Firms' Leverage and Export Market Participation: Evidence from South Korea

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Abstract

To understand why some firms export while others do not, it is necessary to understand major determinants which lead some firms to engage in exporting. A large base of empirical literature provides evidence that firms which trade are systematically different from those which do not trade in size, productivity, and the involvement of multinational corporations. In this paper, we introduce a financial dimension as an additional source of firm heterogeneity to understand export market participation, and examine how the impact of leverage on firms' exporting decisions varies depending on financial constraints, using a panel of 3,353 Korean manufacturing firms over the period of 1994-2011. First, we find that leverage for financially-constrained firms is negatively associated with the probability of exporting while leverage for financially-unconstrained is not. Also, we find that in the sample of financially-constrained firms, future exporters have higher leverage before they begin to export, while in the sample of financially-unconstrained firms, firms with ex-ante lower leverage self-select to export. Finally, it is found that export market participation decreases leverage for both financially-constrained and financially-unconstrained firms, but the magnitudes of decreases in leverage are larger for financially-constrained firms.

Keywords: Exports; Firm heterogeneity; Financial constraints; Leverage

JEL Classication: F14; G32; D92

1 Introduction

Since firm heterogeneity was first introduced as a new channel for better understanding the structure of world trade in the 1990s, empirical research which investigates the links between firm heterogeneity and a firm's decision to export at the microeconomic level has prominently grown in recent decades. Some of these studies have explored

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differences in the firm's export market participation across firms by using a combination of fixed costs and the presence of firm heterogeneity (Melitz, 2003; Greenaway et al., 2007; Chaney, 2013).

Melitz (2003) has theoretically shown that not only the presence of firm heterogeneity in terms of productivity but also sunk entry costs explain why all firms do not engage in international trade activity. When a firm chooses to sell its products abroad, it has to bear the fixed costs associated with the start-up of exports. These fixed costs associated with the start-up of exports may be sunk, in the sense that they need to be paid only once when deciding to participate in a foreign market. Melitz (2003) shows that a highly productive firm is more likely to participate in exporting since it has a greater ability to cover fixed costs than a less productive one, and predicts that the least productive firms exit in the market, the intermediate productive firms choose to serve the domestic market and the most productive firms choose to sell to both the domestic market and the foreign market.

If we assume that there does not exist firm heterogeneity in financial factors or that the financial market is perfect while holding others constant, all firms with productivity above a certain cut-off point will likely participate in exporting, as shown in Melitz (2003). In the real world, however, the financial structure of the firm matters because the capital market is imperfect. Besides, highly productive non-exporting firms or lesser productive exporting firms are easily observed. The coexistence of both financial heterogeneity across firms and an imperfect financial market can help explain why highly productive firms do not export or why lesser productive firms do. That is, it would make some changes to Melitz (2003)'s finding that a more productive firm is likely to participate in international trade through various channels.

Accordingly, the research considering a financial dimension as an additional source of firm heterogeneity to understand export market participation has grown increasingly over the last few years (Greenaway et al., 2007; Manova, 2008; Bellone et al., 2010; Chaney, 2013). Manova (2008), Bellone et al. (2010), and Chaney (2013) introduce financial constraints into a Melitz-type heterogeneous-firm model. Similarly, Greenaway et al. (2007) also consider the financial health of a firm.

Manova (2008) empirically proves that credit constraints restrict firms' export market participation and firms' export sales. Chaney (2013) proves that since 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) have explored an impact of firms' financial health on their export market participation, using UK manufacturing firms. They find that exporting firms in the UK show better financial health than non-exporting firms. They also manifest links between firms' financial health and their export market participation decisions, by employing the liquidity ratio and leverage ratio as financial variables to capture a firm's financial health. In particular, they assess that a firm's financial health is better when the liquidity ratio is higher and the leverage ratio is lower. Bellone et al. (2010) point out that such assessment could be problematic, mentioning that firms' financial health can be poor in practice even when the liquidity ratio is higher or when the leverage ratio is lower. For example, if some firms have difficulties in accessing external financing due to their credit constraints, their leverage ratio would be low. Also, it might be the case that financially vulnerable firms keep a high liquidity ratio so as to mitigate their financial vulnerabilities against uncertain risks. Thus, the analytical framework of Greenaway et al. (2007) was extended by Bellone et al. (2010) who introduce other methodologies to assess firms' financial health. Similarly, Bellone et al. (2010) provide evidence that firms showing better financial health, which is measured by various proxies, are more likely to export.

Although the links between firms' financial constraints and their export decisions have been well documented in the existing literature, an analysis on how firms' leverage affects their export decisions still remains comparatively less explored and not fully understood. Bellone et al. (2010) combined leverage with various other financial variables and therefore the pure impact of leverage on firms' export decisions was not sorted out. Greenaway et al. (2007) directly plugged leverage into the export decision regression, but they did not address various aspects which the leverage in balance sheets means, as Bellone et al. (2010) pointed out. Most recently, Bernini et al. (2013) studied the direct impact of leverage but they focus on the quality of exports.

Our study is guided, most generally by two competing theories regarding financing decisions, which have been widely used in corporate finance literature: the trade-off theory (Myers, 1977) and the pecking order theory (Myers and Majluf , 1984). On one hand, the trade-off theory predicts that some firms would make use of external financing so as to enjoy advantages such as tax benefits of debt financing. According to this view, leverage in balance sheets does not necessarily reflect firms' financial soundness. On the other hand, the pecking order theory predicts that leverage refers to the use of debt after exhausting their internal funds. According to this view, leverage is to some degree related to firms' state of financial distress.

In this paper, we focus on the links between firms' leverage and exporting decisions, taking into account various aspects which leverage in balance sheets means. In particular, we examine how differently firms' leverage impacts between financially-constrained firms and financially-unconstrained firms. For this, we use a panel of 3,353 Korean firms for the period 1994-2011, employ the liquidity ratio and the interest coverage ratio[1] as the criteria for the financial constraints, and split the sample into two sub-samples according to the yearly median value of those ratios: financially-constrained firms and financially-unconstrained firms. In addition, we include two interaction terms of the leverage ratio with the two crisis dummies of the pre-crisis and the post-crisis to compare the impacts of leverage on firms' export decisions before and after the Asian financial crisis of 1997.

Our basic analysis yields two interesting findings. Leverage for financially-constrained firms is negatively associated with the probability of exporting. On the other hand, leverage for financially-unconstrained firms is positively related with the firm's decision

[1]Firm's liquidity ratio is defined as cash flow minus cash needs over beginning total assets, using information reported on the statement of cash flows. The interest coverage ratio is calculated as a firm's earnings before interest and taxes (EBIT) over a firm's interest expenses.

to export. From these two findings, we examine in Section 4.2 an ex-ante effect of leverage on export participation for financially-constrained and financially-unconstrained firms. Also, we test in Section 4.3 how export participation impacts the leverage of financially-constrained and financially-unconstrained firms.

In fact, several attempts have been made to identify causality between being in good financial health and participating in export markets, but, it is nonetheless still ambiguous. Greenaway et al. (2007) find strong evidence that participation in export markets improves firms' financial health, but no strong evidence that firms with better ex-ante financial health are more likely to start exporting. Differently from the findings of Greenaway et al. (2007), Bellone et al. (2010) obtain results that future exporters statistically display significantly better financial health prior to entering into export markets, but they fail to find that export market participation significantly improve firms' financial health. In this paper, we perform ex-ante analysis for financially-constrained and financially-unconstrained firms by employing the approach similar to that of Greenaway et al. (2007). In addition, we perform ex-post analysis for financially-constrained and financially-unconstrained firms by using a Difference-in-Difference estimator (DID). The results are presented in Section 4.2 and Section 4.3.

The rest of this paper is organized as follows. In the next section, we briefly provide theoretical background for our empirical analysis. In Section 3, we describe the data set and present descriptive statistics. In Section 4, we present the empirical results. In particular, in Section 4.1, we examine how the impact of leverage on exporting decisions of firms varies depending on financial constraints. And in Section 4.2, we test an ex-ante effect of leverage on export participation for financially-constrained and financially-unconstrained firms. Also, in Section 4.3, we investigate how export participation impacts the leverage of financially-constrained and financially-unconstrained firms. Finally, in Section 5 we conclude.

2 Literature review and theoretical background

To participate in the international market, a firm will incur additional start-up costs because it needs to gather information on the foreign market, customize its products to foreign tastes, or learn to deal with new bureaucratic procedures, etc. Typically, a firm finances these start-up costs by using internal funds or obtaining external financing, so that a firm's decision to participate in an export market will be highly affected by its financial status.

Manova (2008) suggests that firms which participate in the international market are generally much more dependent on external financing due to additional start-up costs of exports. Thus, it is crucial, most of all, to adequately understand what leverage in balance sheets means.

