

# **Differential Impact of Uncertainty on Exporting Decision in Risk-averse and Risk-taking Firms: Evidence from Korean Firms**

**Haeng-Sun Kim**

Most existing literature examining the links between firm heterogeneity and entry into exporting assumes that firms are risk neutral. In this study, we relax this strict assumption that firms are risk neutral and introduce different attitudes of firms toward risk as an additional source of firm heterogeneity. In particular, we examine how risk attitude changes the effect of uncertainty on the decision of a firm to export considering the different types of uncertainty faced by the firm, namely, firm-specific and macroeconomic. Our analysis yields two interesting findings. First, firm-specific uncertainty discourages risk-averse firms from participating in foreign markets more than risk-taking firms. One possible explanation for this finding is that risk-averse firms are more cautious in export market participation when firm-specific uncertainty increases. Second, we find that risk-averse firms are less likely to decrease their export market participation when responding to macroeconomic uncertainty. Thus, risk-averse firms are more likely to diversify their domestic risk by participating in foreign markets in responding to macroeconomic uncertainty.

*Keywords:* Exports, Risk aversion, Uncertainty, Firm heterogeneity

*JEL Classification:* D81, F14, G32

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## I. Introduction

As the presence of firm heterogeneity is introduced as a new channel to understand international trade, empirical research investigating links between firm heterogeneity and decision to export at the microeconomic level has prominently grown in recent decades. Some of these studies have explored differences in firms' export market participation across firms by combining fixed costs and the presence of firm heterogeneity (Melitz 2003; Greenaway *et al.* 2007; Chaney 2013).

Melitz (2003) has theoretically proved that the presence of firm heterogeneity in terms of productivity and sunk entry costs explains why all firms do not engage in international trading activity. According to his framework, a firm forms expectations about the profitability of entry into exporting when deciding to enter or not. Thus, if expected profits of entry into exporting are high enough to cover its entry cost, then a firm chooses to serve a foreign market on a Melitz-type heterogeneous firm model.

If we assume that firms are risk neutral while holding others constant, firms will enter into exporting until expected profits are equal to the entry costs, as shown in Melitz (2003). In reality, however, firms have different attitudes toward risk under uncertainty. Therefore, considering risk attitude of a firm could result in disparity from Melitz's (2003) finding, that is, firms enter into exporting as long as their expected profits are high enough to cover entry costs. For example, risk-averse firms are willing to accept lower expected profits in exchange for less exposure to risk. Conversely, risk-taking firms are willing to have more exposure to risk in exchange for higher expected profits.

Greenaway *et al.* (2007) and Chaney (2013) consider financial dimension as an additional source of firm heterogeneity to understand export market participation. In particular, Chaney (2013) introduces financial constraints into a Melitz-type heterogeneous firm model. He proves that as participation in the international market incurs substantial start-up costs, liquidity-constrained firms face difficulty in financing such costs and consequently are less likely to export. Greenaway *et al.* (2007) explore the effect of financial health of UK manufacturing firms on their export market participation. Exporting firms in the United Kingdom show better financial health than non-exporting firms. However, as the degree of risk aversion of firms affects heterogeneity in the financial characteristics and exporting decision, direct and indirect effects should

be analyzed.

Most empirical literature that has examined the links between firm heterogeneity and entry into exporting assumes that firms are risk neutral. This assumption is criticized by Sandmo (1971), who argues that a firm's risk attitude is an important factor affecting its decision making. In particular, he points out that the results derived under the assumption that firms are risk neutral can be less informative. For example, Creusen, and Lejour (2011) find the negative effect of uncertainty on exporting decisions of firms, but they do not consider the risk attitudes of firms in their analysis. However, if a higher (lower) degree of risk aversion of firms negatively affects the exporting decisions of firms under uncertainty, the risk attitudes of firms will ruin the effect of uncertainty on exporting decisions of firms. For this reason, Creusen, and Lejour's (2011) finding in which the effect of uncertainty on the exporting decisions of firms is negative is not that convincing.

In this study, we relax the strict assumption that firms are risk neutral and introduce different attitudes of firms toward risk as an additional source of firm heterogeneity. In particular, we examine how risk attitude changes the effect of uncertainty on the decision of a firm to export considering the different types of uncertainty faced by the firm, namely, firm-specific and macroeconomic. For this, we use a panel of 36,530 firm-year observations representing 5,386 Korean firms for the 1991-2011 period.

Our basic analysis yields two interesting findings. First, on average, Korean manufacturing firms were risk taking before the Asian financial crisis of 1997 but became risk-averse after the crisis. Second, the effect of uncertainty on a firm's decision to export is negative. This negative effect of uncertainty is consistent with the findings of Creusen, and Lejour (2011). However, unlike Creusen, and Lejour (2011), we explore the relevance of risk attitudes of firms to the export-uncertainty relation. As a result, we obtain evidence that the degree of the negative effect of uncertainty on a firm's exporting decision varies depending on whether the firm is risk averse or risk taking and whether the firm faces firm-specific or macroeconomic uncertainty. For example, we find that the negative effect of firm-specific uncertainty on a firm's export decision is relatively greater in risk-averse firms than in risk-taking firms. Hence, firm-specific uncertainty discourages risk-averse firms from participating in foreign markets more than risk-taking firms. This observation implies that risk-averse firms are more reluctant to begin exporting when firm-specific uncertainty increases. Further, our results show that the degree

of the negative effect of macroeconomic uncertainty on a firm's exporting decision is lower in risk-averse firms than in risk-taking firms. That is, risk-averse firms are less likely to decrease their export market participation when macroeconomic uncertainty increases. This empirical evidence suggests that under macroeconomic uncertainty, risk-averse firms are more likely to follow a strategy of market spreading by participating in foreign markets than risk taking firms.

The rest of this study is organized as follows. In the following section, we briefly introduce the theoretical background of our empirical analysis. In Section III, we provide details on the data used in this study, the measurement of uncertainty faced by firms, and the measurement of the risk attitude of firms. In Section IV, we present the empirical results. In particular, we examine in Section IV-A how risk attitude changes the effect of uncertainty on the decision of firms to export considering the different types of uncertainty faced by firms. In Section IV-B, we further check the robustness of the results. Finally, Section V concludes.

## II. Related Literature Review

The relationship between firms' different attitudes toward risk and exporting decisions under uncertainty is built on two different strands of literature. The first strand of literature concerns the relationship between investment and uncertainty, particularly how the degree of risk aversion of firms affects the relationship between investment and uncertainty. The second strand is the literature on the relationship between exporting decision and uncertainty of firms.

### A. Investment and Uncertainty

Many studies have attempted to investigate the investment decision of firms under uncertainty. The literature survey in Lensink *et al.* (2001) shows that although most of the analyses (*e.g.*, 17 papers among 20 empirical studies) find a negative effect of uncertainty on investment, some report a positive effect or even a mixed one. For example, Hartman (1972) and Abel (1983) indicate that the relationship between uncertainty and investment will be positive if the marginal product of capital is convex in the output price. By contrast, Leahy, and Whited (1996) present that greater uncertainty exerts a negative effect on investment. Similar conclusions are drawn from Ghosal, and Loungani (2000), who

also find that the effect of uncertainty on investment is negative. In particular, they find the effect to be relatively greater in industries dominated by small firms. Interestingly, Huizinga (1993) reveals mixed results that price uncertainty is a negative determinant of investment, whereas wage and material cost uncertainty have a positive effect.

To sum up, no explicit conclusions can be derived on whether the effect of uncertainty on investment is negative or positive. Moreover, these studies do not clearly agree on which channel uncertainty affects investment. Different channels are identified, namely, (1) convexity of the marginal product of capital (Hartman 1972; Abel 1983), (2) substitutability of production factors (Leahy, and Whited 1996), (3) financial constraints (Ghosal, and Loungani 2000), and (4) firms' attitudes toward risk (Zeira 1990; Nakamura 1999). Many of these studies share a common trait: they assume that a firm is risk neutral except the last case. As this study focuses on exploring how risk attitude changes the effect of uncertainty on firms' decision to export, we review the related literature.

