firm's costs, profits, and relative competitive position by the price change. While using currency derivatives is a financial measure to hedge the FX risk, it has been long argued that MNEs' have a unique advantage in hedging the FX risk, the operational hedge (e.g., Belderbos & Zou, 2009; Pantzalis, Simkins, & Laux, 2001).

Real options theory in international business argues that multinational enterprises (MNEs) have real options which provide operational flexibility under uncertainty concerning future macroeconomic and policy conditions (Belderbos & Zou, 2009) such as exchange rate movement. Kogut and Kulatilaka (1994) identified real option which is "an across-country option," the utilization of multiple manufacturing locations to manage FX exposure as shifting factors of production to countries where the exchange rate is favorable is available. As having a larger number of locations provides higher flexibility in assigning activities to tackle FX exposure, higher subsidiary network breadth is known to provide higher operational flexibility. On the contrary, a higher subsidiary network depth on certain nations reduces operational flexibility and increases FX exposure (Pantzalis et al., 2001). While such findings propose the close relationship between the structure of the subsidiary network and FX exposure, prior studies assume that subsidiaries are doing similar activities in host countries. Hence, to address the research gap, this paper intends to distinguish the types of subsidiary network: manufacturing subsidiary network and marketing subsidiary network. Manufacturing subsidiary network is closely related to operational hedge concept that prior studies suggest as a mean to manage FX exposure. On the contrary, marketing subsidiary network is related to the firm's power in formulating an adequate market strategy for host markets as it is related to the level of market knowledge. As a marketing subsidiary network does not act as how manufacturing subsidiary network, it is important to analyze its role in FX exposure management. The first research question this paper attempts to address is how the breadth and depth of manufacturing/marketing subsidiary networks affect the level of FX exposure?

Furthermore, this paper suggests that there is another ability of the firm to mitigate the FX exposure, the pass-through ability. Exchange rate pass-through is the extent to which firms pass along exchange rate-induced margin increases (decreases) by lowering (raising) prices in market currency terms (Clark, Kotabe, & Rajaratnam, 1999). While the objective of the operational hedge is mitigating the effect of fluctuation of the exchange rate, the pass-through theory argues that if firms have differentiated product and low substitutability for their products, they can bear the exchange rate fluctuation by simply "passing" it on customers as price elasticity of demand is not high. Without considering the firm's competitiveness in the international market which directly related to such ability, our understanding of firm's hedging ability will be limited. The second research question is if MNEs have a competitive market position, is the level of FX exposure lower?

To investigate the foreign exchange exposure hedging mechanisms, this paper utilizes Korean MNEs data. There are mainly two reasons. First, the focus of previous literature has been on the US firms. However, the empirical studies based on US context only provides weak evidence in testing the link between FX movements and firm value (e.g., Bodnar & Gentry, 1993; Chow, Lee, & Solt, 1997; Dominguez & Tesar, 2006; Faff & Marshall, 2005; Jorion, 1990). Some scholars point out that the U.S. economy is not significantly relying on international trade, hence the impact of FX exposure on firm value is relatively limited than other economies. Also, U.S. has a natural advantage that the most widely used trade settlement currency, the dollar, is their home currency. Hence, there is a need to investigate the country with a different economic setting to investigate the FX exposure issue. In this sense, Korea context is the better research setting as Korea is a small and open economy which heavily depends on trade, and the importance of FX risk management is higher. As suggested by open-economy macroeconomics, small and open economies are more sensitive to changes in international conditions (Bodnar & Gentry, 1993). Also, Korea has its own currency, Won, and about 80% of trade settlement involves US dollar, 7% for Euro, and only 1% with Won in 2016 trade settlement. In these aspects, the Korean economy context highlights the FX exposure hedging issue and its implications.

The empirical findings suggest that greater breadth of manufacturing subsidiary network reduces FX exposure, and greater depth increases FX exposure. However, both the breadth and depth of marketing subsidiary network decrease FX exposure due to the firm's higher level of market presence and knowledge to devise an appropriate

marketing strategy that can buffer adverse exchange rate movement. Such an effect is intensified when MNE's have FX exposure pass-through ability stemming from differentiated good.