In corporate finance literature, there are two competing models for financing decisions: the trade-off model (Myers, 1977) and the pecking order model (Myers and Majluf , 1984). The trade-off model suggests that firms determine their optimal leverage by considering the costs and benefits of an additional dollar of debt. As an example of the benefits of additional debt, the interest tax shield is provided, which means the tax savings of firms derived from the deductibility of interest expense. The costs of additional debt could include bankruptcy costs or agency costs. In contrast, in the pecking order model, it has not been well defined as to what optimal leverage level is. Instead, the pecking order model recognizes the presence of asymmetric information between manager and investors, and predicts that a firm prefers internal funds to external financing and prefers external financing to equity financing because of the presence of such information asymmetry. In other words, according to this model, a firm first uses internal funds and obtains external financing as the next step. Thus, leverage is regarded as the cumulative result of sequential financing decisions.

Summing up, the pecking order model (Myers and Majluf , 1984) views leverage as the degree of dependence on external finance after exhausting internal funds, while the trade-off model (Myers, 1977) regards it as an instrument to enjoy benefits derived from the interest tax shield.

The second strand of literature which this study builds on investigates the relationship between investment and leverage, because exporting decisions of firms are similar to their investment decisions due to the presence of sunk costs. Thus, we provide a balanced view regarding such literature as in the following.

Plenty of theoretical and empirical evidence suggests that leverage is negatively related to investment (Myers, 1977; Jensen, 1986; Whited , 1992; Aivazian et al., 2005). For example, Myers (1977) predicts that highly leveraged firms face higher costs of debt financing due to the agency problem between shareholders and debt holders, and thereby add up to less investment. In particular, he demonstrates that firms with good investment opportunities show lower leverage because of the fact that high leverage forces the managers to abandon despite the positive net present investment (NPV) project. Also, Jensen (1986) provides theoretical evidence of the negative relationship between investment and leverage, introducing the free cash flow theory. According to free cash flow, managers serve their own interest rather than serving the benefit of shareholders. Accordingly, this theory predicts if a firm generates more free cash than required to invest in the positive NPV project, the manager of the firm tends to reinvest the excessive free cash, for his own discretionary purpose, in a project that does not provide maximum return to shareholders. In the case of the presence of agency problems between managers and shareholders, leverage can be used as a disciplining device to reduce such agency costs of free cash flows, and firms with poor investment opportunities benefit more from higher leverage. Consequently, this theory implies that leverage can reduce investment, in particular, for firms with weak growth opportunities. Whited (1992) predicts that investment is more sensitive to internal funds of firms with high leverage than those with low leverage. Aivazian et al. (2005) prove empirically that the negative relationship between investment and leverage is particularly stronger for firms with low growth opportunities than firms with high growth opportunities, supporting Jensen (1986)'s theoretical predictions.

In contrast to the above mentioned studies, Lyandres and Zhdanov (2010) argue that the relationship between investment and leverage is positive. According to them, the shareholders of a leveraged firm speed up the exercise of investment because of the presence of the possibility of potential default. As a result, there is a complementary effect that causes a leveraged firm to invest more intensely than its counterpart.

To put it briefly, the relationship between investment and leverage may be regarded as positive or negative depending on its viewpoint. In other words, from the point of view of the free cash flow theory, leverage is negatively related to investment. In a viewpoint emphasizing a complementary effect of leverage on investment, the relationship between investment and leverage is positive.

In this study, we identify a relationship between leverage and exporting decisions. The trade-off theory suggests that leverage in balance sheets does not necessarily reflect firms' financial soundness and is not affected by the presence of financial constraints, while the pecking order theory suggests that leverage is, to some degree, related to firms' state of financial distress, and depends on whether or not the firms are financially-constrained. On the basis of these two theoretical models, we predict that the link between leverage and exporting decisions would be positive or negative depending on financial constraints. If leverage is regarded as a financial distress, in line with the pecking order theory, it would be negatively related to exporting decisions. If leverage is viewed as instruments to enjoy advantages derived from the interest tax shield, in line with the trade-off theory, the relationship between leverage and exporting decisions would not be necessarily negative. Thus, we hypothesized as follow:

Hypothesis 1 *The relationship between leverage and exporting decisions of firms varies depending on financial constraints.*

Hypothesis 2 *For financially-constrained firms, leverage is negatively associated with the probability of exporting.*

Hypothesis 3 *For financially-unconstrained firms, leverage is positively related with the firm's decision to export.*

3 Data and Descriptive Statistics

3.1 Data Description

The data used in this study are the firm-level panel data provided for the period of 1994-2011 by the Korea Information Service, Inc. (KIS), which is one of Korea's major credit-rating agencies. KIS data contains corporate and financial information of all firms with total assets in excess of 7 billion won[2] in Korean manufacturing,

[2]For a better understanding of the threshold of 7 billion won, we introduce the criteria of Korean SMEs. According to the "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 whose capital is 8 billion won or less or whose number of employees is fewer than 300.

mining, and several other service sectors[3]. Our primary focus will be on Korean manufacturing firms with December fiscal-year-end. Also, this study limits its analysis to only surviving firms[4] because the KIS database has not provided information on closed firms. It will be dropped from the analysis if there are any missing observations for our variables of interest. In order to limit the influence of outliers, observations in the top and bottom 0.5 percent of the distribution for each variable were eliminated. To that end, our unbalanced panel data comprises 17,365 annual observations of 3,353 firms for the period 1994-2011. See Appendix Table D.1 for details about the structure of our unbalanced panel.

The key aim of this study is to explore how the impact of leverage on firms' exporting decisions varies depending on financial constraints. Therefore, we use leverage ratio as a key variable to analyze our study. The exporting status of the firm is the dependent variable. The variables employed as determinants of export participation are a firm's age, the number of employees, Total Factor Productivity(TFP), labor productivity, and affiliation with a large business group, following convention in the literature.

Prior studies calculate the leverage ratio using information from a firm's balance sheet. For example, Greenaway et al. (2007) define the leverage ratio as the firm's ratio of short-term debt to total current assets and Kim et al. (2012) define it as the share of total liabilities in total assets. Since both short-term debt and total liabilities represent the debt burden of the firm, it is interpreted that the leverage ratio in previous studies has been mainly used as a measure of the degree of financial constraints faced by firms. In this study, however, the leverage ratio is used to see to which degrees firms are dependent on external financing. For this, we calculate the leverage ratio using information obtained from the statement of cash flows, which is defined as money borrowed from financial institutions in a given year scaled by beginning total assets. Since this study aims at analyzing how the impact of leverage on firms' exporting decisions varies depending on financial constraints, it is more appropriate to measure leverage with money borrowed from financial institutions for this study.

Based on the export sales, firms are classified into exporting and non-exporting firms. We define a firm that shows a positive export sale as an exporting firm. Firm size in this study is measured as the log of the number of employees.

To construct a measure of TFP, we employ the Levinsohn and Petrin (2003) method, which uses intermediate inputs as proxies to control for unobserved productivity shocks. Sales are used as a measure of a firm's output, the number of employees is used as a measure of labor input, and the sum of fixed tangible and intangible assets on the balance sheet is used as a measure of capital input. As a measure of intermedi-

[3] The KIS compiles financial data on not only all publicly listed-firms but also all Korean firms with total assets more than 7 billion won since both of them are required to submit their financial statements to the Financial Supervisory Commission by the Act on External Audit of Joint-Stock Corporations. However, the KIS compiles even firms with less than 7 billion won of total assets, which voluntarily report their financial statement.

[4] Surviving firms are those that exist as of the date we obtain data (April 13, 2013) after the entry into the market.

ate input, we use raw material costs. In the Appendix B, we describe the Levinsohn and Petrin (2003) method in more detail. All variables except the number of employees are expressed in billion won, deflated into real terms using the aggregate GDP deflator with the base year 2005, and logged before entering the production function. Labor productivity is calculated as the ratio of sales to the number of employees.

To account for possible effects of business group affiliation, we include a chaebol dummy variable that has a value of 1 when a firm belongs to business groups and 0 otherwise. This study follows Korean Fair Trade Commission (KFTC) classification in identifying business group-affiliated firms.

We employ the liquidity ratio and the interest coverage ratio as the criteria for the financial constraints, which have been widely used in the literature (e.g. Lee, 2005; Greenaway et al., 2007; Bellone et al., 2010). With these criteria, we classify firms into financially-constrained and financially-unconstrained groups.

Greenaway et al. (2007) identify the liquidity ratio as total current assets less total current liabilities over total assets and Bellone et al. (2010) define it as total current assets over total current liabilities. However, the measurement of the liquidity ratio using total current assets does not adequately reflect a firm's financial constraints. For example, if a firm borrows some money from financial institutions in a given year, it is added to cash and cash equivalents on a firm's balance sheet. Since cash and cash equivalents take up a portion of a firm's total current assets, money borrowed from financial institutions is consequently belonged to total current assets. To address this concern, we define firm's liquidity ratio as cash flow minus cash needs over beginning total assets, using information reported on the statement of cash flows. It is very similar to the way defining liquidity ratio in Bernini et al. (2013).

The second indicator on a firm's financial constraints, the interest coverage ratio, which is defined as a firm's earnings before interest and taxes (EBIT) over a firm's interest expenses, is usually used in measuring a firm's ability to meet its debt obligations. Thus, the interest coverage ratio is inversely related to a firm's financial constraints.

All the values utilized in the analysis have been converted into real values using the aggregate GDP deflator with the base year 2005. Industries are classified into 24 two-digit sectors, based on Korea Standard Industrial Classification (KSIC version 9).

