Global Production vs. Inventory Supply and Financial Performance: Evidence from Korean Multinational Firms

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ABSTRACT

We analyze how firms' global production activities affect their inventory supply and financial performance in regards to its production location. For the analysis, we use information on global production quantities of 3,076 Korean multinational firms that operate business in Europe and Asia through foreign direct investment (FDI) from 2006 to 2013. Our estimation results show that an increase in global production ratio, measured by global production/total production, decreases inventory supply and financial performance of firms that produce in European countries, while it decreases financial performance of firms that produce in Asian countries. Although our results indicate that global production decreases financial performance of firms that produce in Europe and Asia, we find that its negative effects on financial performance are different based on the market demand uncertainty.

Keywords: Global Production, Inventory Supply, Financial Performance

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1. INTRODUCTION

Globalization has allowed firms to make various production location decisions. For instance, Hyundai Motorsproduces its vehicles from seven different foreign countries as well as in Korea. In particular, Hyundai Motors has produced 2,919 thousand vehicles from abroad in 2013, which account for more than 60 percent of its total production (HMG, 2016). Furthermore, its amount of global production keeps increasing. In 2014, the global production has increased 18.6 percent compared to that in 2013 and it was recorded as the highest production ever (Park, 2014).

Firms produce in foreign countries for different reasons. For example, they produce abroad to take advantage of small labor costs and transportation costs, or to gain access to foreign markets and advanced technology. However, production in foreign countries is usually accompanied by the significant risks. According to the survey by Accenture, globalization in supply chains can be negatively associated with firms' financial performances mainly due to the complex logistics, volatile fuel prices and currency exchange rates, consumer preference shifts, and natural disasters (Chopra and Meindl, 2010). Hence, global production may result in a profit or loss.

In this study, we analyze how firms' global production activities affect their inventory supply and financial performances. For the analysis, we use information on global production quantities of 3,076 Korean multinational firms that operate business in Europe and Asia

through foreign direct investment (FDI) from 2006 to 2013, where the data is obtained from the Export-Import Bank of Korea and Data Guide. Following the previous literature on firm's global production (Han *et al*., 2013; Hitt *et al*., 2006), we estimate the effects of global production on inventory supply and financial performance by measuring the global production ratio by (global production/total production); the inventory supply by ((365 ×total inventory)/industry-specific PPI); the financial performance by return on sales (ROS).

In the empirical specifications, we use two separate samples which include firms that locate production in Europe and firms that locate production in Asia. Our estimation results from using a sample of firms that produce in Europe show that an increase in a global production ratio decreases both inventory supply and financial performance, while its negative effects are more evident in countries where demand uncertainty is low. These results imply that higher production in European countries may be detrimental due to higher labor costs. However, the higher production can be beneficial when demand uncertainty is high since the production facilities are located near one of the largest markets in the world, which would reduce lead time. Hence, a firm can adjust its production decisions quickly and global production would have a positive impact on its financial performance in the long-run.

On the other hand, estimation results from using a sample of firms that produce in Asian countries provide different outcomes. We find that while global production decreases firm's financial performance, it is likely to increase financial performance as the firm has more stable market demand. These results imply that, compared to the results from European countries, production facilities in Asian countries are used to satisfy stable demand and as market becomes more stable, an increase in production can lead to better financial performance. We also find that inventory supply and financial performance have U-shaped relationship regardless of foreign production location. That is, financial performance may increase when inventory supply is either too high or too low.

To the best of our knowledge, this study is the first to investigate how global production affects inventory supply and financial performance. Our results show that global production and demand uncertainty have different interaction effects on firm's inventory supply and financial performance in regards to its production location. In contrast to the common belief, in particular, we provide evidence that firm's engagement in global production does not always bring the profits. Instead, effects of global production depend on the location where actual production takes place and its demand conditions.