This paper provides several contributions. First, the study focuses on the value of the subsidiary network for MNEs locate in a small and open economy, i.e., South Korea, and finds the signification effect of the subsidiary network on FX exposure level. As the FX exposure is more important for firms that rely more on the foreign market and more exposed to exchange rate movement, the finding implies that finding a context that is suitable for FX exposure is beneficial in analyzing the FX exposure management. Second, this paper suggests the importance of the types and structure of foreign subsidiary network while prior studies assume that foreign subsidiaries play a similar role. Specifically, this study extends the prior studies on FX exposure hedging that majorly focus on manufacturing subsidiary network by adding another type of subsidiary network, i.e., marketing subsidiary network. Empirical findings propose that the effect of the structure of a manufacturing subsidiary network is in line with prior studies, but marketing subsidiary network plays a different role in managing FX exposure. While manufacturing subsidiary network affects FX exposure by changing the level of operational flexibility, marketing subsidiary network affects FX exposure by having more commitment and market knowledge in multiple markets. This implies that when analyzing the effect of FX exposure, it is adequate to differentiate the types of subsidiary network.

The remainder of the paper is organized as follows. First, section 2 provides related theory and hypotheses. In the third section, the data and method used for the empirical analysis are explained. The third section will present results, and in the final section, the main conclusions are pointed out, and implications are suggested.

2. Theory and Hypotheses Development

The degree of foreign involvement, which is measured by the proportion of foreign sales of firms, has been suggested to be positively related to the degree of FX exposure (e.g., Adler & Dumas, 1984; Faff & Marshall, 2005; He & Ng, 1998; Miller & Reuer, 1998; Pantzalis et al., 2001). Given the importance of FX exposure, firms are likely to give the effort to tackle the risk associated with FX fluctuation (Cheng & Westermann, 2017). Various survey researches show the evidence that firms consider managing the FX exposure is important (i.e., Bodnar, Hayt, & Marston, 1998; Brown, 2001; Krapl, 2017; Marshall, 2000), and analysts and investors expect firms to engage in FX exposure hedging activities to smooth the volatility of return. Also, senior managers regard the hedging activities as a strategical decision which allows the firm to apply competitive pricing without deteriorating margin rate (Brown, 2001). Given the importance of firm's ability to manage FX exposure, this paper analyzes the MNEs' unique ability to hedge FX exposure, i.e., operational flexibility stemming from the subsidiary network, and their competitive position to avoid FX exposure, i.e., pass-through ability.

2.1. The Breadth of Different Types of Subsidiary Network

The international business field has been looking into the unique ability of MNEs regarding FX exposure hedging. The real options theory conceptualizes how the investment in a foreign country generates advantage relative to a purely domestic firm (Belderbos & Zou, 2009; Trigeorgis and Reurer, 2017), mainly suggests two types of options: "within-country option" and "across-country option." While "within-country option" opens the door to subsequent expansion in a host market where a firm already entered into, "across-country option" allows MNEs to coordinate shifting factors within a multinational network (Kogut & Kulatilaka, 1994). Globalized production and supplier platforms can offset or take advantage of exchange rate differentials by shifting sales or production from one country to other when facing newly emerging conditions (Bodnar, Dumas, & Marston, 2002; Lee & Makhija, 2008). Several empirical findings showed the ability of FX exposure hedging by FDI of MNEs (Miller & Reuer, 1998).

Such options are closely related to the structure of the subsidiary network, i.e., breadth and depth of the subsidiary network (Pantzalis et al., 2001). While the concentration (depth) in one country can increase FX exposure, the spread (breadth) of the network among multiple countries can mitigate the FX exposure. Chung, Lee, Beamish, and Isobe (2010) argue that during an economic crisis, MNEs utilize their strength in low-cost manufacturing subsidiaries in multinational networks and exploit across-country operational flexibility. Given that a high degree of exchange rate volatility is one of the big risks during the period of economic crisis, their finding implies manufacturing flexibility can be a way to mitigate FX exposure.

Even though there is evidence which shows operational flexibility reduces FX exposure, the proxies for operational hedging has been the aggregated data which failed to factor the types of subsidiary network in analyzing the level of FX exposure. For example, the number of countries where the subsidiaries situated (e.g., Allayannis,

Ihrig, & Weston, 2001; Pantzalis et al., 2001) or the level of FDI measured by foreign assets divided by total assets (Miller & Reuer, 1998) are the proxies of the operational hedge. In order to reflect the MNEs' characteristics of a subsidiary network, it is needed to investigate the orientation of individual subsidiaries (Chung et al., 2010).