3.2 Summary Statistics

Table 1 shows summary statistics of Korean manufacturing firms according to their exporting status. Specifically, columns 2 and 3, columns 5 and 6, and columns 8 and 9 of Table 1 compare various firm characteristics between exporters and non-exporters during the periods before and after the Korean financial crisis. It is a well-established fact that exporters are on average older and much bigger than non-exporters in terms of assets, the number of employees, and sales (e.g. Bernard and Jensen (2001) for the US; Greenaway et al. (2007) for the UK). The same pattern holds in our results as well. Furthermore, our results show that, on average, business group-affiliated firms have a relatively high propensity to export. In terms of our two measures of productivity, exporting firms are on average more productive than those firms producing only for domestic markets.

With regard to the leverage ratio, we find that exporting firms in Korea have, on average, a higher leverage ratio compared to non-exporting firms. One possible explanation is that Korean exporting firms are dependent much more on external financing than non-exporting firms. In other words, Korean firms finance additional costs associated with export activities participation through mainly debt financing. These findings are in line with those of Joh (2004). It is a well-known fact that, before the financial crisis of 1997, South Korea was one of the world's fastest growing economies for more than 30 years. Joh (2004) has pointed out in his paper that high leverage of Korean firms were behind such a fast growth although referred it as one fundamental cause of the financial crisis in Korea.

Exploring further, we decompose our entire sample into 2 sub-samples based on the number of employees. Firms are classified as large-sized (small and medium-sized) firms whose number of employees is more (fewer) than 300. Panel B and C of Table 1 illustrate mean values of the key variables in two sub-samples of large- and small and medium-sized firms. Not surprisingly, our findings show that large-sized firms are on average larger, older, and more productive than small and medium-sized firms. Furthermore, our sample shows that large-sized firms are, on average, much more business group-affiliated compared to small and medium-sized firms.

Specially, our results show changes in the leverage ratio of Korean manufacturing firms after the Asian financial crisis of 1997. Korean manufacturing firms show more degrees of leverage before the 1997 financial crisis. For example, the mean leverage ratio for large-sized firms is 65% and for small and medium-sized firms is 50%. However, after the financial crisis had occurred, Korean manufacturing firms started to reduce their leverage ratio. As a result, the mean leverage ratio for large-sized firms and small and medium-sized firms decreased up to 47% and 47% after the crisis, respectively. It is interpreted as evidence that the Asian financial crisis has substantially affected corporate finance of Korean firms. In practice, Korean firms were asked to decrease their leverage ratio after the crisis and made efforts to reduce their leverage ratio. In other words, an adjustment in the capital structure after the financial crisis has been made.

Table 1: **Summary Statistics by Firm Size**

	All Period(1994-2011)			**Pre-Crisis(1994-1997)**			**Post-Crisis(1998-2011)**		
	Total	**Exporter**[a]	**Non-exporter**	**Total**	**Exporter**	**Non-exporter**	**Total**	**Exporter**	**Non-exporter**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Panel A: All Firms									
$Real\ assets^{b}{}_{it}$	180.05(560.3)	298.87(752.0)	58.16(162.9)	244.23(564.8)	356.08(690.6)	62.68(98.1)	172.13(559.3)	290.01(760.8)	57.74(167.7)
$Employees_{it}$	386.91(842.3)	588.87(1115.7)	179.74(274.8)	796.86(1412.8)	1111.56(1699.5)	286.08(357.4)	336.34(726.3)	507.86(970.3)	169.89(263.7)
$RealSales_{it}$	156.18(422.0)	248.11(558.9)	61.89(151.4)	193.48(401.4)	276.89(488.3)	58.09(77.8)	151.58(424.3)	243.64(568.9)	62.25(156.4)
Age_{it}	19.66(12.8)	23.25(13.8)	15.97(10.5)	22.48(11.4)	24.94(11.2)	18.48(10.4)	19.31(12.9)	22.99(14.2)	15.73(10.5)
TFP_{it}	12.67(17.8)	17.23(22.2)	7.99(9.6)	12.91(14.5)	16.54(16.8)	7.01(5.8)	12.64(18.1)	17.33(22.9)	8.08(9.8)
$LaborProductivity_{i}$	0.38(0.4)	0.40(0.4)	0.35(0.4)	0.24(0.2)	0.26(0.2)	0.22(0.2)	0.39(0.4)	0.43(0.4)	0.36(0.4)
$Chaebol_{i}$	0.65	0.76	0.54	0.78	0.85	0.67	0.64	0.75	0.53
$Leverage_{it}$	0.48(0.5)	0.49(0.5)	0.47(0.5)	0.58(0.6)	0.61(0.6)	0.52(0.6)	0.47(0.5)	0.47(0.5)	0.46(0.5)
Observations	17,365	8,793	8,572	1907	1,180	727	15,458	7,613	7,845
Panel B: Large-Sized Firms: Employment $\geq$ 300									
$Real\ assets_{it}$	549.39(982.9)	632.89(1079.1)	257.07(402.8)	451.16(745.3)	516.12(807.5)	162.23(155.8)	574.22(1033.0)	664.26(1139.2)	276.04(433.3)
$Employees_{it}$	1084.73(1392.6)	1201.78(1531.1)	674.95(554.0)	1432.40(1791.1)	1593.04(1930.9)	717.83(523.3)	996.87(1257.5)	1096.67(1386.2)	666.37(559.8)
$Real\ sales_{it}$	459.87(724.7)	518.49(788.4)	254.62(365.5)	350.80(523.5)	397.13(566.6)	144.69(116.0)	487.43(764.8)	551.09(835.1)	276.61(393.4)
Age_{it}	27.66(13.7)	28.92(13.9)	23.24(12.0)	26.69(11.1)	27.27(10.9)	24.10(11.7)	27.90(14.3)	29.36(14.5)	23.07(12.1)
TFP_{it}	27.31(27.3)	29.45(29.2)	19.81(17.7)	19.82(17.6)	21.47(18.8)	12.49(7.7)	29.20(29.0)	31.59(31.0)	21.28(18.8)
$LaborProductivity_{i}$	0.42(0.4)	0.44(0.4)	0.36(0.3)	0.25(0.2)	0.25(0.2)	0.21(0.2)	0.47(0.4)	0.49(0.4)	0.39(0.3)
$Chaebol_{i}$	0.87	0.90	0.79	0.87	0.90	0.76	0.87	0.90	0.79
$Leverage_{it}$	0.51(0.6)	0.52(0.6)	0.48(0.5)	0.65(0.7)	0.67(0.7)	0.60(0.7)	0.47(0.5)	0.48(0.5)	0.45(0.5)
Observations	4,699	3,655	1,044	948	774	174	3,751	2,881	870
Panel C: Small and Medium-Sized Firms: Employment < 300									
$Real\ assets_{it}$	43.03(51.8)	61.27(62.0)	30.58(38.7)	39.67(35.9)	50.99(39.1)	31.36(30.8)	43.30(52.8)	62.15(63.5)	30.51(39.3)
$Employees_{it}$	128.02(74.3)	152.87(74.9)	111.07(68.9)	168.61(72.7)	193.66(68.5)	150.23(70.2)	124.70(73.4)	149.37(74.4)	107.96(67.8)
$Real\ sales_{it}$	43.52(49.9)	55.76(58.1)	35.17(41.4)	37.96(30.0)	47.67(33.1)	30.84(25.3)	43.98(51.2)	56.46(59.8)	35.51(42.4)
Age_{it}	16.69(11.1)	19.22(12.3)	14.96(9.8)	18.32(10.0)	20.50(10.5)	16.72(9.3)	16.55(11.2)	19.11(12.4)	14.82(9.9)
TFP_{it}	7.24(6.8)	8.53(7.5)	6.35(6.2)	6.07(4.0)	7.15(4.2)	5.28(3.5)	7.33(7.0)	8.65(7.7)	6.44(6.4)
$LaborProductivity_{i}$	0.36(0.4)	0.38(0.4)	0.35(0.4)	0.24(0.2)	0.26(0.2)	0.23(0.2)	0.37(0.4)	0.39(0.4)	0.36(0.4)
$Chaebol_{i}$	0.57	0.66	0.51	0.69	0.75	0.64	0.56	0.65	0.50
$Leverage_{it}$	0.47(0.5)	0.48(0.5)	0.47(0.5)	0.50(0.5)	0.51(0.5)	0.49(0.5)	0.47(0.5)	0.47(0.5)	0.46(0.5)
Observations	12,666	5,138	7,528	959	406	553	11,707	4,732	6,975

Notes: Table 1 reports the mean statistics for the variables. Standard deviations are reported in parentheses.

[a] Exporters and Non-exporters are observations such that $EXPDUM_{it} = 1$ and $EXPDUM_{it} = 0$, respectively.
[b] $Real\ assets_{it}$ and $Real\ sales_{it}$ are in billion won.