Zeira (1990), Nakamura (1999), and Bo, and Sterken (2007) investigate the effects of the degree of risk aversion on the relationship between investment and uncertainty. Zeira (1990) analyzes how the degree of risk aversion of firms affects the investment decision of a firm under wage rate uncertainty. His framework proves that uncertainty has a different effect on investment. On the one hand, uncertainty decreases investment through the concavity of the utility function representing the degree of risk aversion of the firm; on the other hand, uncertainty increases investment through the convexity of the profit function. Thus, the net effect of uncertainty on investment depends on the trade-off between the degree of risk aversion of the firm and the convexity of the profit function. Similar to Zeira (1990), Nakamura (1999) finds that the effect of output price uncertainty on investment changes depending on the degree of risk aversion of firms and the elasticity of output to labor in a production function. Bo, and Sterken (2007) examine how firms' risk attitude affects the impact of demand uncertainty on fixed investment. They find that risk-averse firms decrease investment in the presence of demand uncertainty, whereas risk-taking firms increase investment in the same situation.

### *B. Exporting Decisions and Uncertainty*

The discussion is limited to investment studies. The export decision

is akin to an investment decision in some aspects. These two decisions are independent of firm behavior in the domestic market and require a firm to bear the sunk costs regarding their decisions. Thus, we can regard export decision as an investment decision.

The second strand is drawn from the literature on firms' exporting decision under uncertainty (*e.g.*, Creusen, and Lejour 2011; Greenaway *et al.* 2010; Segura-Cayuela, and Vilarrubia 2008). Creusen, and Lejour (2011) investigate the exporting decisions of firms under uncertainty by using Dutch firm-level data. They find that more uncertainty reduces the probability of firms entering the export market. Segura-Cayuela, and Vilarrubia (2008) reveal that the most productive firms do not always enter the export market in the presence of market size uncertainty. Most studies have focused on export market entry and exit decisions under different kinds of uncertainty. However, Greenaway *et al.* (2010) explore the effect of exchange rate uncertainty on export market participation and export intensity of UK manufacturing firms. They find that exchange rate uncertainty is insignificant in explaining entry into export markets but is positively associated with export intensity.

The above mentioned studies have introduced different kinds of uncertainties and have identified the relationship between firms' exporting decision and uncertainty. However, the channels through which uncertainty can affect a firm's exporting decision have not been analyzed much in these studies. Thus, we introduce firms' different attitudes toward risk as a channel through which uncertainty can affect exporting decision. Then, we examine how risk attitude changes the effect of uncertainty on a firm's decision to export by considering firm-specific and macroeconomic uncertainty. Before initiating the empirical analysis, we hypothesize the following:

**Hypothesis 1.** The effect of uncertainty on firms' exporting decision is negative.

**Hypothesis 2.** Risk attitude changes the effect of uncertainty on firms' exporting decision.

**Hypothesis 3.** Firm-specific or macroeconomic uncertainty has a different role in firms' exporting decision between risk-averse and risk-taking firms.

To the best of our knowledge, no study has investigated the relationship between risk attitudes and export market participation under uncertainty. Thus, this paper contributes to the literature on firms' ex-

porting decision under uncertainty.

### III. Data and Methodology

In this section, we provide details on the data used in this study and the measurement of uncertainty and risk attitude of the firm.

#### A. Data Description

Our main source of data is the KIS database compiled by the Korea Information Service, Inc. (KIS), which is one of Korea's major credit-rating agencies. The KIS database provides corporate and financial information on all publicly listed Korean firms or on those with a total asset of 7 billion won<sup>1</sup> or more. However, this study only uses manufacturing firm data with a December fiscal year end. We restrict our analysis to surviving firms<sup>2</sup> only because the KIS database does not provide information on closed firms. We focus on the 1991-2011 sample period as we consider the effect of the Asian financial crisis of 1997. To control for the potential influence of outliers, we exclude firms that declared negative values for total assets and total sales.<sup>3</sup> We also exclude observations in the top and bottom 1 percent of the sample in terms of total assets, total sales, and number of employees. These cut-offs aim to eliminate coding errors or extraordinary firm shocks. In addition, we drop from the analysis firms that have any missing observations for our variables of interest. Accordingly, the final data set we obtain is an unbalanced panel structure of 36,530 firm-year observations representing 5,386 Korean firms for the 1991-2011 period (See Appendix Table 1 for details about the structure of our unbalanced panel). All values utilized in the analysis have been converted into real values using the aggregate gross domestic product (GDP) deflator with a base year of 2005.

Table 1 provides descriptive statistics for the relevant variables by export status.<sup>4</sup> In particular, the table reports the mean, median,

<sup>1</sup> For a better understanding of the threshold of 7 billion won, we introduce the criteria of Korean small and medium enterprises (SMEs). According to "Article 2 of Framework Act on SMEs" and "Article 3 of Enforcement Decree of the Act," Korean SMEs in the manufacturing industry are defined as firms with a capital of 8 billion won or less or with a number of employees of fewer than 300.

<sup>2</sup> Surviving firms are those that exist as of the date we obtained the data (April 13, 2013) after the entry into the market.

<sup>3</sup> We drop one observation for total assets and two observations for total sales.

standard deviation, minimum and maximum for each variable. Exporters are on average larger than non-exporters in terms of total assets, total sales, and number of employees (*e.g.*, Bernard, and Jensen (2001) for the United States; Greenaway *et al.* (2007) for the United Kingdom). The same pattern also holds true in our results. We observe that exporting firms are on average larger than firms producing only for domestic markets over the whole-period sample (1991-2011), pre-crisis sample (1991-1997), and post-crisis sample (1998-2011). Moreover, total assets, total sales, and number of employees, which are generally used as indicators of size in the literature, are more volatile for exporting firms than for non-exporting firms. Labor productivity is defined as the ratio of total sales to the number of employees. Our results show that productivity of exporting firms is higher and less volatile for exporting firms than for non-exporting firms. Firm profit is calculated as the difference between sales and cost of goods sold. Exporting firms are on average more profitable than non-exporting firms. In addition, profits of exporting firms are more variable than those of non-exporting firms during the whole-period (1991-2011), pre-crisis (1991-1997), and post-crisis sample (1998-2011).

Panels B and C of Table 1 compare various firm characteristics between exporters and non-exporters during the periods before and after the Korean financial crisis. Overall, our findings show that labor productivity of Korean manufacturing firms improved after the 1997 financial crisis. However, against our expectation, firms are on average larger and more profitable before the Asian financial crisis of 1997 than after the crisis. However, the decrease in the mean of firm size or firm profitability over time is not surprising given that this study is based on information only for surviving firms. Firms surviving in the long-term are likely to be larger or more profitable on average, and the inclusion of relatively small firms over time will obviously decrease the mean of firm size or firm profitability.

Finally, the extent to which our sample of firms is representative of the Korean manufacturing firms should be considered. As our empirical work pertains mainly to firm heterogeneity at the micro level, findings from this study may not be generalizable if our sample of firms does not exhibit the entire manufacturing firms in South Korea. To address

<sup>4</sup>Based on the export sales, firms are classified into exporting and non-exporting. We define a firm that shows a positive export sale as an exporting firm.