This paper specifically identifies whether each foreign subsidiary is manufacturing or marketing subsidiary to test the influence of the different type of subsidiary network. Manufacturing subsidiary network is closer to the focus of prior research. Having the ability to manufacture in different nations allows firms to utilize operational flexibility fully. Hence, the breadth of manufacturing subsidiary network is expected to reduce the FX exposure. The other type of subsidiary network is marketing subsidiary network which manages the host environment interaction. A higher breadth of marketing subsidiary network implies that MNEs have been penetrated multiple markets and actively doing international business. While marketing subsidiary network may not provide operational flexibility by manufacturing subsidiary network, a having a wide range of international market can bring geographic portfolio effects that smoothen the volatility in income. MNEs are expected to experience natural hedge, i.e., a negative impact of exchange rate movement on income in one market is offset by a positive impact of exchange rate movement on income in another market. Hence, the breadth of marketing subsidiary network is expected to reduce FX exposure of MNEs. Thus, following hypotheses are suggested:

H1a: The greater breadth of manufacturing subsidiary network, the lower FX exposure.
H1b: The greater breadth of marketing subsidiary network, the lower FX exposure.

2.2. The Depth of Different Types of Subsidiary Network

The depth of the subsidiary network has been known as FX exposure increasing factor (Pantzalis et al., 2001). The underlying logic is that the key factor which gives MNE flexibility is the possibility to utilize different macroeconomic situation across countries. As concentrating manufacturing in one country does not give such an option, higher depth of subsidiary network reduces MNE's operational flexibility. Pantzalis et al. (2001) provide the empirical evidence that if foreign subsidiaries are concentrated in a limited number of markets, MNEs are more exposed to FX exposure. Based on this idea, it is natural to expect that depth of manufacturing subsidiary network is positively related to the level of FX exposure.

Then, how does greater depth of marketing networks change FX exposure? Consider a case when an MNE faces considerable FX risk in certain host market where it sees great market growth opportunity. When it has to keep doing business for strategic reasons, they may increase commitment to enhance local responsiveness and market presence. Through well-developed market knowledge, MNE is able to push the products to customers in effective ways. Thus, having a deeper marketing network in the host market may enhance the ability of MNEs to find ways to deal with the market. A larger number of marketing subsidiaries within a country helps MNE to accumulate specific market knowledge and to have strong local orientation. This will intensify MNE's strength to read the local context and adequately set up strategy from the beginning which can better address the adverse effect of future exchange rate movement. Therefore, unlike increasing FX exposure due to a greater depth of manufacturing subsidiary network, greater depth of marketing subsidiary network is likely to reduce the FX exposure. Thus, following hypotheses are suggested:

H2a: The greater depth of manufacturing subsidiary network, the higher FX exposure.
H2b: The greater depth of marketing subsidiary network, the lower FX exposure.

2.3. Moderating Effect of Pass-through Ability

While both breadth and depth of marketing subsidiary network are predicted to lower FX exposure unlike manufacturing subsidiary network, pass-through ability can intensify such FX exposure reducing the effect of marketing subsidiary network. Pass-through ability is an ability of a firm to reflect FX movement on the price of the product which can act as a buffer for FX movement. The main interest of trade economists regarding the exchange rate pass-through has been the structural explanations why pass-through is not 100% in the globalized market. Well-known factors which determine pass-through level are a degree of competition, market power, and product differentiation (Bartram, Brown, & Minton, 2010; Feenstra, Gagnon, & Knetter, 1996; Jiawen, 1997). For example, a greater number of export competitors in a market leads to lower pass-through level (Dornbusch, 1987), and in industries where competition is intense, the price should be set near marginal cost and firms have less room to alter the prices they charge (Allayannis & Ihrig, 2001).

These explanations imply that firms are able to reduce FX exposure when they have high product differentiation which is closely related to the degree of substitutability and price elasticity of customer demand. As higher product differentiation level is related to low price elasticity, firms have more room to absorb FX exposure by changing price (Bodnar et al., 2002). Hutson and Stevenson (2009) have shown that industry with a lower degree of differentiation products (e.g., raw materials or metal) face lesser ability to pass-through. Also, firms with differentiated products are likely to have a higher margin rate than competitors, and FX exposure may have less impact relative to their competitors. While pass-through ability has importance in determining the level of FX exposure, there is not enough empirical evidence on the effect of such ability on FX exposure.

This paper suggests that pass-through ability matters for FX exposure when MNEs has a market commitment to the host markets. Firstly, added to the portfolio effect that greater breadth of market subsidiary network, pass-through ability coming from differentiated goods allows MNEs to utilize different market opportunities in various market timely. MNEs with wider marketing network may experience higher profits in a market where the exchange rate is favorable and relatively easily endure less margin or increased price due to the low-price elasticity. Such offsetting effect will be greater for MNEs with a greater breadth of marketing subsidiary network. Also, MNEs with higher pass-through ability may utilize the depth of marketing subsidiary network. To formulate an adequate pricing strategy that can alter the level of FX exposure, a number of transaction and experiences should accumulate to market firm's differentiated products efficiently to the host market. Having pass-through ability is expected to allow the firm to take advantage of their competitiveness actively in a nation where they have greater market knowledge and market presence. Thus, following hypotheses are suggested:

H3a: The greater the degree of pass-through ability, the FX exposure reducing the effect of the breadth of marketing subsidiary network increases.
H3b: The greater the degree of pass-through ability, the FX exposure reducing the effect of depth of marketing subsidiary network on FX exposure increases.