2. LITERATURE REVIEW

Our study is related to the previous literatures that

analyze the relationship between international diversification and firms' performance.[1] Findings from researchers are mixed. For instance, Vernon (1971) and Kim *et al*. (1993) show that international diversification and firm performance are positively related; whereas, Fatemi (1984) shows a negative relationship. In addition, an inverted U-shape is used to explain the relationship between international diversification and firms' performances, see Hitt *et al*. (1997). We refer Hitt *et al*. (2006), which provides a comprehensive review in this area.

Among recent studies, our work is closely related to Han *et al*. (2012) who analyze how firm sales in emerging markets are related to its inventory supply and financial performance. In their empirical analysis, the emerging market sales ratio is measured by sales in emerging markets/total sales, inventory supply by (365×total inventory)/cost of goods sold, and financial performances by net income/sales (i.e., return on sales, or ROS) and net income/assets (i.e., return on assets, or ROA). They find that an increase in emerging market sales ratio decreases firm's inventory supplies while increasing both ROS and ROA. Although our study is closely related to Han *et al*. (2012), we focus on examining how inventory supply and financial performances are associated with the global *production* ratio rather than the global (or emerging) markets *sales* ratio. Furthermore, while Han *et al*. (2012) find that global sales increase firm performance, our results provide evidence that global production may rather decrease firm's financial performance.

3. ESTIMATION STRATEGY

Global production may increase or decrease firm's financial performance. Firms make production location decisions in foreign countries to take advantage of small labor costs, transportation costs, inventory holding costs, and import and export taxes. On the other hand, firms sometimes establish global production platform to absorb superior technology at the expense of large costs that include operational and financial risks, such as complex logistics and currency exchange rates (Hitt *et al*., 2006; Han *et al*., 2012).

Production in foreign countries as well as in the home country may increase or decrease firm's inventory supply. If a production facility is located in a faraway region from customers to exploit low labor costs, it may increase firm's inventory supply because of an increase in lead time. On the other hand, locating production facility nearby final consumption market, mainly to save transportation costs and import taxes, is likely to decrease firm's inventory supply because of a decrease in lead time (Chopra and Meindl, 2010).

Here, we use following estimation equations to ex-

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1) The international diversification is also referred to as global diversification.

amine how global production affects inventory supply and financial performance:

$$Inventory\_Supply = \alpha_0 + \alpha_1 \cdot Global\_Production$$
$$+ \alpha_2 \cdot Demand\_Uncertainty$$
$$+ \alpha_3 \cdot Global\_Production \cdot Demand\_Uncertainty$$
$$+ \alpha_4 \cdot Exchange\_Rate + \alpha_5 \cdot Debt\_Cost$$
$$+ \alpha_6 \cdot Gross\_Margin + \alpha_7 \cdot Capital\_Intensity$$
$$+ \alpha_8 \cdot Firm\_Size + Industry\_Effects + Firm\_Effects$$
$$+ Time\_Effects + \varepsilon_1 \qquad (1)$$

$$Financial\_Performance = \beta_0 + \beta_1 \cdot Global\_Production$$
$$+ \beta_2 \cdot Demand\_Uncertainty$$
$$+ \beta_3 \cdot Global\_Production \cdot Demand\_Uncertainty$$
$$+ \beta_4 \cdot Exchange\_Rate + \beta_5 \cdot Inventory\_Supply$$
$$+ \beta_6 \cdot Inventory\_Supply\_Squared + \beta_7 \cdot Leverage\_Level$$
$$+ \beta_8 \cdot Capital\_Intensity + Industry\_Effects$$
$$+ Firm\_Effects + Time\_Effects + \varepsilon_2 \qquad (2)$$

where
- Inventory_Supply: 365×total inventory (deflated using industry-specific PPI);
- Inventory_Supply_Squared: square of Inventory_Supply;
- Global_Production: total production in foreign plants/total production;
- Financial_Performance: net profit/total sales (i.e., return on sales or ROS);
- Demand_Uncertainty: standard deviation of de-trended annual sales during a rolling 3-year period;
- Exchange_Rate: real exchange rate of Korea;
- Debt_Cost: total interest expenses/total liabilities
- Gross_Margin: cost of goods sold/total sales;
- Capital_Intensity: capital investment/total sales;
- Firm_Size: total sales (deflated using industry-specific ppi);
- Leverage_Level: total liabilities/total assets;
- Industry_Effects: two-digit KSCI industry-specific dummy variables;
- Firm_Effects: firm-specific dummy variables;
- Time_Effects: year-specific dummy variables.