**TABLE 1**  
DESCRIPTIVE STATISTICS BY EXPORT STATUS

	All Firms					Exporting Firm <sup>a</sup>					Non-Exporting Firms							
	Mean	Median	Std. Dev.	Minimum	Maximum	Obs.	Mean	Median	Std. Dev.	Minimum	Maximum	Obs.	Mean	Median	Std. Dev.	Minimum	Maximum	Obs.
<b>Panel A: All Period (1991-2011)</b>																		
Real Asset <sub>it</sub>	55.81	24.66	87.10	0.49 <sup>b</sup>	1231.68	36,530	92.94	56.24	108.82	0.49	1202.28	14,089	32.50	15.16	59.22	0.49	1231.68	22,441
Real Sales <sub>it</sub>	55.51	26.90	73.58	0.49	512.73	36,530	83.94	51.95	87.88	0.56	512.73	14,089	37.66	18.36	56.03	0.49	512.59	22,441
Employees <sub>it</sub>	174.96	106.00	188.16	8.00	1098.00	36,530	262.18	190.00	225.66	8.00	1098.00	14,089	120.21	76.00	133.76	8.00	1098.00	22,441
Labor Productivity <sub>it</sub>	0.35	0.25	0.47	0.00	51.24	36,530	0.36	0.26	0.35	0.00	14.47	14,089	0.35	0.24	0.53	0.00	51.24	22,441
Profit <sub>it</sub>	9.62	4.19	15.94	-64.78	313.20	36,530	15.34	8.75	19.74	-57.93	313.20	14,089	6.03	2.81	11.65	-64.78	268.98	22,441
<b>Panel B: Pre-Crisis (1991-1997)</b>																		
Real Asset <sub>it</sub>	68.32	35.83	91.23	0.50	1202.03	4,666	90.02	56.16	103.25	0.83	1202.03	2,540	42.40	22.07	65.58	0.50	1190.15	2,126
Real Sales <sub>it</sub>	60.90	36.29	69.24	0.49	512.73	4,666	78.76	53.53	79.00	0.82	512.73	2,540	39.55	23.70	47.24	0.49	467.58	2,126
Employees <sub>it</sub>	283.50	205.00	240.47	8.00	1098.00	4,666	362.59	276.00	260.91	14.00	1098.00	2,540	189.00	134.00	170.86	8.00	1098.00	2,126
Labor Productivity <sub>it</sub>	0.24	0.18	0.22	0.01	7.30	4,666	0.23	0.18	0.16	0.01	2.03	2,540	0.25	0.18	0.27	0.01	7.30	2,126
Profit <sub>it</sub>	11.76	6.36	15.46	-36.07	204.48	4,666	14.72	8.92	17.33	-24.49	204.48	2,540	8.22	4.24	11.94	-36.07	179.21	2,126
<b>Panel C: Post-Crisis (1998-2011)</b>																		
Real Asset <sub>it</sub>	53.98	23.01	86.33	0.49	1231.68	31,864	93.58	56.28	110.00	0.49	1202.28	11,549	31.46	14.42	58.42	0.49	1231.68	20,315
Real Sales <sub>it</sub>	54.72	25.43	74.17	0.49	512.69	31,864	85.07	51.50	89.68	0.56	512.69	11,549	37.47	17.70	56.87	0.49	512.59	20,315
Employees <sub>it</sub>	159.07	96.00	173.63	8.00	1098.00	31,864	240.10	172.00	210.83	8.00	1098.00	11,549	113.01	71.00	127.13	8.00	1097.00	20,315
Labor Productivity <sub>it</sub>	0.37	0.26	0.49	0.00	51.24	31,864	0.39	0.28	0.37	0.00	14.47	11,549	0.36	0.24	0.55	0.00	51.24	20,315
Profit <sub>it</sub>	9.31	3.89	15.99	-64.78	313.20	31,864	15.48	8.72	20.23	-57.93	313.20	11,549	5.80	2.69	11.60	-64.78	268.98	20,315

Notes: Real Asset<sub>it</sub>, Real Sales<sub>it</sub>, and Profit<sub>it</sub> are in billion won. Labor Productivity<sub>it</sub> is calculated as the ratio of sales to the number of employees.

<sup>a</sup>Exporting firms and non-exporting firms are observations such that EXPDUM<sub>it</sub> = 1 and EXPDUM<sub>it</sub> = 0, respectively.

<sup>b</sup>The KIS compiles financial data on all publicly listed firms and Korean firms with total assets of more than 7 billion won as both of them are required to submit their Financial Supervisory Commission by the Act on External Audit of Joint-Stock Corporations. However, KIS compiles data on firms with less than 7 billion won of total assets and on those that voluntarily report their financial statements.

this concern, Appendix Figure B.1-(a) compares the sales growth of our sample of firms with that<sup>5</sup> of aggregate manufacturing firms in South Korea. Appendix Figure B.1-(b) compares the employment growth of our sample of firms with that<sup>6</sup> of all Korean manufacturing firms with more than 10 employees. We observe similar patterns for sales and employment growth as shown in Appendix Figures 1-(a) and (b). This result suggests that our sample of firms is reflective of aggregate manufacturing firms in South Korea.

### B. Measuring Uncertainty

Bo, and Sterken (2007) empirically analyze the effect of the risk attitudes of firms on the investment-uncertainty relationship. In this study, we investigate how risk attitude changes the effect of uncertainty on decision to export by extending the model of Bo, and Sterken (2007). Our specification is largely similar to that of Bo, and Sterken (2007), but we consider two sources of uncertainty, namely, firm-specific and macroeconomic. In the following section, we describe the construction of empirical proxies for firm-specific and macroeconomic uncertainties.

**Identifying Firm-specific Uncertainty** Several studies analyzing the effects of uncertainty on firm behavior implement different approaches to construct a proxy for firm-specific uncertainty. For example, Leahy, and Whited (1996), Bloom *et al.* (2001), Bond, and Cummins (2004), and Lee (2005) measure firm-level uncertainty by computing the standard deviation of individual daily stock returns. Baum *et al.* (2009) proxy for firm-specific uncertainty from the volatility of closing price for firms' shares. However, most studies cited above have focused only on publicly listed firms. Given that the focus of this study is on both publicly listed and unlisted firms, we measure firm-specific uncertainty by regressing firm sales on the firm effect ( $\phi_i$ ) and the time effect ( $\phi_t$ ):

$$Sales_{i,t} = \phi_i + \phi_t + \phi_{i,t}, \quad (1)$$

where  $Sales_{i,t}$  is the firm sales scaled by total assets, and  $\phi_{i,t}$  is the error term.  $\phi_i$  and  $\phi_t$  represent firm and year fixed-effects, respectively. We estimate Equation (1) firm by firm based on the original data set for the 1991-2011 period. The absolute value of residuals from this regres-

<sup>5</sup> Data come from the aggregate balance sheet of manufacturing firms reported in the Bank of Korea, Financial Statement Analysis.

<sup>6</sup> Obtained from the Korea National Statistics Office.

sion,  $\sigma_{i,t}^{firm} = |\phi_{i,t}|$ , is used to measure firm-specific uncertainty. This procedure is similar to that of Morgan *et al.* (2004) and Caglay, and Rashid (2014).

**Identifying Macroeconomic Uncertainty** One can employ different methodologies to construct a proxy for macroeconomic uncertainty. For instance, Driver *et al.* (2005), Baum *et al.* (2009), and Baum *et al.* (2012) use conditional variance obtained from a GARCH model to measure macroeconomic uncertainty. Federer (1993) and Huizinga (1993) obtain a measure of macroeconomic uncertainty from moving standard deviations of past changes in inflation. Graham, and Harvey (2001) and Kaufmann *et al.* (2005) use survey data for a measure of macroeconomic uncertainty. However, the disadvantages of the proxy for macroeconomic uncertainty from the moving standard deviations of the macroeconomic series or from the survey data are that the former may have a serial correlation problem and the latter is subject to measurement error. Thus, we build a GARCH (1, 1) model in which the mean equation is a first-order autoregression to proxy for macroeconomic uncertainty, following Driver *et al.* (2005), Baum *et al.* (2009), and Baum *et al.* (2012).