<Figure 1> illustrates the theoretical model based on given hypotheses.

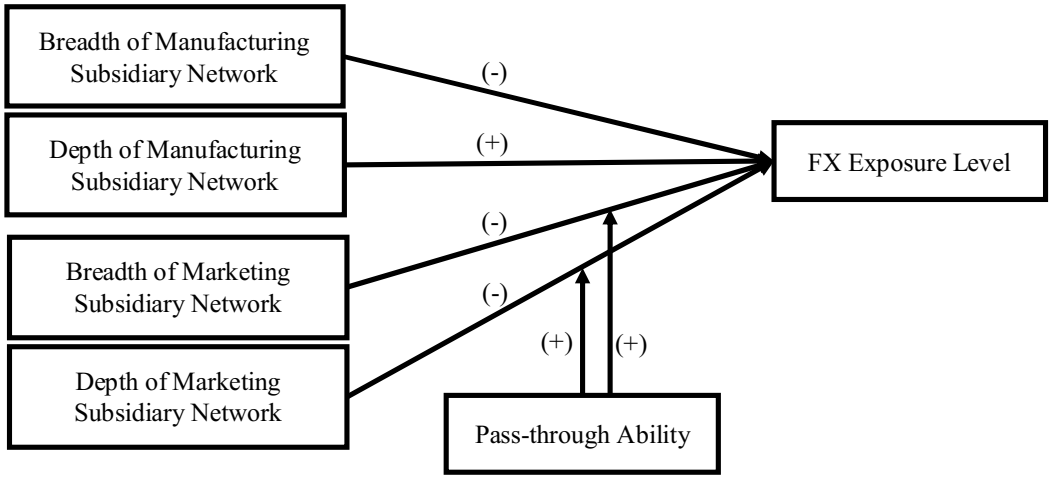

Figure 1: Theoretical Model

3. Research Design

3.1. Sample and Methodology

This paper analyzes the FX exposure of Korean MNEs. In identifying the foreign subsidiary network, this paper utilizes the Overseas Investment Information System (OIS) offered by the Korea Trade-Investment Promotion Agency (KOTRA). As there are differences between industries in need of having a manufacturing plant abroad, the

study focuses on MNE in the manufacturing industry. Firm-level variables are obtained through KIS-VALUE, and foreign exchange rates are obtained from a World Bank database. The final sample consists of 309 Korean MNEs.

The hypotheses are tested with an ordinary least squared regression methodology. Two-step regressions are used. First regression is to estimate the FX exposure level, and second regression is the main analysis that FX exposure coefficient is regressed on the type of subsidiary network, hedging mechanisms, and control variables.

3.2. Variables and Measures

The dependent variable for the hypotheses is the FX exposure coefficient. While the accounting measure of foreign exchange rate exposure looks into to book value of foreign currency denominated assets and liabilities, the economic measure of foreign exchange rate exposure is interested in the sensitivity of company value to fluctuations in the foreign exchange rate (Adler & Dumas, 1984). The economic concept can fully reflect the exposure as it can also capture the exposure of purely domestic firms. It is a forward-looking concept which considers future cash flows rather than historical accounting values (Miller & Reuer, 1998). Most of the research on FX exposure follows this definition of exposure. According to Jorion (1990), FX exposure can be estimated with the following equation.

$$R_{it} = \beta 0_i + \beta 1_i R_{mt} + \beta 2_i RTWE + \varepsilon_{it}, \qquad (2)$$

where R_{it} is the rate of return on the ith company's common stock in month t, RTWE is the rate of change in a trade-weighted exchange rate index, R_{mt} is the value-weighted market return, and ε_{it} is idiosyncratic error term. The trade-weighted index includes US dollar, Japanese Yen, and Euro as those currencies are main trade settlement currencies for Korean firms which accounts for nearly 80%. A positive value for RTWE indicates domestic currency depreciation. R_{mt} is the KOSPI market return. The estimated $\beta 2_i$ is FX exposure coefficient which is the dependent variable in the main regression analysis.