4 Empirical Results

4.1 The Differential Impact of Leverage on Exporting Decisions of Firms

In this section, we explore the links between firms' leverage and exporting decisions, taking into account various aspects which leverage in balance sheets means. Greenaway et al. (2007) show that leverage is shown to play an important role in firms' exporting decisions and higher leverage is negatively associated with the probability of exporting. However, so far there has been no paper which has pondered how the impact of leverage on exporting decisions of firms varies depending on financial constraints, as far as we know. In this section, we will identify a relationship between leverage and exporting decisions depending on financial constraints and in particular examine how the impact of leverage on firms' exporting decisions varies depending on financial constraints.

As the first step, we compare the mean leverage between exporters and non-exporters. And then we test the significance of the mean difference of leverage between exporters and non-exporters. We repeat the same procedure for the two sub-samples[5], financially-constrained and financially-unconstrained groups, and for the two sub-periods, the pre-crisis period of 1994-1997 and the post-crisis period of 1998-2011. In particular, we employ the liquidity ratio[6] as an indicator for the financial constraint. The results are reported in Table 2.

[5]Each year during the sample period, firms are ranked according to their liquidity ratio and classified as financially-constrained (financially-unconstrained) firms if their liquidity ratio is below (above) the median value of each year.

[6]We repeat the analysis with an alternative measure of firms' financial constraints, the interest coverage ratio, and the results are reported in Appendix Table C.1.

Table 2: **The Mean of Leverage for Exporters and Non-exporters**

		Entire Sample			High-Liquidity Firms			Low-Liquidity Firms		
		Leverage Ratio		**Observations**	**Leverage Ratio**		**Observations**	**Leverage Ratio**		**Observations**
All Period(1994-2011)	**Non-exporters**		0.4679	8,572		0.1410	4,338		0.8027	4,234
	Exporters		0.4933	8,793		0.1537	4,340		0.8243	4,453
	t-Test(P-value)	-3.2361***	(0.0012)		-5.4930***	(0.0000)		-1.8255*	(0.0680)	
Pre-Crisis(1994-1997)	**Non-exporters**		0.5187	727		0.1787	385		0.9014	342
	Exporters		0.6130	1,180		0.2176	568		0.9800	612
	t-Test(P-value)	-3.4410***	(0.0006)		-5.0517***	(0.0000)		-1.8453*	(0.0654)	
Post-Crisis(1998-2011)	**Non-exporters**		0.4631	7,845		0.1373	3,953		0.7940	3,892
	Exporters		0.4748	7,613		0.1441	3,772		0.7996	3,841
	t-Test(P-value)	-1.4254	(0.1541)		-2.8290***	(0.0047)		-0.4504	(0.6524)	

Notes: t-test compares mean differences of leverage between exporters and non-exporters with unequal variances assumed. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

More specifically, the mean leverage of non-exporters and exporters is provided in rows 1 and 2 of each panel of Table 2. Evidently, exporters show on average higher leverage than non-exporters in all cases. Our results show to which degrees exporting firms are dependent on external financing to support their export activities, compared to non-exporting firms. It implies that Korean exporting firms raise additional costs related with export activities through mainly debt financing.

The most striking difference between our study and other studies is that we divide the sample into two sub-samples, high-liquidity and low-liquidity groups, according to the yearly median value of the liquidity ratio. If we compare a high-liquidity group and a low-liquidity group, the mean leverage in low-liquidity firms is higher than that of high-liquidity firms. It implies that higher liquidity is to some degree associated with lower leverage, as predicted by the pecking order theory (Myers and Majluf , 1984).

In addition, the mean leverage is lower after the crisis than before the crisis. These findings are in line with those of Joh (2004) and Yoon et al. (2008). Joh (2004) showed that most Korean manufacturing firms were very highly leveraged, but after the crisis, they were required to reduce their leverage ratio. Yoon et al. (2008) have showed that Korean manufacturing firms were much more dependent on debt financing than on equity financing before the financial crisis because of the fact that raising money from debt financing was much easier than equity financing during that time.

Row 3 of each panel of Table 2 presents the results of the mean-difference test for leverage. We find that the mean differences of leverage are statistically significant between exporters and non-exporters in all cases. The noticeable thing, furthermore, is that the differential is more substantial in financially-unconstrained firms than in financially-constrained firms.

Based on the above results, we next examine with the following Pooled Probit specification how leverage affects exporting decisions of firms.

$$\begin{aligned} EXPDUM_{it} = {} & \alpha_0 + \alpha_1 Leverage_{i(t-1)} + \alpha_2 Log(Employment)_{i(t-1)} \\ & + \alpha_3 Log(Firm\ Age)_{i(t-1)} + \alpha_4 Log(TFP)_{i(t-1)} \\ & + \alpha_5 Chaebol_i + Industry\ Dummies_i \\ & + Time\ Dummies_t + Error\ Term_{it} \end{aligned} \tag{1}$$

First subscript i denotes a firm and the second subscript t denotes time. The dependent variable of this estimation is firms' exporting status, so that $EXPDUM_{it}$ is a binary indicator variable equal to 1 for firms that are exporters:

$$EXPDUM_{it} = \begin{cases} 0 & \text{if } Export\ Sales^*_{it} \leq 0 \\ 1 & \text{if } Export\ Sales^*_{it} > 0. \end{cases} \tag{2}$$

Since in this paper we focus on the links between firms' leverage and exporting decisions, $Leverage_{i(t-1)}$ is used as a key variable in the regression model. As for firm-specific variables, we include firm size, firm age, productivity, and chaebol status, following convention in the literature.

In Table 1, we showed changes in the leverage ratio of Korean manufacturing firms after the Asian financial crisis of 1997. To compare the impacts of leverage on exporting decisions of firms before and after the Asian financial crisis of 1997, we set up the two dummies, the pre-crisis dummy and the post-crisis dummy. The pre-crisis dummy takes the value of one for the period of 1994-1997 and zero otherwise, while the post-crisis dummy takes the value of one for the period of 1998-2011 and zero otherwise. The impact of the crisis would be estimated through interaction terms of the leverage ratio with the two crisis dummies, as expressed in Equation 3.

$$\begin{aligned} EXPDUM_{it} = \alpha_0 &+ \alpha_1(Pre\,Crisis\;Dummy \times Leverage)_{i(t-1)} \\ &+\alpha_2(Post\,Crisis\;Dummy \times Leverage)_{i(t-1)} + \alpha_3 Log(Employment)_{i(t-1)} \\ &+\alpha_4 Log(Firm\;Age)_{i(t-1)} + \alpha_5 Log(TFP)_{i(t-1)} \\ &+\alpha_6 Chaebol_i + Industry\;Dummies_i \\ &+ Time\;Dummies_t + Error\;Term_{it} \end{aligned} \quad (3)$$

As for all control variables, we use the values from one year before a firm's export status is observed, taking into account the time difference between the decision to export and actual exporting, following previous studies (e.g. Bernard and Jensen, 2001; Greenaway et al., 2007).

Throughout the paper, we include 18 yearly dummies and 24 KSIC industry dummies to capture time and industry effects, but not report. Since Korea has a comparative advantage in electronics, textile, steel and automobiles[7], firms belonging to those industries are more likely to export regardless of their financial status. Industry fixed effects control for these unobserved industry characteristics that may affect a firm's decision to export. Time dummies capture variation over time common to all firms.

The results of the Pooled Probit estimations are shown in Table 3. Model I and Model II refer to Equation 1 and Equation 3, respectively. In particular, to examine the hypothesis on the differential impact of leverage on exporting decisions of firms between financially-constrained and financially-unconstrained firms, we employ the liquidity ratio and the interest coverage ratio as the criteria for the financial constraints. The sample is split into 2 sub-samples according to these criteria: financially-constrained firms and financially-unconstrained firms. Each year during the sample period, firms are ranked according to their liquidity ratio and interest coverage ratio, respectively and classified as financially-constrained (financially-unconstrained) firms if their liquidity ratio or interest coverage ratio is below (above) the median value of each year.

[7]See Yoon and Kim (2006). Korea has a comparative advantage in electronics, textile, steel and automobiles. Among them, for the past ten years, Korea's comparative advantage has decreased in textile, while it has increased in automobiles. During the same period, Korea's general machinery and petrochemical sectors have gained some comparative advantage. On the other hand, Korea's comparative advantage in the agriculture sector is quite low and continues to decline.