For this, we use the quarterly series of real GDP growth<sup>7</sup> from the first quarter of 1971 to the fourth quarter of 2013 and the monthly series of changes in the index<sup>8</sup> of leading indicators from January 1990 to June 2014. The results of the GARCH (1,1) estimation for each series are reported in Table 2.

The conditional variances obtained from this GRACH specification are annualized by averaging over 4 quarters for the GDP and over 12 months for the index of leading indicators and then used as proxies for macroeconomic uncertainty (e.g.,  $\sigma_{i,t}^{GDP}$ ,  $\sigma_{i,t}^{LI}$ ).

To ascertain that these measures ( $\sigma_{i,t}^{GDP}$ ,  $\sigma_{i,t}^{LI}$ ) are different from a proxy for firm-specific uncertainty, we examine the correlations between firm-specific and macroeconomic uncertainty. As shown in Table 3, correlation coefficients are very low. This observation implies that each measure captures different aspects of uncertainty faced by a firm.

In addition, Appendix Figure 2 shows the evolution of macroeconomic and firm-specific uncertainty obtained by the analysis. Macroeconomic uncertainty has a similar trend to firm-specific uncertainty except in the 2003-2005 period. In particular, South Korea experienced substantial

<sup>7</sup> Information comes from the Bank of Korea, and 2005 is used as the base year.

<sup>8</sup> Obtained from Korea National Statistics Office.

**TABLE 2**  
GARCH (1, 1) PROXIES FOR MACROECONOMIC UNCERTAINTY

	$\Delta$ GDP	$\Delta$ Leading Indicators
Lagged Dependent Variable	0.842*** (0.039)	0.930*** (0.015)
Constant	0.904*** (0.295)	-0.293** (0.141)
ARCH(l)	0.316* (0.163)	0.421*** (0.136)
GARCH(l)	0.735*** (0.099)	0.280* (0.159)
Constant	0.260 (0.256)	1.955*** (0.664)
Log-Likelihood	-396.6325	-667.7330
Observations	171	293

Notes: OPG standard errors are reported in parentheses. \* indicates significance at the 10% level. \*\* indicates significance at the 5% level. \*\*\* indicates significance at the 1% level.

**TABLE 3**  
CORRELATIONS OF PROXIES FOR FIRM-SPECIFIC AND MACROECONOMIC UNCERTAINTY

	$\sigma_{i,t}^{firm}$	$\sigma_{i,t}^{GDP}$	$\sigma_{i,t}^{LI}$
$\sigma_{i,t}^{firm}$	1.0000		
$\sigma_{i,t}^{GDP}$	0.0327	1.0000	
$\sigma_{i,t}^{LI}$	0.0204	0.8095	1.0000

increases in both macroeconomic uncertainty and firm-specific uncertainty during the Asian financial crisis of 1997-1998 or during the global financial crisis of 2008-2009. However, macroeconomic uncertainty gradually decreased while firm-specific uncertainty suddenly increased in 2003. One possible explanation for this finding is that the credit card crisis that South Korea experienced in 2003 remarkably increased firm-specific uncertainty.

### C. Measuring Risk Attitude of Firms

We have so far measured firm-specific and macroeconomic uncertainty. In this section, we present details on the measurement of the risk attitude of firms. Given that the empirical literature on the risk attitude

of firms in decision making is relatively scant, the challenge for this study is to construct an appropriate proxy. Pattillo, and Soderbom (2000) measure the risk attitudes of firm managers using experimental data. These experimental data are obtained by asking firm managers to choose from lotteries with different expected returns and variances, in which higher returns can be traded off with higher variances. However, their findings from experimental data are somewhat less conclusive as the study does not control for other demographic factors that may affect decision making. Another alternative for measuring the risk attitudes of firms is to use survey data. However, as Binswanger (1980) points out, resurveying of respondents is subject to measurement error and unstable results.

To alleviate such concerns, we apply an econometric procedure for the estimation of risk attitudes of firms by following Fisher, and Hall (1969), Arrow (1971), or Bo, and Sterken (2007). Fisher, and Hall (1969) show that the risk premium of the firm can be estimated by using the standard deviation and the skewness of distribution of firms' profit. The theoretical work of Arrow (1971) indicates that the risk attitude of firms can be measured if the risk premium of firms is estimated.

To measure the risk premium of firms, we first follow the framework of Fisher, and Hall (1969) and estimate the following form:

$$\gamma_{i,t} = \gamma_0 + \beta_1 \sigma_{i,t} + \beta_2 \omega_{i,t}, \tag{2}$$

where  $\gamma_{i,t}$  = observed profit scaled by total assets for firm  $i$ , year  $t$ ;  
 $\sigma_{i,t}$  = standard deviation of the profit rate for firm  $i$ , year  $t$ ; and  
 $\omega_{i,t}$  = skewness of the profit rate for firm  $i$ , year  $t$ .

The standard deviation ( $\sigma_{i,t}$ ) and the skewness ( $\omega_{i,t}$ ) of the profit rate are calculated from the previous three years of profit rate. Thus, the standard deviation and the skewness of the profit rate are saved for the 1993-2011 period. The intercept,  $\gamma_0$ , is referred to as the risk-adjusted profit rate that reflects all influences on firms' profit not explained by the standard deviation and the skewness. In the analytical framework of Fisher, and Hall (1969), the risk premium of firms is computed as the difference between the observed profit and the risk-adjusted profit rate.

To compute the time-varying measures of the risk premium of firms, we estimate Equation (2) over three-year rolling time periods for each firm. Thus, two observations are lost in each firm, and the longest time

**TABLE 4**  
MEAN OF RISK ATTITUDES ACROSS FIRMS

Firm Type	All Period (1991–2011)	Pre-Crisis (1991–1997)	Post-Crisis (1998–2011)
Total Firms	0.8745 (100.0%)	-1.1874 (100.0%)	0.9974 (100.0%)
<b>Panel A.</b> Classifying Firms by Export Status			
Exporting Firms	1.1971 (38.0%)	-3.1516 (48.2%)	1.6539 (37.2%)
Non-exporting Firms	3.9377 (62.0%)	-1.9692 (51.8%)	4.3320 (62.8%)
<b>Panel B.</b> Classifying Firms by Risk Attitudes			
Risk-averse Firms	27.8843 (48.3%)	17.4483 (47.1%)	28.4888 (48.4%)
Risk-taking Firms	-24.3965 (51.7%)	-17.7630 (52.9%)	-24.8019 (51.6%)
<b>Panel C.</b> Classifying Firms by Firm Size			
Large-sized Firms	3.8131 (12.7%)	7.5206 (24.1%)	3.3712 (12.0%)
Small- and Medium-sized Firms	0.4466 (87.3%)	-3.9488 (75.9%)	0.6726 (88.0%)

Notes: Fractions of risk-averse and risk-taking firms are reported in parentheses. Firms are classified as large-sized (small- and medium-sized) firms if their number of employees is more (fewer) than 300.

series of the risk premium of the firm is 1995-2011. This estimation is based on the data set excluding the outliers of the upper and lower 1 percent of profits.

If the risk premium of firms is obtained from Equation (2), we then measure the risk attitudes of firms following the framework of Bo, and Sterken (2007), which transforms the theoretical model of Arrow (1971) into an empirical model. Thus, we estimate<sup>9</sup> the risk premium regression of the following form:

$$\gamma_{i,t}^* = \eta \sigma_{i,t} + \phi \omega_{i,t}, \quad (3)$$

<sup>9</sup>To compute the time-varying measures of the risk attitude of firms, we estimate Equation (3) over three-year rolling time-periods for each firm.

where  $\gamma_{i,t}^*$ =risk premium firm  $i$ , year  $t$ ;  
 $\eta$ =risk aversion coefficient of the firm.  
 $\sigma_{i,t}$ =standard deviation of the profit rate for firm  $i$ , year  $t$ ; and  
 $\omega_{i,t}$ =skewness of the profit rate for firm  $i$ , year  $t$ .