Depth and Breadth of manufacturing and marketing subsidiary network are constructed following Pantzalis et al. (2001). The depth of subsidiary network is the ratio of the number of subsidiaries in the two countries where the MNEs have the majority of its operations divided by a total number of foreign subsidiaries. The breadth of the subsidiary network is a number of the country where MNEs have a subsidiary. Factors deciding pass-through ability are well investigated in the economics field, such as product differentiation. To achieve product differentiation, firms should have competitive advantages. High R&D intensity can capture the ownership advantages MNEs have. For R&D intensity, R&D expenses are divided by total assets.

The analysis also includes several control variables. A logarithm value of total market value to control for size effect, and a foreign sale, which is a strong predictor of FX exposure level, is included as a logarithm value. Also, the logarithm value of total market value and debt ratio are also included. Also, following Dominquez and Tesar (2006), use industry-level markup index is used to control for industry effect. To control for financial hedging, the dummy variables on the usage of FX derivatives and foreign currency denominated debt are constructed. Chaebol membership is included as a dummy variable.

The operationalizations of variables are as follows:

Table 1: Operationalization of Variables

Variables	Explanations
FX_EXPOSURE	Dependent variable FX exposure coefficient calculated from equation (2)
BREADTH_MANU	Number of the country where MNEs have a manufacturing subsidiary
BREADTH_MARKET	Number of the country where MNEs have a marketing subsidiary
DEPTH_MANU	The ratio of the number of manufacturing subsidiaries in the two countries where the MNEs have the majority of its operations divided by a total number of foreign subsidiaries.
DEPTH_MARKET	The ratio of the number of marketing subsidiaries in the two countries where the MNEs have the majority of its operations divided by a total number of foreign subsidiaries.
R&D_INTENSITY	R&D expenses divided by total assets

SIZE	A logarithm value of total market value
EXPORTS	A logarithm value of exports
DEBT_RATIO	Total debt divided by total assets
PROFIT_MARGIN	Industry-level markup index
FOR_DEBT	The value of 1 when using FX derivatives, otherwise 0
FOR_DERIVATIVES	The value of 1 when using foreign currency denominated debt, otherwise 0
CHAEBOL	The value of 1 when defined as chaebol group, otherwise 0

4. Empirical Analysis

4.1. Sample Description

Table 2 and Table 3 present the summary statistics and correlation matrix for all variables used for the empirical analysis, respectively.

Table 2: Descriptive Statistics

Variable	Mean	Std.Dev.	Min	Max
FX_EXPOSURE	0.37	1.13	-2.44	12.54
BREADTH_MANU	0.81	0.56	0.00	2.71
BREADTH_MARKET	0.70	0.76	0.00	3.83
DEPTH_MANU	0.94	0.14	0.33	1.00
DEPTH_MARKET	0.92	0.19	0.13	1.00
R&D_INTENSITY	0.01	0.02	0.00	0.12
SIZE	0.63	1.34	0.00	7.55
EXPORTS	25.53	1.77	22.49	32.27
DEBT_RATIO	25.02	2.16	18.26	31.95
PROFIT_MARGIN	0.99	0.77	0.17	3.19
FOR_DEBT	0.52	0.50	0	1
FOR_DERIVATIVES	0.25	0.43	0	1
CHAEBOL	0.89	0.32	0	1

Table 3: Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12
1 FX_EXPOSURE	1											
2 BREADTH_MANU	0.02	1										
3 BREADTH_MARKET	-0.14*	0.12*	1									

4 DEPTH_MANU	0.03	-0.74*	-0.24*	1								
5 DEPTH_MARKET	0.13*	-0.28*	-0.84*	0.30*	1							
6 R&D_INTENSITY	-0.06	-0.12*	0.09	0.01	-0.02	1						
7 SIZE	-0.28*	0.32*	0.65*	-0.33*	-0.61*	0.01	1					
8 EXPORTS	0.24*	0.36*	0.55*	-0.34*	-0.53*	0.01	0.72*	1				
9 DEBT_RATIO	0.02	0.03	0.19*	0.02	-0.19*	-0.05	0.03	0.21*	1			
10 PROFIT_MARGIN	-0.09	-0.13*	0.12*	0.01	-0.04	0.24*	0.10	-0.26*	-0.23*	1		
11 FOR_DEBT	-0.01	0.04	0.21*	-0.05	-0.15*	-0.02	0.17*	0.31*	0.33*	-0.26*	1	
12 FOR_DERIVATIVE	-0.09	-0.00	0.06	-0.04	-0.08	-0.05	0.10	0.21*	0.09	-0.09	0.15*	1
13 CHAEBOL	-0.04	0.04	0.15*	-0.05	-0.11*	-0.09	0.21*	0.12*	-0.01	0.09	0.04	0.06