Table 3: **Pooled Probit Model for Leverage and Exporting Decisions**

	Liquidity Ratio				Interest Coverage Ratio			
	High		Low		High		Low	
	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Leverage_{i(t-1)}$	0.808***		-0.041		0.105**		-0.109**	
	(0.209)		(0.046)		(0.049)		(0.053)	
$(Pre\,Crisis\,Dummy \times Leverage)_{i(t-1)}$		1.795**		-0.183		0.162		-0.365**
		(0.745)		(0.127)		(0.187)		(0.148)
$(Post\,Crisis\,Dummy \times Leverage)_{i(t-1)}$		0.694***		-0.026		0.100**		-0.079
		(0.218)		(0.048)		(0.050)		(0.056)
$Log(Employment)_{i(t-1)}$	0.376***	0.376***	0.403***	0.405***	0.382***	0.382***	0.411***	0.415***
	(0.048)	(0.048)	(0.051)	(0.052)	(0.050)	(0.050)	(0.053)	(0.053)
$Log(Firm\,Age)_{i(t-1)}$	0.179***	0.177***	0.119***	0.119***	0.095**	0.095**	0.202***	0.202***
	(0.046)	(0.046)	(0.043)	(0.043)	(0.046)	(0.046)	(0.045)	(0.045)
$Log(TFP)_{i(t-1)}$	0.212***	0.213***	0.169***	0.168***	0.176***	0.176***	0.180***	0.177***
	(0.053)	(0.053)	(0.052)	(0.052)	(0.054)	(0.054)	(0.056)	(0.056)
$Chaebol_i$	0.277***	0.277***	0.238***	0.238***	0.254***	0.254***	0.280***	0.279***
	(0.077)	(0.078)	(0.076)	(0.076)	(0.078)	(0.078)	(0.078)	(0.078)
Constant	-1.533***	-1.514***	-2.124***	-2.143***	-0.867*	-0.865	-2.393***	-2.414***
	(0.433)	(0.433)	(0.446)	(0.446)	(0.527)	(0.526)	(0.427)	(0.427)
Observations	5,957	5,957	6,357	6,357	6,098	6,098	6,216	6,216
R-Squared	0.2430	0.2435	0.2260	0.2262	0.1938	0.1938	0.2766	0.2773

Notes: All estimates in table 3 are obtained from the Pooled Probit model with Panel data. Lagged values are used as independent variables while contemporaneous values are used as a dependent variable. Robust standard errors are reported in parentheses. Time dummies and Industry dummies are included but not reported. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Columns 3,4, 7, and 8 of Table 3 report the results for financially-constrained firms. We find that financially-constrained firms with higher leverage are less likely to export both before and after the Korean financial crisis. It is a generally reported result in the literature(e.g. Greenaway et al., 2007) that firms with higher leverage have less possibilities of exporting. Our result derived from financially-constrained firms confirms a general finding shown in previous studies. However, the most noticeable difference between our findings and those of previous studies is that we find a positive relation between leverage and exporting decisions for financially-unconstrained firms. Columns 1, 2, 5, and 6 of Table 3 show the results for financially-unconstrained firms. Financially-unconstrained firms with higher leverage have a relatively high propensity to export both before and after the Korean financial crisis. The positive effect on firms' export decisions is more prominent before the 1997 financial crisis since the coefficient on an interaction term of the leverage ratio with the pre-crisis dummy is generally larger than that on an interaction term between the leverage ratio and the post-crisis dummy. One possible explanation from Yoon et al. (2008) is that before the crisis, Korean manufacturing firms depended more on debt financing than on equity financing since debt financing was much easier than equity financing, but after the crisis, they have begun to depend more on equity financing than on debt financing.

To put it shortly, the relationship between leverage and exporting decisions of firms varies depending on financial constraints[8]. On the one hand, the probability

[8] We repeat our regression analysis by employing an alternative measure of leverage (i.e., the share of total liabilities in total assets) used in the financing literature(e.g. Kim et al., 2012). Results are

of exporting is negatively related to leverage for financially-constrained firms. On the other hand, the firm's decision to export is not necessarily negatively related to leverage for financially-unconstrained firms. Our results show that leverage works as a financial burden for financially-constrained firms while refers to the use of debt financing for financially-unconstrained firms.

TFP which included to capture relative differences in productivity show a significantly positive effect on exporting decisions of firms, suggesting that more productive firms have a relatively high propensity to export. Firm size and firm age also have positive effects on exporting decisions of firms. These results are same with the results generally found in the literature(e.g. Bernard and Jensen (2001) for the US; Greenaway et al. (2007) for the UK).

We find, across all specifications, that Korean manufacturing firms are more likely to export when turning business group affiliated. It implies that business group affiliated firms may share their knowledge about the export market, thereby it would be predicted for business group affiliated firms to export more easily than business group unaffiliated firms.

We check the robustness of the differential impact of leverage on exporting decisions of firms between financially-constrained and financially-unconstrained firms using dynamic Random-Effects Probit specification. Our dynamic Random-Effects Probit specification draws on Roberts and Tybout (1997) and Campa (2004), who find evidence of hysteresis[9] in export market. In order to estimate a dynamic model of exporting decisions, we add the lagged dependent variable as a regressor. The results are reported in Appendix Table D.1, confirming several general conclusions from our results; for financially-constrained (financially-unconstrained) firms, the probability of exporting in the current year is negatively (positively) related with the leverage ratio in the previous year. We also check robustness of our results using labor productivity instead of TFP, and the results are reported in Appendix Table D.2. Appendix Table D.3 shows the results of the regression which define the pre-crisis period as from the year of 1994 to 1996 and the post-crisis period as from the year of 1997 to 2011, respectively. As an additional robustness check, we perform the regression analysis, using labor productivity instead of TFP and defining the pre-crisis period as from the year of 1994 to 1996 and the post-crisis period as from the year of 1997 to 2011. The results are shown in Appendix Table D.4. As shown in Table 3, here too (e.g. Table D.2, Table D.3, and Table D.4 in the Appendix D), the differential impact of leverage on exporting decisions of firms is observed; leverage for financially-constrained firms is negatively associated with the probability of exporting while leverage for financially-unconstrained is not.

broadly similar to those we report in Table 3. These results are not reported, for brevity, but are available upon request.

[9] Due to the possibility of learning-by-exporting effects, prior export market participation increases the probability of exporting in the current year.

4.2 Ex-ante Effect of Leverage on Export Participation

In Section 4.1, we have explored how the impact of leverage on firms' exporting decisions varies depending on financial constraints, and found that leverage for financially-constrained firms is negatively associated with the probability of exporting while leverage for financially-unconstrained firms is positively related with the firm's decision to export. However, some caution is required in interpreting these findings because so far we only considered exporting firms or non-exporting firms. In fact, exporting firms at the dynamic view include continuous exporters, export starters, or export quitters and non-exporting firms do continuous non-exporters, export starters, or export quitters[10]. Thus, findings from Section 4.1 could come from the result of exporting.

Also, firms could be already in different financial characteristics before exporting. According to a Melitz (2003) type heterogeneous firm framework, a firm self-selects to participate in exporting on the basis of heterogeneity in firm characteristics. It implies that financial characteristics of firms should be different across firms before participating in export markets. In fact, several attempts have been made to test the self-selection hypothesis of the ex-ante more financially healthy firms into export markets, but, it is nonetheless still ambiguous. Greenaway et al. (2007) find no strong evidence for the self-selection hypothesis. Instead, they give some evidence that firms use their internal funds or borrow money from financial institutions for export market participation. Bellone et al. (2010), however, find strong evidence that firms with better ex-ante financial health are more likely to start exporting.

In this section, we analyze an ex-ante effect of leverage on export participation for financially-constrained and financially-unconstrained firms by employing the approach similar to that of Greenaway et al. (2007). For this, we run the following cross-sectional regression for the whole sample period of 1994-2011 and for the two sub-periods of 1994-2011 (e.g., 1994-1997 and 1998-2011):

$$\begin{aligned} Leverage_{it} = \alpha_0 + \alpha_1 EXPDUM_{iT} + \alpha_2 Industry\ Dummies_i \\ + \alpha_3 Log(Employment)_{i1} + Error\ Term_i \end{aligned} \tag{4}$$

where $Leverage_{it}$ is the average leverage over all the years (1994-1996; 1998-2010; 1994-2010) excluding the final year T (1997, 2011, 2011) in each sample (1994-1997; 1998-2011; 1994-2011), which accounts for ex-ante financial characteristics of firms, $EXPDUM_{iT}$ is the exporting status of the firm in the last year T for each sample, $Industry\ \ Dummies_i$ is a vector of industry dummies, $Log(Employment)_{i1}$ is the log of the number of employees in the beginning year (1994, 1998, 1994) of each period, which captures firm initial size, and $Error\ Term_i$ is the error term.

[10] Continuous exporters are a group of firms that were exporters in the first year they appear in the data set and never switched their exporting status. Similarly, continuous non-exporters are a group of those firms which never exported over the same period. Export starters are a group of firms that were non-exporters in the first year they appear, switched to exporters, and never switched back thereafter. Likewise, export quitters are a group of firms that were exporters in the first year they appear, switched to non-exporters, and remained as non-exporters afterwards.

We drop from our data set firms that are continuous exporters, and focus on firms that haven't ever participated in exporting during all the years except the last year T but started exporting in the year T. Then we compare ex-ante leverage of such export starters with that of continuous non-exporters. Continuous non-exporters are firms that have never exported for the years preceding the year T and also do not export in the year T.

Table 4 shows how leverage of export starters is different from that of continuously non-exporting firms before starting exporting. In particular, we has examined how our empirical result varies depending on financial constraints. For this, we employ the liquidity ratio as the primary indicator for the financial constraint. The results[11] for high-liquidity firms[12] and for low-liquidity firms are presented in Panel A and B of Table 4, respectively. We repeat the analysis with an alternative to measure firms' financial constraints, the interest coverage ratio, and the results are reported in Appendix Table E.1.