In both estimation equations, we include demand uncertainty in the production location as a control variable which reflects market dynamics faced by a firm that produce abroad. While above estimation equations and variables are similar to Han *et al.* (2012)'s estimation strategy, we consider global production instead of emerging market sales and additionally include currency exchange rate as a control variable that might affect firm's inventory supply and financial performance.

For the empirical analysis, we use dataset that includes information on global production quantities of Korean multinational firms that operate business in Europe and Asia through FDI from 2006 to 2013. This foreign affiliate-level dataset is obtained from the Overseas Direct Investment Statistics from the Export-Import

Bank of Korea and contains information on individual foreign affiliates owned by Korean firms, such as location, industry sectors, and account variables. Since our dataset provides the firm identification number for each foreign affiliate, we match foreign affiliates to their parent firms and aggregate foreign affiliate accounts by their parent firms for the analysis.

To capture firm activity and performance, on the other hand, we use firm-level data from the Data Guide. This dataset includes all Korean firms that are registered as corporations which are externally audited or publicly traded in the Korean Stock Exchange. It contains information on account variables of firms that are classified by the five-digit Korean Standard Industrial Classification (KSIC).

For the estimation, while most of variables in Eq. (1) and Eq. (2) are computed by using information on firm account variables, such as inventory level, debt cost, gross margin, firm size, and leverage level, we use information on foreign affiliate accounts to measure the variables of our interest. In particular, using information on foreign affiliate's inventory asset and sales, we calculate firm's total production in foreign country as a sum of foreign affiliate's current sales and net inventory change between current and previous year. We then divide foreign production by firm's total production to obtain global production ratio. To measure demand uncertainty in the foreign production location, on the other hand, we calculate the standard deviation of foreign affiliate's de-trended annual sales from their location during a rolling 3-year period. For instance, for a firm that makes production at country j in 2013, demand uncertainty is computed by the standard deviation of annual sales made by its foreign affiliates in country j during 2010~2013 after controlling for time trends. For our new variable, currency exchange rate, we use data on real exchange rates of Korea, which is obtained from Bruegel, the Brussels-based Think Tank.[2]

To prevent a potential bias that may arise from the extreme values on regression results, we winsorize all variables by replacing high extreme values with 99 percentiles and low extreme values with 1 percentile. Descriptive summary statistics for winsorized variables are presented in Table 1.

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2) Note that different from the *nominal* exchange rate, according to IMF (2016), the *real* exchange rate measures "the value of a country's goods against those of another country, a group of countries, or the rest of the world." In other words, the real exchange rate measures the average real value of a currency compared to multiple countries. For instance, Bruegel's real exchange rates are based on data from 178 countries, Bruegel (2016). We use the real exchange rate due to the fact that our dependent variables (i.e., inventory supply and ROS) may be affected by multiple currencies because firms can either produce or sell in multiple countries.

Table 1. Descriptive Summary Statistics

	Mean	Standard Deviation	Mini-mum	Maxi-mum
Inventory_Supply	18.63	2.306	12.03	24.74
Financial_Performance	-0.0186	0.598	-11.11	1.31
Global_Production	0.0004	0.0042	-0.081	0.2376
Demand_Uncertainty	15.35	1.99	9.74	20.75
Exchange_rate	4.706	0.091	4.52	4.867
Debt_Cost	-7.865	3.22	-15.67	-0.281
Gross_Margin	0.47	3.424	-7.591	8.984
Capital_Intensity	0.068	3.319	-8.245	8.403
Firm_Size	21.08	3.319	-8.245	8.403
Leverage_Level	-0.821	0.603	-3.918	0.482

Note) All variables represent performance of firms that produce in Europe and Asia. Inventory_Supply and Firm_Size are computed in logarithm terms.