Note: P-value in parentheses. (* p<0.05)

4.2. Empirical Results

Table 4 presents the empirical results on the effect of the breadth of the subsidiary network. Model (1) shows a negative effect of the breadth of manufacturing subsidiary network on FX exposure, supporting H1(a). Model (2) also presents the negative effect of the breadth of marketing subsidiary network on FX exposure, thereby supporting H1(b). In model (3), when both types of subsidiary network are considered together, only the effect of the breadth of manufacturing subsidiary network remains.

Table 4: The Effect of Breadth of Subsidiary Network

	Model 1		Model 2		Model 3	
	Coefficient	p-values	Coefficient	p-values	Coefficient	p-values
CONSTANT	5.652***	0.000	6.052***	0.000	6.865***	0.000
BREADTH_MANU	-0.260*	0.032			-0.286*	0.019
BREADTH_MARKET			-0.138*	0.021	0.175	0.122
SIZE	-0.116*	0.042	-0.130*	0.035	-0.153*	0.014
EXPORTS	-0.100*	0.045	-0.093+	0.062	-0.114*	0.024
DEBT_RATIO	0.04	0.645	0.015	0.868	0.014	0.875
PROFIT_MARGIN	-0.008	0.118	-0.011*	0.046	-0.010+	0.067
FOR_DEBT	0.107	0.437	0.071	0.608	0.093	0.499
FOR_DERIVATIVES	-0.127	0.390	-0.14	0.345	-0.112	0.448
CHAEBOL	0.072	0.720	0.065	0.746	0.07	0.724
R-squared	0.112		0.103		0.119	
Adjusted R-squared	0.0882		0.0786		0.0924	
Observation	309		309		309	

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 5: The Effect of Depth of Subsidiary Network

	Model 1		Model 2		Model 3	
	Coefficient	p-values	Coefficient	p-values	Coefficient	p-values
CONSTANT	6.317***	0.000	6.453***	0.000	7.341***	0.000
DEPTH_MANU	0.723*	0.013			0.663*	0.017
DEPTH_MARKET			-0.492*	0.024	-0.418	0.326
SIZE	-0.110+	0.055	-0.128*	0.037	-0.131*	0.032
EXPORTS	-0.096+	0.056	-0.090+	0.069	-0.101*	0.045
DEBT_RATIO	0.044	0.616	0.016	0.861	0.026	0.771
PROFIT_MARGIN	-0.009+	0.069	-0.010+	0.062	-0.010+	0.060
FOR_DEBT	0.09	0.513	0.088	0.521	0.093	0.498
FOR_DERIVATIVES	-0.146	0.322	-0.149	0.314	-0.146	0.324
CHAEBOL	0.069	0.730	0.071	0.724	0.072	0.717
R-squared	0.105		0.102		0.108	
Adjusted R-squared	0.0810		0.0782		0.0809	
Observation	309		309		309	

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 5 shows the empirical results on the effect of depth of subsidiary network. While model (1) shows the positive effect of depth of manufacturing subsidiary network on FX exposure, model (2) shows that depth of marketing subsidiary network decreases the FX exposure. Hence, H2(a) and (b) are both supported. When considering two types of the subsidiary network simultaneously, the effect of depth of marketing subsidiary network erodes just as shown in table 4. This implies that in managing FX exposure, manufacturing subsidiary network has a relatively higher impact.

Table 6: The Moderating Effect of Pass-through Ability

	Model 1		Model 2		Model 3	
	Coefficient	p-values	Coefficient	p-values	Coefficient	p-values
CONSTANT	5.838***	0.000	6.531***	0.000	5.728***	0.000
BREADTH_MARKET	-0.220+	0.078			-0.235	0.195
DEPTH_MARKET			-0.574*	0.024	-0.139+	0.084
BREADTH_MARKET* R&D INTENSITY	-0.056	0.133			-0.095+	0.071
DEPTH_MARKET* R&D INTENSITY			-0.049+	0.073	-0.215*	0.029
R&D INTENSITY	0.034	0.371	-0.056	0.688	0.267	0.236
SIZE	-0.134*	0.030	-0.128*	0.037	-0.141*	0.024
EXPORTS	-0.082	0.105	-0.089+	0.073	-0.077	0.130