Table 4: **Ex-ante leverage of future exporters**

	No Control	**Industry Control**	**Industry and Size Control**	**Observations**
	(1)	**(2)**	**(3)**	**(4)**
		Panel A: High-Liquidity Firms		
Pre-Crisis (1994-1997)	0.322***	-0.058	-0.189**	36
	(0.079)	(0.035)	(0.086)	
Post-Crisis (1998-2011)	-0.025	-0.034*	-0.026***	200
	(0.047)	(0.020)	(0.008)	
All Period (1994-2011)	-0.037	-0.079***	-0.061*	194
	(0.066)	(0.021)	(0.036)	
		Panel B: Low-Liquidity Firms		
Pre-Crisis (1994-1997)	0.501***	0.598***	0.599***	36
	(0.092)	(0.049)	(0.069)	
Post-Crisis (1998-2011)	0.219**	0.131*	0.153*	200
	(0.102)	(0.073)	(0.079)	
All Period (1994-2011)	0.325***	0.154***	0.141***	194
	(0.089)	(0.053)	(0.051)	

Notes: Table 4 examines the ex-ante effects of leverage on export participation for high-liquidity firms in Panel A and for low-liquidity firms in Panel B, using the cross-sectional approach. The numbers reported in Table 4 represent the coefficients on $EXPDUM_{iT}$, which is the exporting status of the firm in the last year T (1997, 2011, 2011) for each sample (1994-1997; 1998-2011; 1994-2011). The dependent variable is the average leverage of firms before starting export. Industry dummies are included in the second column of Table 4. The third column in this table includes not only industry dummies but also the log of the number of employees in the first year (1994, 1998, 1994) of each period, which captures the firm's initial size. Robust standard errors are reported in parentheses. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

In Panel A of Table 4, we find strong evidence of self-selection for high-liquidity firms, in which firms showing ex-ante lower leverage self-select to participate in exporting. This is interpreted to mean that future exporters show the ex-ante financial advantage for high-liquidity firms. Our finding for high-liquidity firms is in line with

[11]The results for the alternative estimation which also controls for productivity are broadly similar to those we report in Table 4. These results are not reported, for brevity, but are available upon request.

[12]We define a firm whose liquidity ratio is higher (lower) than the median value in the initial year as a high(low) liquidity firm.

those of Bellone et al. (2010), in which future exporters statistically display significantly better financial health prior to entering into export markets.

Also, Panel B of Table 4 gives some evidence for low-liquidity firms that future exporters have a significantly higher leverage ratio before starting export through all specifications. These results can be viewed as being consistent with those of Greenaway et al. (2007), in which future exporters usually display higher leverage prior to entering into export markets. Loosely interpreted, a firm finances the start-up costs associated with export participation by using internal funds or obtaining external financing. This implies that the existence of sunk costs associated with export participation forces low-liquidity firms to use more external funds than high-liquidity firms, in line with the pecking order model.

In short, we found significant evidence that in the sample of low-liquidity firms, future exporters have higher leverage before they begin to export, while in the sample of high-liquidity firms, firms with ex-ante lower leverage self-select to export, basically in line with the pecking order theory (Myers and Majluf , 1984). Our results, varying with the sub-samples to which firms belong, are different from the constant results of Greenaway et al. (2007) or Bellone et al. (2010). Such a difference could come from how the financial characteristics of firms are identified. For example, Greenaway et al. (2007) separately employs the liquidity ratio and the leverage ratio so as to capture firms' financial characteristics. Our study, however, simultaneously considers the liquidity ratio and the leverage ratio. Note that in this section we split the sample into high-liquidity and low-liquidity firms and then examine how ex-ante leverage plays a different role between high-liquidity and low-liquidity firms.

4.3 Ex-post Benefit of Export Participation on Leverage

In Section 4.1, we found significant evidence that the impact of leverage on the probability of exporting varies between financially-constrained and financially-unconstrained firms. However, we cannot exclude the possibility that such findings could come from the result of exporting. Accordingly, we empirically test in this section how export participation impacts on leverage of financially-constrained and financially-unconstrained firms.

For this, we focus on firms which start exporting in the year t during the whole sample period of 1994-2011 and during the two sub-periods of 1994-2011 (e.g., 1994-1997 and 1998-2011) and compare the ex-post leverage of them with that of the control group firms. Greenaway et al. (2007) and Bellone et al. (2010) use firms that have never exported as control group firms. However, note that export starters are not random because we find in Section 4.2 that firms with ex-ante higher (lower) leverage self-select to export in the case of financially-constrained (financially-unconstrained) firms. For this reason, in the absence of random assignment it should be concerned with the simple comparison of ex-post leverage differences between export starters and continuous non-exporters firms.

In order to alleviate such concerns, we use matching techniques to construct the control group firms, following the empirical literature such as Wagner (2002) or Girma et al. (2004). The main idea of matching techniques is to match a group of export starters with a group of non-exporters with similar characteristics. Our approach is similar to that of Girma et al. (2004) and follows their notations.

Let $EXP_{it} \in \{0, 1\}$ denote an indicator of whether firm i starts exporting in year t. Export starters are defined as firms that do not export in the year t-1 and start exporting in year t. In addition to this, we exclude intermittent exporters in defining export starters. Non-exporters are defined as firms that neither exported for at least one year before the year t nor in the year t. Firms that switched their exporting status more than twice for the whole sample period of 1994-2011 are dropped from the analysis.

We denote ΔY as the difference in leverage. More formally, ΔY^1_{it+s} and ΔY^0_{it+s} indicate the difference in leverage between t and t+s, s $\geq$ 0, for firm i which starts exporting and firm i which does not start exporting in year t, respectively. Thus, the impact of exporting on firm i is as follow:

$$\delta_i = \Delta Y^1_{it+s} - \Delta Y^0_{it+s} \tag{5}$$

Following the evaluation literature (e.g. Heckman et al., 1998), we can compute the average effect of exporting on export starters (ATT):

$$\begin{aligned} ATT = E[\delta_i] &= E[\Delta Y^1_{it+s} - \Delta Y^0_{it+s} \mid EXP_{it} = 1] \\ &= E[\Delta Y^1_{it+s} \mid EXP_{it} = 1] - E[\Delta Y^0_{it+s} \mid EXP_{it} = 1] \end{aligned} \tag{6}$$

However, the problem of Equation 6 is that we cannot simultaneously observe the same firm i as both export starters and non-exporters. In fact, a counterfactual ΔY^0_{it+s} cannot be observed. We can solve this problem using matching techniques.

The main idea of matching techniques is to match each export starter with a non-exporter with similar characteristics. Thus, for each export starter there is another matched non-exporter with similar characteristics. It requires that all variables X for identifying characteristics should be observable. We assume that for every characteristics there is a positive probability of exporting, which states that

$$0 < Pr[EXP = 1 \mid X] < 1. \tag{7}$$

We also assume that conditional on X, the difference in leverage of export starters is independent of their export participation. It states that

$$Y^0, Y^1 \perp EXP \mid X. \tag{8}$$

By these two assumptions, Equation 6 can be rewritten as

$$E[\Delta Y^1_{it+s} \mid X_{it}, EXP_{it} = 1] - E[\Delta Y^0_{it+s} \mid X_{it}, EXP_{it} = 0] \tag{9}$$

This allows a group of non-exporters to be used in order to construct an unbiased counterfactual for a group of export starters. However, note that variables X are required for the second assumption to be met, and more variables make it difficult to match firms. To overcome these problems, we employ the propensity score matching (PSM) proposed by Rosenbaum and Rubin (1983). The PSM identifies the probability of export participation with the following Probit model:

$$P(EXP_{it} = 1) = F(X_{i(t-1)}, C_i, T_t) \tag{10}$$

where C_i is a set of industry and business group affiliation dummies, T_t indicates time dummies, and $X_{i(t-1)}$ is a set of leverage, TFP, age, and firm size. From Equation 10, we obtain the probability of export participation for firms which are actually exporting. Based on it, we construct[13] the counterfactual from selecting non-exporters with the most similar propensity score. Appendix Figure G.1 compares the density distribution of propensity score for a group of non-exporters versus a group of export starters, over the whole period and the two sub-periods of pre-crisis and post-crisis[14]. From Appendix Figure G.2 through Appendix Figure G.5, it is seen how the histograms of propensity score for a group of non-exporters versus a group of export starters vary with the samples classified according to the liquidity ratio and the interest coverage ratio.

After we construct the counterfactual with the propensity score matching, we next employ a Difference-in-Difference estimator (DID) to examine how export participation impacts on leverage of financially-constrained and financially-unconstrained firms[15]. To do it, we compare the average difference in leverage before and after export participation. In more detail, we compute the average differences in leverage for the periods t-1 to t, t-1 to t+1, and t-1 to t+2.

Table 5 reports the ex-post analysis results for financially-constrained firms, and in particular for low-liquidity firms. We find that in the case of financially-constrained firms, the magnitude of decreases in leverage is larger for export starters than for non-exporters, both for the whole period and for the post-crisis period. In other words, it is found that leverage is more decreased through export market participation, except for the pre-crisis period. Furthermore, those magnitudes increase with the elapse of time although many of them are insignificant. Greenaway et al. (2007) find strong evidence that participation in export markets improves firms' financial health. It is also found in our analysis that export market participation decreases leverage for financially-constrained firms, but it does not provide very strong evidence.