In Equation (3), the estimated coefficient of the standard deviation of the profit rate ( $\eta$ ) implies the measure of absolute risk aversion of firms. We employ the risk coefficient as a proxy for the risk attitude of firms. The utility theory of Arrow (1971) predicts that firms are more risk averse when the risk coefficient is higher, and that firms with a positive risk coefficient are risk averse ( $\eta > 0$ ) while firms with a negative risk coefficient are risk taking ( $\eta < 0$ ).

To observe the change in risk attitude of firms before and after the Asian financial crisis, we compare the mean of the risk coefficients across firms and document the results in Table 4.

Two patterns in particular stand out. First, Korean manufacturing firms before the Asian financial crisis of 1997 were on average risk taking but became risk averse after the crisis. The same pattern holds for exporting firms and non-exporting firms. This behavior is consistent with the evidence that after the crisis, the ratio of risk-averse firms to total firms is increased, while the ratio of risk-taking firms to total firms is decreased as shown in Panel B of Table 4. These findings imply that the financial crisis of 1997 affected the risk attitudes of firms. The second feature emerges in Panel C of Table 4. If we compare the mean of risk coefficients between large-sized firms and small- and medium-sized firms, large-sized firms during the sample period were on average risk averse, while small- and medium-sized firms changed from risk taking to risk averse during the periods before and after the financial crisis of 1997. Hence, a larger portion of the risk-taking firms before the crisis was small- and-medium-sized firms. Particularly, small and-medium-sized firms in South Korea tended to take more risks than large firms. Appendix Figure 3 presents the details on the distribution of risk coefficients during whole-period sample (1991-2011), pre-crisis sample (1991-1997), and post-crisis sample (1998-2011).

#### IV. Empirical Results

In this section, we explore how risk attitude changes the effect of uncertainty on the decision of firms to export by considering different

types of uncertainty faced by the firm. For this aim, we first estimate a model by using dummy variables of risk attitudes of firms with full sample data. For robustness checks, we further divide the sample into risk-averse and risk-taking firms according to the risk coefficient sign and examine how firm-specific or macro-economic uncertainty plays a different role between risk-averse and risk-taking firms.

#### A. Differential Effect of Uncertainty across Risk-Averse and Risk-Taking Firms

We test the hypothesis that both uncertainty and the risk attitudes of firms have important effects on firm decisions to export by extending the model of Bo, and Sterken (2007). Bo, and Sterken (2007) analyze the effect of risk attitudes of firms on the investment-uncertainty relationship, but they focus only on firm-specific uncertainty. However, our study simultaneously considers firm-specific and macroeconomic uncertainty.

To examine how the effect of uncertainty on the decisions of firms to export varies with their risk attitudes, we set up two dummy variables for risk-averse firms ( $D^{risk-averse}$ ) and risk-taking firms ( $D^{risk-taking}$ ), and then interact all the proxies of uncertainty with these two dummy variables. The risk-averse dummy takes the value of 1 for firms with a positive risk coefficient and 0 otherwise. The risk-taking dummy takes the value of 1 for firms with a negative risk coefficient and 0 otherwise. Specifically, we estimate with the following pooled probit specification:

$$\begin{aligned}
 EXPDUM_{it} = & \beta_0 + \beta_1 Firm\ Size_{i(t-1)} + \beta_2 Labor\ Productivity_{i(t-1)} \\
 & + \beta_3 (\sigma^{firm} \times D^{risk-averse})_{i(t-1)} + \beta_4 (\sigma^{firm} \times D^{risk-taking})_{i(t-1)} \\
 & + \beta_5 (\sigma^{macro} \times D^{risk-averse})_{i(t-1)} + \beta_6 (\sigma^{macro} \times D^{risk-taking})_{i(t-1)} \\
 & + Industry\ Dummies_i + Time\ Dummies_t + Error\ Term_{it}
 \end{aligned} \tag{4}$$

The first subscript  $i$  denotes a firm, and the second subscript  $t$  denotes time. The dependent variable of this estimation is the exporting status of firms. Hence,  $EXPDUM_{it}$  is a binary indicator variable equal to 1 for firms that are exporters. To control for firm characteristics, we include variables such as firm size and labor productivity. Firm size and labor productivity are measured as the log of the number of employees and the log of the ratio of total sales to the number of employees, respectively.  $\sigma^{firm}$  and  $\sigma^{macro}$  indicate the measurement of firm-specific and macro-economic uncertainty faced by a firm.  $D^{risk-averse}$  denotes a dummy



variable for risk-averse firms, and  $D^{risk-taking}$  denotes a dummy variable for risk-taking firms. Industry dummies<sup>10</sup> and time dummies are included to capture time- and industry-specific effects on the decision of firms to export. As for all control variables, we use values from one year before the firm decides to export. We consider the time difference between the export market participation decision and the actual participation by following previous studies (*e.g.*, Bernard, and Jensen 2001; Greenaway *et al.*, 2007).

We also consider the effect of the Asian financial crisis of 1997 that significantly affected the South Korean economy and particularly the risk behavior of Korean firms. Consistent with the findings in Table 4, changes in the risk attitudes of Korean manufacturing firms are observed after the Asian financial crisis of 1997. Thus, to determine if the effect of risk attitudes on firms' exporting decision has changed since the Asian financial crisis of 1997, we divide the sample into two sub-samples: pre-crisis sample of 1991-1997 and post-crisis sample of 1998-2011. The results for the whole sample period of 1991-2011 and for the two sub-periods of 1991-1997 and 1998-2011 are presented in Table 5. Table 5 also presents the results for models that use two proxies for macroeconomic uncertainty. These proxies are based on the GDP or on the leading indicators (*e.g.*,  $\sigma_{i,t}^{GDP}$ ,  $\sigma_{i,t}^{LI}$ ) during the whole sample period of 1991-2011 and during the two sub-periods of 1991-2011 (*e.g.*, 1991-1997 and 1998-2011).

Specifically, columns 1 and 2 of Table 5 report the results for the whole sample period. Our key findings indicate that the effect of uncertainty on the decision of firms to export is negative. Further, the degree of the negative effect of uncertainty on the exporting decision of firms varies depending on whether firms are risk averse or risk taking and whether firms face firm-specific or macroeconomic uncertainty. For example, if firms face firm-specific or macroeconomic uncertainty (measured by either proxy), then the uncertainty lowers the export market participation of firms. However, the negative effect of firm-specific uncertainty is greater in risk-averse firms, while the quantitative negative effect of macroeconomic uncertainty is lesser in risk-averse firms. The former means that firm-specific uncertainty discourages risk-averse firms from participating in foreign markets more than risk-taking firms. Hence, risk-averse firms are more cautious when responding to firm-specific

<sup>10</sup> Industries are classified into 24 two-digit sectors based on the Korea Standard Industrial Classification (KSIC version 9).