DEBT_RATIO	0.017	0.849	0.016	0.860	0.021	0.812
PROFIT_MARGIN	-0.010+	0.070	-0.009+	0.094	-0.009+	0.096
FOR_DEBT	0.043	0.756	0.087	0.533	0.047	0.740
FOR_DERIVATIVES	-0.162	0.275	-0.156	0.295	-0.164	0.271
CHAEBOL	0.069	0.732	0.068	0.737	0.071	0.724
R-squared	0.110		0.103		0.114	
Adjusted R-squared	0.0802		0.0729		0.0779	
Observation	309		309		309	

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 6 displays the moderating effect of pass-through ability measured by R&D ratio. As a model (1) shows that the R&D ratio has an insignificant moderating effect on the breadth of the market subsidiary network but model (3) displays the significant result, H3(a) is partially supported. On the contrary, model (2) and (3) shows the R&D ratio further intensify the FX exposure reducing the effect of depth of marketing subsidiary network.

5. Conclusion and Discussion

This paper tests whether Korean MNEs are exposed to FX movement and operational hedge suggested by prior research matters in changing FX exposure. Empirical findings imply that Korean MNEs' operational hedge through subsidiary network indeed changes the level of FX exposure. The results suggest that while the breadth of manufacturing subsidiary network reduces the FX exposure, the depth increases the FX exposure. For marketing subsidiary network, both breadth and depth are likely to reduce the level of FX exposure faced by MNEs. Furthermore, such FX exposure reducing the effect of marketing subsidiary network is intensified when MNEs have higher R&D intensity.

The empirical findings provide several theoretical implications. Firstly, unlike prior studies, by identifying the types of subsidiaries, this paper differentiates the impact of manufacturing subsidiary and marketing subsidiary network. Empirical findings suggest that real option's value related to reducing FX exposure management comes from the wider manufacturing network that MNEs have established. However, for marketing subsidiary network, a larger commitment in a limited number of markets also reduces FX exposure, suggesting that marketing subsidiary network plays a different role in managing FX exposure. Instead of having a real option in shifting factors of production, marketing subsidiary may provide strategies that can buffer the adverse effect of FX movement. Hence, the results imply that, in order to analyze the value operational hedge for FX exposure, we have to take consider the type of subsidiary network to reflect different strengths possessed by different types of subsidiary network. Secondly, this paper suggests that benefits of marketing subsidiary network increase when the firm is focusing on technological competence that provides pass-through ability. As pass-through ability reduces FX exposure level through the marketing subsidiary network, it is better to analyze the firm's managerial ability and technological competitiveness together for investigating the FX exposure management issues.

This paper also provides managerial implications. Firstly, as the evidence of FX exposure managing ability of manufacturing and marketing subsidiary network is provided, managers may consider such hedging effect at the beginning of the foreign direct investment planning. Especially, firms that are extensively involved with foreign market may think about widening the manufacturing subsidiary network or focusing on a certain market with more marketing subsidiaries. Secondly, while the direct effect of R&D intensity on FX exposure is not existing, firms with the higher depth of marketing subsidiary network are supported by the pass-through ability. This suggests to practitioners that accumulating the market knowledge and building up a marketing network is important to efficiently utilize the resource competitiveness in reacting to the unexpected event such as FX movement.

This paper is not without limitation. While focusing on a sample of manufacturing firms allows to test the effect of manufacturing subsidiary together with the marketing subsidiary network, the relative importance of manufacturing subsidiary network may differ based on the industry characteristics. For instance, the FX exposure

hedging effect of manufacturing subsidiary network is likely to be minimal for services industry firms. Hence, further research that accounts for the different emphasis on different types of subsidiary network is needed. Also, while this paper mainly focuses on the technological competency using R&D ratio, firms may have market power based on other competencies. For instance, logistics company may exert influence based on their efficient management system and the size of the product flow. Hence, further research can utilize another element that provides firms a pass-through ability is needed.

Reference

Adler, M., & Dumas, B. (1984). Exposure to currency risk: definition and measurement. *Financial Management*, *13*(2), 41-50.

Allayannis, G., & Ihrig, J. (2001). Exposure and markups. *The Review of Financial Studies*, *14*(3), 805-835.

Allayannis, G., Ihrig, J., & Weston, J. P. (2001). Exchange-rate hedging: Financial versus operational strategies. *The American Economic Review*, *91*(2), 391-395.

Allayannis, G., & Ofek, E. (2001). Exchange rate exposure, hedging, and the use of foreign currency derivatives. *Journal of International Money and Finance*, *20*(2), 273-296.