[13] We choose the nearest neighbor matching for this.

[14] The programs were downloaded from the following link http://www.ifs.org.uk/publications/6285

[15] The whole sample is split into 2 sub-samples according to the liquidity ratio: high-liquidity firms and low-liquidity firms. The year t-1 during the sample period, firms are ranked according to their liquidity ratio and classified as high-liquidity firms (low-liquidity) firms if their liquidity ratio is above (below) the median value of the year t-1.

Table 5: **The average difference in leverage before and after export participation: Low-Liquidity Firms**

Low-Liquidity Firms		All Period (1994-2011)	Pre-Crisis (1994-1997)	Post-Crisis (1998-2011)
t-1/t	**Treated**	-0.266	0.097	-0.264
	Controls	-0.119	-0.150	-0.112
	Difference	**-0.147**	**0.246***	**-0.151**
		(0.144)	(0.094)	(0.167)
	P-value	0.290	0.056	0.355
t-1/t+1	**Treated**	-0.280	0.095	-0.374
	Controls	-0.073	-0.159	-0.074
	Difference	**-0.206**	**0.254***	**-0.300**
		(0.182)	(0.106)	(0.182)
	P-value	0.237	0.075	0.101
t-1/t+2	**Treated**	-0.393	-0.612	-0.445
	Controls	-0.135	-0.169	-0.262
	Difference	**-0.258***	**-0.444**	**-0.183**
		(0.160)	(0.598)	(0.189)
	P-value	0.074	0.429	0.326
	# of control firms	**1,149**	**26**	**1,064**
	# of treatment firms	**45**	**3**	**32**

Notes: Difference is calculated as: Difference=$(after - before)_{treated}$-$(after - before)_{control}$. We construct the counterfactual with the propensity score matching, in particular the nearest neighbor matching algorithm. Standard errors are reported in parentheses. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

For robustness checks, we estimate the average difference in leverage before and after export participation for another sample of financially-constrained firms: low-interest-coverage firms. Appendix Table F.3 confirms that, in the case of financially-constrained firms, leverage decrease is larger for export starters than for non-exporters except for the pre-crisis period, as shown in Table 5.

Appendix Table F.1 and Appendix Table F.2 report the ex-post analysis results for the samples of financially-unconstrained firms: high-liquidity firms and high-interest-coverage firms. They are broadly similar to those we report in the case of financially-constrained firms but the magnitudes of decreases in leverage are smaller.

5 Conclusions

This paper introduces a financial dimension as an additional source of firm heterogeneity to understand export market participation, and in particular provides micro-level evidence on how the link between leverage and exporting decisions varies with financial constraints. For more complete and robust results, we introduce various criteria for the financial constraints: the liquidity ratio and the interest coverage ratio. The sample is split into two sub-samples according to the yearly median value of those ratios: financially-constrained firms and financially-unconstrained firms.

We find that leverage for financially-constrained firms is negatively associated with the probability of exporting while leverage for financially-unconstrained firms is positively related with the firm's decision to export. Our results derived from financially-constrained firms could be interpreted as confirming the findings of previous studies, which less leveraged firms are more likely to export(e.g. Greenaway et al., 2007). However, the most noticeable difference between our findings and those of previous studies is that we find a positive relation between leverage and exporting decisions for financially-unconstrained firms. It implies that leverage has a differential impact on exporting decisions of firms depending on whether leverage refers to the use of debt after exhausting internal funds (Myers and Majluf , 1984), or an optimizing choice for firms' capital structure(Myers, 1977). For example, for financially-constrained firms, leverage works as a financial burden, and therefore we find the negative impact of leverage on exporting decisions of firms. On the contrary, for financially-unconstrained firms, leverage refers as a way to enjoy advantages such as tax benefits of debt financing, and therefore the firm's decision to export is not necessarily negatively related to leverage.

To establish what is behind our main results, additional analyses have been conducted. Through ex-ante analysis, we find strong evidence of self-selection, in the sample of high-liquidity firms, that future exporters have lower leverage before they begin to export, in line with that of Bellone et al. (2010). On the contrary, in the sample of low-liquidity firms, we find that firms with ex-ante higher leverage self-select to export. This implies that the existence of sunk costs associated with export participation forces low-liquidity firms to use more external funds than high-liquidity firms, in line with the pecking order model(Myers and Majluf , 1984). We also find that export market participation decreases leverage for financially-constrained and financially-unconstrained firms but the magnitudes of decreases in leverage are larger for financially-constrained firms. From a policy point of view, the latter result suggests that export promotion policies may be more effective in reducing leverage for financially-constrained firms.

There are two major caveats to our findings. The first is that we face a sample selection problem due to the fact that this study is based on information only for surviving firms. It is a well-known fact that surviving firms are generally older, more productive, less leveraged, and more credit-worthy(e.g. Görg and Spaliara, 2009). Therefore, it should be noted that the results in this study could be biased by a selection of only surviving firms. Second, the results of this study pertain mainly to sources of firm heterogeneity at a micro level. For better understanding a firm's exporting decisions, it is also necessary to consider the overall situation of the financial market (exchange rate, interest rate, inflation rate, etc.) at a macro level.

Despite these limitations, however, our study represents a first step towards a deeper and more rigorous analysis of how the link between leverage and exporting decisions varies with financial constraints.

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Appendix A: DATA SET

Table A.1: **Structure of the Unbalanced Panel**

Number of Observations per Firm	Number of Firms	Percent	Cumulative
1	745	4.29	4.29
2	428	4.93	9.22
3	435	7.52	16.73
4	297	6.84	23.58
5	246	7.08	30.66
6	220	7.60	38.26
7	166	6.69	44.95
8	141	6.50	51.45
9	115	5.96	57.41
10	97	5.59	62.99
11	97	6.14	69.14
12	69	4.77	73.91
13	70	5.24	79.15
14	49	3.95	83.10
15	40	3.46	86.55
16	53	4.88	91.44
17	43	4.21	95.65
18	42	4.35	100.00
Total	3,353	100.00	

Appendix B: TFP Estimation (Levinsohn and Petrin, 2003)

The possible correlation between unobservable productivity shocks and input choices has been a key issue in estimating production functions. For example, the firm will expand its output as a response to positive productivity shocks, which requires for additional inputs. In a similar way, negative productivity shocks will decrease input usage. Due to this simultaneity bias, Ordinary Least Squares (OLS) estimates of production functions are clearly biased, and lead to biased estimates of productivity.

Olley and Pakes (1996) suggest an estimator using investment as a proxy for these unobserved shocks in order to obtain consistent estimates. Olley and Pakes (1996)' estimator, however, may not be precise enough, as Levinsohn and Petrin (2003) point out that there are considerable adjustment costs which can lead to bias in the investment function. Instead, they introduce an estimator that employs intermediate inputs as a proxy, arguing that intermediates may respond more smoothly to productivity shocks. Estimation using the Levinsohn and Petrin (2003) method can be done employing value-added or gross revenue as the dependent variable. We use sales as a measure of a firm's gross revenue.

For the purpose of illustration of this method, Levinsohn and Petrin (2003) consider the following Cobb-Douglas Production function:

$$y_t = \beta_0 + \beta_l l_t + \beta_k k_t + \beta_m m_t + \omega_t + \eta_t,$$

where y_t denotes the logarithm of gross revenue, l_t, m_t, and k_t are the logarithm of labor input, intermediate input, and capital input, respectively. ω_t and η_t are the error components. It is important to note that ω_t is a state variable which can impact the firm's decision on the choices of inputs. It is not, however, observed by the econometrician, causing to the simultaneity bias in production function estimation. Rewriting the equation above, we have

$$y_t = \beta_l l_t + \phi_t(k_t, m_t) + \eta_t,$$

where

$$\phi_t(k_t, m_t) = \beta_0 + \beta_k k_t + \beta_m m_t + \omega_t(k_t, m_t)$$

Substituting $\phi_t(k_t, m_t)$ with a third-order polynomial approximation in k_t and m_t can consistently estimate parameters considered.