4. EXPERIMENTAL RESULTS

Table 2 and Table 3 present the results from estimating the effects of global production on firm's inventory level and financial performance by using a sample of firms that locate production in European countries and firms in Asian countries respectively. In all specifications, we include year-, firm-, and two-digit KSIC industry-specific fixed effect to control for unobserved firm characteristics and unobserved systematic differences across time and industry sectors that also may affect inventory supply and financial performance. Robust standard errors clustering for host countries are reported in the parenthesis to control for the possible correlated shocks that might affect all foreign affiliates producing in the same host country.

4.1 Inventory Supply

Investigating the effects of global production on firm's inventory supply in different regions, coefficients in columns (1) and (2) in Table 2 show that inventory supply is negatively and significantly associated with the global production ratio in European countries, while there is no significant relationship between the two variables in Asian countries. Taking into account that Europe is one of the largest markets in the world, these results imply that producing nearby large final consumption market reduces lead time between production and sales which in turn reduces inventory supply of firms. On the other hand, insignificant relationship between global production ratio and inventory supply in Asian countries may be explained by the fact that most of Korean FDI firms in these countries heavily rely on export than local sales. Therefore, production in either Korea or Asian countries may not reduce lead time and inventory supply.

Table 2. Global Production and Inventory Supply

	Europe	Asia
	(1)	(2)
	Inventory_Supply	Inventory_Supply
Global_Production	-206.2***	35.93
	(32.34)	(28.24)
Demand_Uncertainty	0.00115	-0.0515**
	(0.0243)	(0.0185)
Global_Production ×Demand_Uncertainty	12.09**	-2.321
	(1.853)	(2.528)
Exchange_Rate	-0.125	0.209
	(0.469)	(1.141)
Debt_Cost	-0.00581	0.0461
	(0.0367)	(0.0317)
Gross_Margin	0.0133	0.0116
	(0.0364)	(0.0276)
Capital_Intensity	-0.0255	0.0496***
	(0.0155)	(0.0138)
Firm_Size	0.555***	0.984***
	(0.181)	(0.0198)
Constant	8.036*	-2.155
	(4.220)	(4.870)
N	576	3521
Adjusted R-square	0.998	0.758

Note) Robust standard errors clustering for host countries are in parenthesis. *, **, *** denote statistically significant at the 10%, 5%, and 1% level, respectively.

Examining the effects of demand uncertainty, we find that coefficient estimates on demand uncertainty in Asian countries is negative and significant. Considering that Asia is one of the largest production platform in the world consisting of countries that are largely different in economic growth and demand risks, negative and significant coefficient on demand uncertainty in the second column in Table 2 provides evidence that as market demand becomes more predictable, firms are likely to exploit economies of scale in that location and increase inventory supplies (Allon and van Mieghem, 2010).

We also estimate the effects of firm's global production on inventory supply by considering demand uncertainty in its production location. The coefficient estimate on interaction term between global production and demand uncertainty in the first column is positive and significant, while it is insignificant in the second column in Table 2. This implies that the effects of global production on firm's inventory supply are significantly associated with demand uncertainty from the production location for firms that locate production in European countries than firms that produce in Asian countries. That is, firms that locate production in European countries are likely to increase their inventory supply as they face unstable market demand in the production location. These results suggest that the high demand uncertainty induces a firm to increase its safety stock not in Korea but in Europe due to the closeness to the market.

4.2 Financial Performance

In regards to firm's financial performance from producing in different regions, coefficient estimate in the first column in Table 3 indicates that ROS for firms that locate production in European countries is negatively and significantly associated with the global production ratio. It implies that firm's ROS increases as its global production in European countries decreases, which may be explained by the higher labor costs in these countries compared to that in Korea. While demand uncertainty has insignificant effects, its interaction term with global production ratio has positive and significant effects on firm's ROS. This implies that negative effects of global production on firm's ROS are offset by the high demand uncertainty in the production location. In other words, firms are more likely to increase their ROS as they make production in European countries where demand is unpredictable. While most of European countries in our sample incur high labor costs, due to the small lead time between production and sales, firms can make more flexible operation decisions than the case when they produce in Korea. Therefore, under the high uncertainty in market demand, locating production nearby large final consumption markets can be profitable.