Bartov, E., Bodnar, G. M., & Kaul, A. (1996). Exchange rate variability and the riskiness of U.S. multinational firms: Evidence from the breakdown of the Bretton Woods system. *Journal of Financial Economics*, *42*(1), 105-132.

Bartram, S. M., Brown, G. W., & Minton, B. A. (2010). Resolving the exposure puzzle: The many facets of exchange rate exposure. *Journal of Financial Economics*, *95*(2), 148-173.

Belderbos, R., & Zou, J. (2009). Real options and foreign affiliate divestments: A portfolio perspective. *Journal of International Business Studies*, *40*(4), 600-620.

Bodnar, G. M., Dumas, B., & Marston, R. C. (2002). Pass-through and exposure. *The Journal of Finance*, *57*(1), 199-231.

Bodnar, G. M., & Gentry, W. M. (1993). Exchange rate exposure and industry characteristics: evidence from Canada, Japan, and the USA. *Journal of International Money and Finance*, *12*(1), 29-45.

Bodnar, G. M., Hayt, G. S., & Marston, R. C. (1998). 1998 Wharton survey of financial risk management by US non-financial firms. *Financial Management*, *27*(4), 70-91.

Brown, G. W. (2001). Managing foreign exchange risk with derivatives. *Journal of Financial Economics*, *60*(2), 401-448.

Cheung, Y. W., & Westermann, F. (2017). *International Currency Exposure* (Eds.). MIT Press.

Chow, E. H., Lee, W. Y., & Solt, M. E. (1997). The exchange-rate risk exposure of asset returns. *Journal of Business*, *70*(1), 105-123.

Chung, C. C., Lee, S. H., Beamish, P. W., & Isobe, T. (2010). Subsidiary expansion/contraction during times of economic crisis. *Journal of International Business Studies, 41*(3), 500-516.

Clark, T., Kotabe, M., & Rajaratnam, D. (1999). Exchange rate pass-through and international pricing strategy: A conceptual framework and research propositions. *Journal of International* Business Studies, *30*(2), 249-268.

Dominguez, K. M. E., & Tesar, L. L. (2006). Exchange rate exposure. *Journal of International Economics, 68*(1), 188-218.

Dornbusch, R. (1987). Exchange rates and prices. *The American Economic Review, 77*(1), 93-106.

Faff, R. W., & Marshall, A. (2005). International evidence on the determinants of foreign exchange rate exposure of multinational corporations. *Journal of International Business Studies, 36*(5), 539-558.

Feenstra, R. C., Gagnon, J. E., & Knetter, M. M. (1996). Market share and exchange rate pass-through in world automobile trade. *Journal of International Economics*, *40*(1-2), 187-207.

He, J., & Ng, L. K. (1998). The foreign exchange exposure of Japanese multinational corporations. *The Journal of Finance, 53*(2), 733-753.

Hutson, E., & Stevenson, S. (2009). Openness, hedging incentives and foreign exchange exposure: A firm-level multi-country study. *Journal of International Business Studies*, *41*(1), 105-122.

Jiawen, Y. (1997). Exchange rate pass-through in U.S. manufacturing industries. *The Review of Economics and Statistics*, *79*(1), 95-104.

Jorion, P. (1990). The exchange-rate exposure of US multinationals. *Journal of Business*, 63(3), 331-345.

Kogut, B., & Kulatilaka, N. (1994). Operating flexibility, global manufacturing, and the option value of a multinational network. *Management Science*, *40*(1), 123-139.

Krapl, A. A. (2017). Asymmetric foreign exchange cash flow exposure: A firm-level analysis. *Journal of Corporate Finance, 44*(C), 48-72.

Lee, S.-H., & Makhija, M. (2008). The effect of domestic uncertainty on the real options value of international investments. *Journal of International Business Studies*, *40*(3), 405-420.

Marshall, A. P. (2000). Foreign exchange risk management in UK, USA and Asia Pacific multinational companies. *Journal of Multinational Financial Management*, *10*(2), 185-211.

Miller, K. D., & Reuer, J. J. (1998). Firm strategy and economic exposure to foreign exchange rate movements. *Journal of International Business Studies*, *29*(3), 493-513.

Pantzalis, C., Simkins, B. J., & Laux, P. A. (2001). Operational hedges and the foreign exchange exposure of U.S. multinational corporations. *Journal of International Business Studies, 32*(4), 793-812.

Trigeorgis, L., & Reuer, J. J. (2017). Real options theory in strategic management. *Strategic Management Journal, 38*(1), 42-63.

Williamson, R. (2001). Exchange rate exposure and competition: evidence from the automotive industry. *Journal of Financial Economics, 59*(3), 441-475.