**TABLE 5**  
RISK ATTITUDES AND EXPORT MARKET PARTICIPATION

	All Period (1991-2011)		Pre-Crisis (1991-1997)		Post-Crisis (1998-2011)	
	1	2	3	4	5	6
$\text{Log}(\text{Firm Size})_{i(t-1)}$	0.662*** (0.030)	0.661*** (0.030)	0.674*** (0.124)	0.676*** (0.124)	0.660*** (0.030)	0.660*** (0.030)
$\text{Log}(\text{Labor Productivity})_{i(t-1)}$	0.246*** (0.035)	0.246*** (0.035)	-0.059 (0.170)	-0.057 (0.170)	0.252*** (0.035)	0.253*** (0.035)
$(\sigma^{\text{firm}} \times D^{\text{risk-averse}})_{i(t-1)}$	-0.219*** (0.065)	-0.216*** (0.066)	0.094 (0.444)	0.101 (0.445)	-0.216*** (0.065)	-0.213*** (0.066)
$(\sigma^{\text{firm}} \times D^{\text{risk-taking}})_{i(t-1)}$	-0.195*** (0.069)	-0.198*** (0.071)	0.117 (0.436)	0.101 (0.437)	-0.205*** (0.069)	-0.209*** (0.071)
$(\sigma^{\text{GDP}} \times D^{\text{risk-averse}})_{i(t-1)}$	-0.114*** (0.015)		0.059 (0.175)		-0.113*** (0.015)	
$(\sigma^{\text{GDP}} \times D^{\text{risk-taking}})_{i(t-1)}$	-0.116*** (0.015)		0.135 (0.182)		-0.116*** (0.015)	
$(\sigma^{\text{I}} \times D^{\text{risk-averse}})_{i(t-1)}$		-0.038*** (0.005)		-0.153 (0.238)		-0.038*** (0.005)
$(\sigma^{\text{I}} \times D^{\text{risk-taking}})_{i(t-1)}$		-0.040*** (0.005)		-0.098 (0.234)		-0.040*** (0.005)
Constant	-5.831*** (0.844)	-6.636*** (0.813)	-2.418 (3.631)	-1.678 (3.447)	-5.917*** (0.847)	-6.716*** (0.817)
Observations	20,720	20,720	631	631	20,045	20,045
R-squared	0.2267	0.2267	0.1813	0.1814	0.2220	0.2220

Notes: Robust standard errors are reported in parentheses. In all specification, we include 21 yearly dummies and 24 industry dummies to capture time and industry effects, but they are not reported. \* indicates significance at the 10% level. \*\* indicates significance at the 5% level. \*\*\* indicates significance at the 1% level.

uncertainty. The latter means that risk-averse firms are less likely to decrease their export market participation when responding to macroeconomic uncertainty. Therefore, risk-averse firms are more likely to diversify their domestic risk by participating in foreign markets in response to macroeconomic uncertainty.

Columns 5 and 6 of Table 5 report the estimation results in the post-crisis sample. These results are broadly consistent with those in columns 1 and 2 of Table 5, that is, firm-specific or macroeconomic uncertainty has a statistically different effect on the exporting decision of firms depending on whether firms are risk averse or risk taking. However, in the pre-crisis sample, no significant coefficients are estimated regard-

less of whether proxies for macroeconomic uncertainty are based on the GDP or based on leading indicators. On the one hand, this behavior could imply that before the financial crisis, firms decide on exporting without sufficient risk consideration under uncertainty. On the other hand, we do not find any evidence that risk attitude changes the effect of uncertainty on the decision of firms to export before the financial crisis simply because of data limitation.<sup>11</sup>

In addition, we examine how risk attitude changes the effect of uncertainty on export intensity of firms. The export intensity of firms is measured as the share of exports in total sales and is used as the log of the export intensity of firms in regression. As reported in Appendix Table 2, this result is generally consistent with that of Greenaway *et al.* (2010) that uncertainty has a significant positive effect on the export share of firms.

*B. Results for the Sub-samples of Firms: Risk-averse and Risk-taking Firms*

For robustness checks, we run the regression separately for the sample of risk-averse firms and risk-taking firms to examine if the effects of firm-specific uncertainty on the decision of firms to export differ across risk-averse and risk-taking firms. Thus, we divide the sample into risk-averse and risk-taking firms according to the sign of the risk coefficient in the whole, pre-crisis, and post-crisis periods. For example, firms with a positive risk coefficient are classified as risk-averse firms, as mentioned in Section III-C. Likewise, firms with a negative risk coefficient are classified as risk-taking firms.

As the first step, we estimate the following for the whole sample:

$$\begin{aligned}
 EXPDUM_{it} = & \beta_0 + \beta_1 Firm\ Size_{i(t-1)} + \beta_2 Labor\ Productivity_{i(t-1)} \\
 & + \beta_3 \sigma_{i(t-1)}^{firm} + \beta_4 \sigma_{i(t-1)}^{macro} + Industry\ Dummies_t \\
 & + Time\ Dummies_t + Error\ Term_{it}
 \end{aligned}
 \tag{5}$$

The results for the whole sample are reported in Table 6. Specifically,

<sup>11</sup>As stated in Section III-C, the first two observations are lost for each firm in constructing the standard deviation and the skewness of the profit rate. The next two observations are lost for each firm to compute the time-varying measures of the risk attitudes of firms. Therefore, the longest time series of the risk attitudes of firms is 1995-2011.

**TABLE 6**  
WHOLE SAMPLE

	All Period (1991–2011)		Pre-Crisis (1991–1997)		Post-Crisis (1998–2011)	
	1	2	3	4	5	6
$\text{Log (Firm Size)}_{it(-1)}$	0.625*** (0.024)	0.625*** (0.024)	0.484*** (0.067)	0.484*** (0.067)	0.632*** (0.024)	0.632*** (0.024)
$\text{Log (Labor Productivity)}_{it(-1)}$	0.230*** (0.028)	0.230*** (0.028)	0.069 (0.094)	0.069 (0.094)	0.239*** (0.028)	0.239*** (0.028)
$\sigma_{it(-1)}^{firm}$	-0.186*** (0.045)	-0.186*** (0.045)	-0.329* (0.172)	-0.329* (0.172)	-0.176*** (0.045)	-0.176*** (0.045)
$\sigma_{it(-1)}^{GDP}$	-0.134*** (0.013)		0.240 (0.159)		-0.133*** (0.013)	
$\sigma_{it(-1)}^{LI}$		-0.046*** (0.004)		-0.321 (0.212)		-0.045*** (0.004)
Constant	-5.069*** (0.688)	-6.006*** (0.662)	-3.045 (2.071)	-1.013 (2.063)	-5.301*** (0.699)	-6.229*** (0.673)
Observations	29,107	29,107	2,479	2,479	26,628	26,628
R-squared	0.2309	0.2309	0.1668	0.1668	0.2244	0.2244

Notes: Robust standard errors are reported in parentheses. In all specification, we include 21 yearly dummies and 24 industry dummies to capture the time and industry effects, but they are not reported. \* indicates significance at the 10% level. \*\* indicates significance at the 5% level. \*\*\* indicates significance at the 1% level.

columns 1 and 2, columns 3 and 4, and columns 5 and 6 of Table 7 show that Korean manufacturing firms decrease their export market participation when firm-specific or macroeconomic uncertainty increases over the whole period and the two sub-periods of pre-crisis and post-crisis. This negative effect of uncertainty on the exporting decision of firms is consistent with the findings of Creusen, and Lejour (2011).

Next, we examine how firm-specific or macroeconomic uncertainty plays a different role between risk-averse and risk-taking firms. For this purpose, we estimate the same regression equation for each sub-sample as in Table 6. The results for risk-averse firms and risk-taking firms are shown in columns 1-6 and columns 7-12 of Table 7, respectively.

Consistent with our earlier findings, Table 7 shows that firm-specific uncertainty or macro-economic uncertainty lowers the export market participation of firms in the whole and post-crisis periods. Particularly, if we compare the negative effect of firm-specific uncertainty on firms' export decision between risk-averse and risk-taking firms, the negative effect is relatively more in risk-averse firms than in risk-taking firms

(*e.g.*, -0.214 *vs.* -0.200 for the whole period and -0.214 *vs.* -0.207 for the post-crisis period). This result implies that risk-averse firms are more cautious in export market participation when firm-specific uncertainty increases.

Similarly, our results show that the degree of negative effect of macroeconomic uncertainty on firms' exporting decision is lower in risk-averse firms (*e.g.*, -0.106 *vs.* -0.124 for the whole period and -0.105 *vs.* -0.123 for the post-crisis period) in the whole and post-crisis periods. This empirical evidence suggests that under macroeconomic uncertainty, risk-averse firms are more likely to follow a strategy of market spreading by participating in foreign markets than risk-taking firms.