Table 3. Global Production and Financial Performance

	Europe	Asia
	(1)	(2)
	Financial_ Performance	Financial_ Performance
Global_Production	-292.2***	-214.5***
	(22.38)	(31.8)
Demand_Uncertainty	0.0521	-0.0164
	(0.036)	(0.0227)
Global_Production ×Demand_Uncertainty	16.71***	-20.86***
	(1.307)	(2.697)
Exchange_Rate	0.66	0.342
	(1.513)	(0.235)
Capital_Intensity	-0.0065	0.0065
	(0.0855)	(0.078)
Inventory_Supply	-1.02**	-0.861***
	(0.381)	(0.18)
Inventory_Supply_ Squared	0.0212**	0.0227***
	(0.01)	(0.0048)
Leverage_Level	0.0435	0.001
	(0.086)	(0.01)
Constant	3.438	3.566**
	(8.98)	(1.517)
N	811	3811
Adjusted R-square	0.704	0.184

Note) Robust standard errors clustering for host countries are in parenthesis. *, **, *** denote statistically significant at the 10%, 5%, and 1% level, respectively. In addition, the number of firms in Table 2 and Table 3 are different because we use different control variables (i.e., Debt_Cost, Gross_Margin, and Firm_Size are only used in Eq. (1) and Leverage_Level is only used in Eq. (2)) and there are more missing values in control variables in Eq. (1) than those in Eq. (2).

Coefficient estimates in the second column in Table 3 indicate that global production in Asian countries has negative and significant effects on firm's ROS, which is consistent with firms in European countries. While demand uncertainty does not appear to have significant effects, its interaction term with global production ratio now has negative and significant effects on ROS. In contrast to the European countries, this implies that negative effects of global production on firm's ROS are strengthened by the high demand uncertainty in the production location. In other words, firms are more likely to incur loss on their ROS as they locate production in Asian countries where demand is not stable.

Turning to our control variables, we find a significant curvilinear association between inventory supply and ROS for firms that locate production in European countries and in Asian countries. The U-shaped relationship between inventory supply and ROS in both European and Asian countries suggest that ROS may increase when inventory supply is either too low or too high. Considering the significant relationship between global production ratio and inventory supply for firms that locate production in European countries, these results suggest that increasing global production in European countries initially decreases firm's inventory supply and ROS. However, after inventory supply reaches beyond certain lowest point, global production will increase firm's ROS.

5. CONCLUSIONS

In this study, we investigate how firm's global production is related to its inventory supply and financial performance in regards to its production location. Using a sample of firms that locate production in European countries and firms that locate production in Asian countries, we first find that firm's inventory supply is likely to decrease as the global production ratio increases in European countries. In particular, negative effects of global production on inventory supply appears to be more evident in countries where market demand is more predictable. Among firms that produce in Asian countries, on the other hand, our results indicate that there is no significant relationship between global production and inventory supply, while market demand uncertainty has significant and negative effects on firm's inventory supply.

We additionally find that while firm's global production significantly reduces ROS, global production has different effects when market demand uncertainty is considered. Our results suggest that firms that locate production in Asian countries are likely to have a high ROS as they produce in countries where market demand is more stable. For firms that locate production in European countries, on the other hand, they are more likely to have a high ROS as they produce in countries where market demand is less stable.

Although this study provides rigorous analysis, several extensions may be possible. Recent free trade ag-

reements (FTAs) among countries have significantly changed the global supply chain. Hence, analyzing the effects of FTAs on global production and financial performance may be interesting. Also, considering that firms may influence inventory supply of their own foreign affiliates that operate business abroad through intra-firm trade, it will be interesting to study how global production is linked to firm's inventory supply through inventory changes in foreign production facilities.

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