In addition, the coefficients on uncertainty for each sub-sample are statistically insignificant during the pre-crisis period. This evidence implies that either Korean firms decide on exporting without sufficient risk consideration before the financial crisis or that any significant evidence is not found because of data limitation. The insignificant relationship between risk attitudes and export market participation is possible during the pre-crisis sample because of data limitation. Nevertheless, a more convincing explanation for this result is that during the period of high economic growth before the financial crisis of 1997, Korean firms decided on exporting without sufficient risk consideration. In fact, before the financial crisis, the Korean government encouraged firms to invest more in export-oriented industries by providing loans at a low interest rate. Therefore, Korean firms before the financial crisis were generally viewed to have decided on exporting without sufficient risk consideration. However, the Asian financial crisis of 1997 significantly affected the South Korean economy, particularly the risk management of Korean firms. As Korean firms showed low risk-endurance ability under the currency crisis of 1997, the Korean government needed to reform the corporate governance system after the crisis. Thus, the Korean government introduced several measures to improve the corporate governance system (*e.g.*, Cha 1999; Chang, and Shin 2002). As a result, corporate restructuring after the financial crisis could have led Korean firms to decide on exporting in a more risk-averse way. This claim is consistent with the finding that the relationship between uncertainty and firms' exporting decision is statistically significant for the post-crisis sample as shown in columns 5-6 and columns 11-12 of Table 7.

**TABLE 7**  
RISK-AVERSE AND RISK-TAKING FIRMS

	Risk-averse Firms ( $\eta > 0$ )						Risk-taking Firms ( $\eta < 0$ )					
	All Period (1991-2011)		Pre-Crisis (1991-1997)		Post-Crisis (1998-2011)		All Period (1991-2011)		Pre-Crisis (1991-1997)		Post-Crisis (1998-2011)	
	1	2	3	4	5	6	7	8	9	10	11	12
$\text{Log}(\text{Firm Size})_{it-1}$	0.666*** (0.033)	0.666*** (0.033)	0.617*** (0.153)	0.617*** (0.153)	0.667*** (0.033)	0.667*** (0.033)	0.659*** (0.033)	0.659*** (0.033)	0.765*** (0.148)	0.765*** (0.148)	0.655*** (0.033)	0.655*** (0.033)
$\text{Log}(\text{Labor Productivity})_{it-1}$	0.258*** (0.040)	0.258*** (0.040)	-0.116 (0.221)	-0.116 (0.221)	0.266*** (0.040)	0.266*** (0.040)	0.239*** (0.039)	0.239*** (0.039)	-0.027 (0.204)	-0.027 (0.204)	0.243*** (0.039)	0.243*** (0.039)
$\sigma_{it-1}^{firm}$	-0.214*** (0.068)	-0.214*** (0.068)	0.120 (0.460)	0.120 (0.460)	-0.214*** (0.068)	-0.214*** (0.068)	-0.200*** (0.074)	-0.200*** (0.074)	0.254 (0.465)	0.254 (0.465)	-0.207*** (0.074)	-0.207*** (0.074)
$\sigma_{it-1}^{GDP}$	-0.106*** (0.030)		0.165 (0.353)		-0.105*** (0.030)		-0.124*** (0.026)		0.031 (0.415)		-0.123*** (0.026)	
$\sigma_{it-1}^{LI}$		-0.036*** (0.010)		-0.220 (0.473)		-0.036*** (0.010)		-0.042*** (0.009)		-0.041 (0.555)		-0.042*** (0.009)
Constant	-6.021*** (0.985)	-6.760*** (0.912)	-0.745 (4.717)	0.647 (4.445)	-6.211*** (0.987)	-6.945*** (0.913)	-5.734*** (0.971)	-6.596*** (0.910)	-3.232 (4.460)	-2.973 (4.717)	-5.717*** (0.979)	-6.576*** (0.919)
Observations	9,936	9,936	305	305	9,611	9,611	10,784	10,784	322	322	10,434	10,434
R-squared	0.2242	0.2242	0.1399	0.1399	0.2223	0.2223	0.2328	0.2328	0.2520	0.2520	0.2253	0.2253

Notes: Robust standard errors are reported in parentheses. In all specification, we include 21 yearly dummies and 24 industry dummies to capture time and industry effects, but they are not reported. \* indicates significance at the 10% level. \*\* indicates significance at the 5% level. \*\*\* indicates significance at the 1% level.

## V. Conclusions

Most existing literature examining the links between firm heterogeneity and entry into exporting rests on the assumption that firms are risk neutral. In this study, we argue that previous studies neglect the effect of the risk attitude of firms on the export-uncertainty relationship, and that such risk attitude plays an important role in explaining this relationship. Thus, we relax this strict assumption and introduce firms' different attitudes toward risk as an additional source of firm heterogeneity.

We examine the effects of uncertainty on exporting decisions of firms differing across risk-averse and risk-taking firms based on an unbalanced panel of 5,386 Korean manufacturing firms from 1991 to 2011. Our analysis yields interesting findings. First, we find that the effect of uncertainty on firms' decision to export is generally negative. This negative effect of uncertainty on a firm's exporting decision is consistent with the findings of Creusen, and Lejour (2011). However, different from Creusen, and Lejour (2011), we explore the export-uncertainty relation by considering the risk attitude of firms. The results show that the degree of the negative impact of uncertainty on a firm's exporting decision depends on whether the firm is risk averse or risk taking and whether the firm faces firm-specific or macroeconomic uncertainty. Specifically, we obtain evidence that firm-specific uncertainty discourages risk-averse firms from participating in foreign markets more than risk-taking firms. This finding implies that risk-averse firms are more reluctant to begin exporting when firm-specific uncertainty increases. We also find that risk-averse firms are less likely to decrease their export market participation when macroeconomic uncertainty increases. This empirical evidence suggests that risk-averse firms are more likely to diversify their domestic risk by participating in foreign markets when macroeconomic uncertainty increases.

The results of this study should be interpreted with some caveats in mind. First, discussions on the different channels through which uncertainty can affect a firm's exporting decision remain scant. Therefore, an open question of whether these channels are adequately identified in the analysis remains. Second, the challenge for this study is to construct an appropriate proxy for the risk attitude of a firm. We measure risk attitude by applying an econometric procedure for the estimation of firms' risk attitude following Fisher, and Hall (1969), Arrow (1971), or

Bo, and Sterken (2007). To obtain more complete and robust results, various criteria should be introduced to assess if a proxy for firms' risk attitude is appropriate.

Despite these limitations, this study contributes to the literature in two ways. First, firms' risk attitude is introduced as an additional source of firm heterogeneity for the better understanding of the exporting decision of firms. Second, this study considers the firm-specific and macroeconomic uncertainty of firms. Given that firms simultaneously face internal and external uncertainty, this approach seems to be in reasonable accord with the real world.

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## Appendix

### A. DATA SET

**APPENDIX TABLE 1**  
STRUCTURE OF THE UNBALANCED PANEL

Number of Observations per Firm	Number of Firms	Percent	Cumulative
1	852	2.33	2.33
2	473	2.59	4.92
3	636	5.22	10.15
4	431	4.72	14.86
5	381	5.21	20.08
6	318	5.22	25.30
7	271	5.19	30.50
8	264	5.78	36.28
9	264	6.50	42.78
10	246	6.73	49.52
11	204	6.14	55.66
12	222	7.29	62.95
13	186	6.62	69.57
14	123	4.71	74.28
15	96	3.94	78.23
16	51	2.23	80.46
17	84	3.91	84.37
18	39	1.92	86.29
19	42	2.18	88.48
20	53	2.90	91.38
21	150	8.62	100.00
Total	5,386		100.00

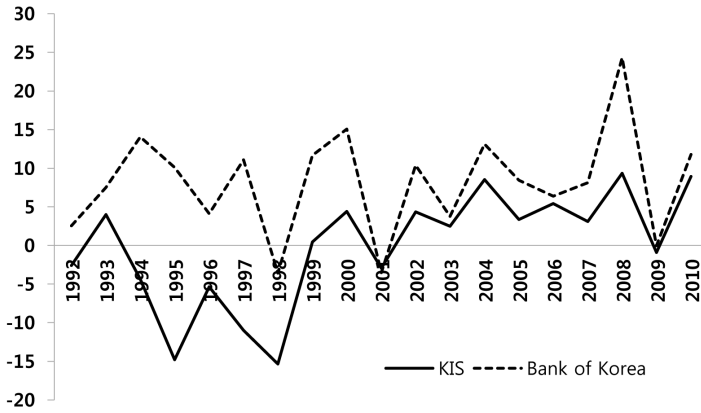


**APPENDIX TABLE 2**  
RISK ATTITUDES AND EXPORT INTENSITY WITH GLS

	All Period (1991-2011)		Pre-Crisis (1991-1997)		Post-Crisis (1998-2011)	
	1	2	3	4	5	6
$\text{Log}(\text{Firm Size})_{i(t-1)}$	0.316*** (0.009)	0.305*** (0.009)	0.556*** (0.032)	0.556*** (0.032)	0.307*** (0.008)	0.297*** (0.008)
$\text{Log}(\text{Labor Productivity})_{i(t-1)}$	0.281*** (0.014)	0.272*** (0.014)	0.157*** (0.044)	0.158*** (0.044)	0.294*** (0.014)	0.287*** (0.014)
$(\sigma^{\text{firm}} \times D^{\text{risk-averse}})_{i(t-1)}$	0.099** (0.041)	0.133*** (0.041)	-0.210 (0.135)	-0.205 (0.133)	0.085** (0.041)	0.121*** (0.040)
$(\sigma^{\text{firm}} \times D^{\text{risk-taking}})_{i(t-1)}$	0.137*** (0.045)	0.103** (0.046)	-0.172 (0.128)	-0.182 (0.127)	0.127*** (0.045)	0.095** (0.046)
$(\sigma^{\text{GDP}} \times D^{\text{risk-averse}})_{i(t-1)}$	0.029** (0.013)		-0.194** (0.084)		0.033*** (0.011)	
$(\sigma^{\text{GDP}} \times D^{\text{risk-taking}})_{i(t-1)}$	0.024* (0.013)		-0.203** (0.081)		0.028** (0.011)	
$(\sigma^{\text{JJ}} \times D^{\text{risk-averse}})_{i(t-1)}$		0.009** (0.004)		0.273** (0.109)		0.012*** (0.004)
$(\sigma^{\text{JJ}} \times D^{\text{risk-taking}})_{i(t-1)}$		0.008** (0.004)		0.268** (0.110)		0.011*** (0.003)
Constant	-3.694*** (0.332)	-3.281*** (0.309)	0.000 (0.000)	0.000 (0.000)	-3.982*** (0.323)	-3.582*** (0.307)
Number of Observations	8,739	8,739	518	518	8,221	8,221
Number of Firms	1,279	1,279	286	286	1,254	1,254

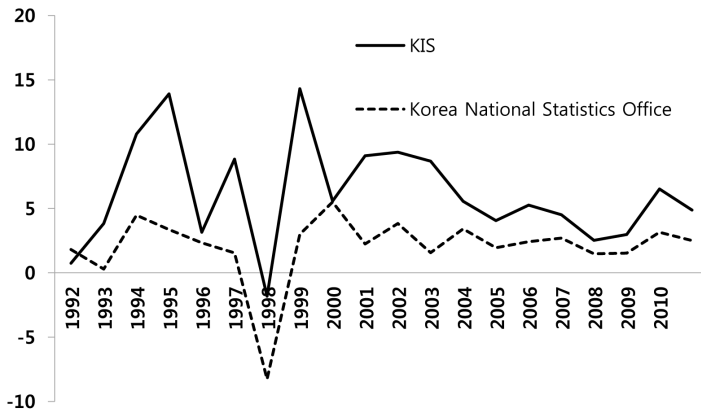
Notes: The dependent variable used in the regression analysis is the share of exports in total sales. We analyze it using the Generalized Least Squares (GLS). Robust standard errors are reported in parentheses. In all specification, we include 21 yearly dummies and 24 industry dummies to capture the time and industry effects, but they are not reported. \* indicates significance at the 10% level. \*\* indicates significance at the 5% level. \*\*\* indicates significance at the 1% level.

B. Figures



Source: Aggregate Data is from Bank of Korea and Firm-level Data is from KIS

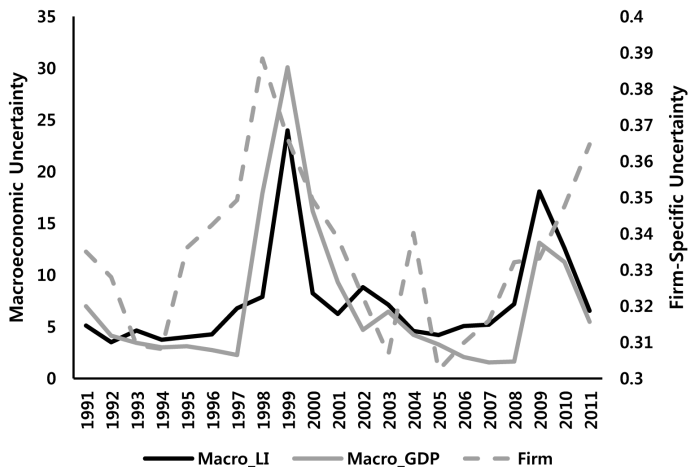
(a) Firm Sales Growth (Annual, %)



Source: Aggregate Data is from the Korea National Statistics Office and Firm-level Data is from KIS

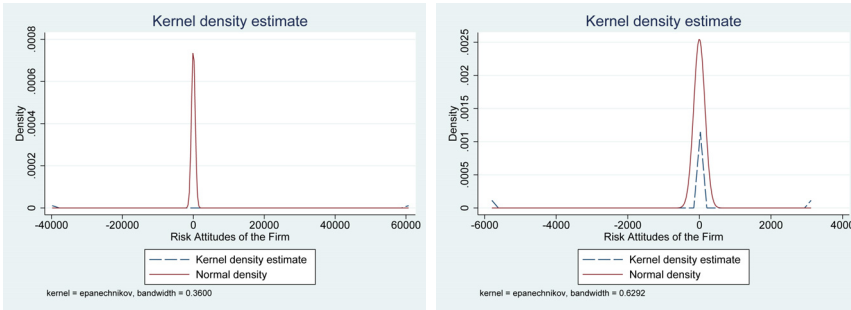
(b) Firm Employment Growth (Annual, %)

**APPENDIX FIGURE 1**  
AGGREGATE AND FIRM-LEVEL DATA



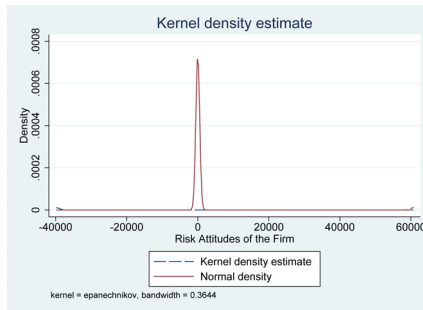
Source: Firm-specific and Macroeconomic Uncertainty is from KIS; it is the author's calculations.

**APPENDIX FIGURE 2**  
 FIRM-SPECIFIC AND MACROECONOMIC UNCERTAINTY



(a) Whole-Period Sample (1991-2011)

(b) Pre-Crisis Sample (1991-1997)



(c) Post-Crisis Sample (1998-2011)

Notes: The dashed lines plot the results of the kernel density estimates using the Gaussian kernel functions. The solid lines graph the results of the normal density estimates.

### APPENDIX FIGURE 3

#### DISTRIBUTION OF RISK COEFFICIENT

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