Appendix C: Additional Mean Difference Tests

Table C.1: **The Mean of Leverage for Exporters and Non-exporters**

		Entire Sample			High-Interest-Coverage Firms			Low-Interest-Coverage Firms		
		Leverage Ratio		Observations	Leverage Ratio		Observations	Leverage Ratio		Observations
All Period(1994-2011)	Non-exporters		0.4679	8,572		0.4430	4,080		0.4904	4,492
	Exporters		0.4933	8,793		0.4759	4,598		0.5125	4,195
	t-Test(P-value)	-3.2361***	(0.0012)		-3.0068***	(0.0026)		-1.9405*	(0.0524)	
Pre-Crisis(1994-1997)	Non-exporters		0.5187	727		0.4311	366		0.6075	361
	Exporters		0.6130	1,180		0.5618	587		0.6637	593
	t-Test(P-value)	-3.4410***	(0.0006)		-3.7954***	(0.0002)		-1.3343	(0.1825)	
Post-Crisis(1998-2011)	Non-exporters		0.4631	7,845		0.4442	3,714		0.4801	4,131
	Exporters		0.4748	7,613		0.4633	4,011		0.4876	3,602
	t-Test(P-value)	-1.4254	(0.1541)		-1.6616*	(0.0966)		-0.6361	(0.5247)	

Notes: T-test compares mean differences of leverage between exporters and non-exporters with unequal variances assumed. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Appendix D: Robustness Checks on the Main Results

Table D.1: **Dynamic Random-Effects Probit Model for Leverage and Exporting Decisions**

	Liquidity Ratio				Interest Coverage Ratio			
	High		Low		High		Low	
	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$EXPDUM_{i(t-1)}$	3.155***	3.159***	3.132***	3.131***	3.083***	3.084***	3.220***	3.221***
	(0.062)	(0.062)	(0.059)	(0.059)	(0.059)	(0.059)	(0.064)	(0.064)
$Leverage_{i(t-1)}$	0.443		0.044		0.091*		-0.101*	
	(0.284)		(0.052)		(0.055)		(0.058)	
$(Pre\,Crisis\ Dummy \times Leverage)_{i(t-1)}$		2.168**		-0.022		0.173		-0.393***
		(0.875)		(0.155)		(0.182)		(0.151)
$(Post\,Crisis\ Dummy \times Leverage)_{i(t-1)}$		0.241		0.052		0.083		-0.057
		(0.297)		(0.055)		(0.057)		(0.061)
$Log(Employment)_{i(t-1)}$	0.160***	0.159***	0.137***	0.138***	0.123***	0.123***	0.203***	0.209***
	(0.046)	(0.046)	(0.042)	(0.042)	(0.042)	(0.042)	(0.047)	(0.047)
$Log(Firm\ Age)_{i(t-1)}$	-0.002	-0.004	-0.006	-0.006	-0.049	-0.05	0.066	0.066
	(0.043)	(0.044)	(0.038)	(0.038)	(0.040)	(0.040)	(0.041)	(0.041)
$Log(Labor\ Productivity)_{i(t-1)}$	0.036	0.037	0.055	0.055	0.089*	0.089*	-0.043	-0.047
	(0.051)	(0.051)	(0.048)	(0.048)	(0.050)	(0.050)	(0.053)	(0.053)
$Chaebol_i$	0.064	0.063	0.128**	0.128**	0.133**	0.133**	0.07	0.071
	(0.066)	(0.066)	(0.063)	(0.063)	(0.063)	(0.063)	(0.066)	(0.067)
Constant	-1.744***	-1.680***	-2.722***	-2.733***	-1.327*	-1.315*	-2.951***	-2.986***
	(0.561)	(0.563)	(0.381)	(0.382)	(0.701)	(0.702)	(0.386)	(0.386)
Observations	5,957	5,957	6,357	6,357	6,098	6,098	6,216	6,216

Notes: All estimates in table D.1 are obtained from the Random-Effects Probit model. Lagged values are used as independent variables while contemporaneous values are used as a dependent variable. Robust standard errors are reported in parentheses. Time dummies and Industry dummies are included but not reported. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table D.2: **Pooled Probit Model for Leverage and Exporting Decisions using Labor Productivity as a Proxy for Firms' Productivity**

	Liquidity Ratio				**Interest Coverage Ratio**			
	High		**Low**		**High**		**Low**	
	Model I	**Model II**	**Model I**	**Model II**	**Model I**	**Model II**	**Model I**	**Model II**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
$Leverage_{i(t-1)}$	0.804***		-0.045		0.100**		-0.114**	
	(0.209)		(0.046)		(0.049)		(0.053)	
$(Pre\,Crisis\,Dummy \times Leverage)_{i(t-1)}$		1.784**		-0.188		0.155		-0.371**
		(0.746)		(0.127)		(0.188)		(0.148)
$(Post\,Crisis\,Dummy \times Leverage)_{i(t-1)}$		0.690***		-0.03		0.095*		-0.084
		(0.218)		(0.048)		(0.050)		(0.056)
$Log(Employment)_{i(t-1)}$	0.500***	0.500***	0.503***	0.504***	0.486***	0.486***	0.515***	0.518***
	(0.038)	(0.038)	(0.044)	(0.044)	(0.043)	(0.043)	(0.040)	(0.040)
$Log(Firm\ Age)_{i(t-1)}$	0.177***	0.175***	0.116***	0.117***	0.092**	0.092**	0.200***	0.200***
	(0.046)	(0.046)	(0.043)	(0.043)	(0.046)	(0.046)	(0.045)	(0.045)
$Log(Labor\ Productivity)_{i(t-1)}$	0.238***	0.239***	0.194***	0.193***	0.208***	0.208***	0.204***	0.202***
	(0.052)	(0.052)	(0.050)	(0.050)	(0.053)	(0.053)	(0.053)	(0.053)
$Chaebol_i$	0.271***	0.271***	0.229***	0.229***	0.245***	0.245***	0.272***	0.272***
	(0.078)	(0.078)	(0.076)	(0.077)	(0.079)	(0.078)	(0.079)	(0.079)
Constant	-6.409***	-6.393***	-6.085***	-6.088***	-5.118***	-5.116***	-6.563***	-6.547***
	(1.105)	(1.106)	(1.081)	(1.081)	(1.182)	(1.182)	(1.107)	(1.107)
Observations	5,957	5,957	6,357	6,357	6,098	6,098	6,216	6,216
R-Squared	0.2450	0.2454	0.2275	0.2277	0.1957	0.1957	0.2781	0.2788

Notes: All estimates in table D.2 are obtained from the Pooled Probit model with Panel data. Lagged values are used as independent variables while contemporaneous values are used as a dependent variable. Robust standard errors are reported in parentheses. Time dummies and Industry dummies are included but not reported. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table D.3: **Pooled Probit Model for Leverage and Exporting Decisions considering 1994-1996 as Pre-Crisis Years**

	Liquidity Ratio				**Interest Coverage Ratio**			
	High		**Low**		**High**		**Low**	
	Model I	**Model II**	**Model I**	**Model II**	**Model I**	**Model II**	**Model I**	**Model II**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
$Leverage_{i(t-1)}$	0.808***		-0.041		0.105**		-0.109**	
	(0.209)		(0.046)		(0.049)		(0.053)	
$(Pre\,Crisis\,Dummy \times Leverage)_{i(t-1)}$		1.275		-0.104		0.182		-0.276*
		(0.801)		(0.138)		(0.203)		(0.145)
$(Post\,Crisis\,Dummy \times Leverage)_{i(t-1)}$		0.766***		-0.037		0.101**		-0.093*
		(0.215)		(0.048)		(0.050)		(0.055)
$Log(Employment)_{i(t-1)}$	0.376***	0.376***	0.403***	0.404***	0.382***	0.382***	0.411***	0.413***
	(0.048)	(0.048)	(0.051)	(0.052)	(0.050)	(0.050)	(0.053)	(0.053)
$Log(Firm\,Age)_{i(t-1)}$	0.179***	0.178***	0.119***	0.119***	0.095**	0.095**	0.202***	0.202***
	(0.046)	(0.046)	(0.043)	(0.043)	(0.046)	(0.046)	(0.045)	(0.045)
$Log(TFP)_{i(t-1)}$	0.212***	0.212***	0.169***	0.169***	0.176***	0.176***	0.180***	0.178***
	(0.053)	(0.053)	(0.052)	(0.052)	(0.054)	(0.054)	(0.056)	(0.056)
$Chaebol_i$	0.277***	0.277***	0.238***	0.238***	0.254***	0.253***	0.280***	0.279***
	(0.077)	(0.077)	(0.076)	(0.076)	(0.078)	(0.078)	(0.078)	(0.078)
Constant	-1.533***	-1.526***	-2.124***	-2.130***	-0.867*	-0.866*	-2.393***	-2.403***
	(0.433)	(0.433)	(0.446)	(0.447)	(0.527)	(0.526)	(0.427)	(0.427)
Observations	5,957	5,957	6,357	6,357	6,098	6,098	6,216	6,216
R-Squared	0.2430	0.2431	0.2260	0.2260	0.1938	0.1938	0.2766	0.2769

Notes: All estimates in table D.3 are obtained from the Pooled Probit model with Panel data. The pre-crisis dummy takes the value of one for the period of 1994-1996 and zero otherwise, while the post-crisis dummy takes the value of one for the period of 1997-2011 and zero otherwise. Lagged values are used as independent variables while contemporaneous values are used as a dependent variable. Robust standard errors are reported in parentheses. Time dummies and Industry dummies are included but not reported. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table D.4: **Pooled Probit Model for Leverage and Exporting Decisions using Labor Productivity as a Proxy for Firms' Productivity and considering 1994-1996 as Pre-Crisis Years**

	Liquidity Ratio				Interest Coverage Ratio			
	High		Low		High		Low	
	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Leverage_{i(t-1)}$	0.804***		-0.045		0.100**		-0.114**	
	(0.209)		(0.046)		(0.049)		(0.053)	
$(Pre\,Crisis\ Dummy \times Leverage)_{i(t-1)}$		1.784**		-0.188		0.155		-0.371**
		(0.746)		(0.127)		(0.188)		(0.148)
$(Post\,Crisis\ Dummy \times Leverage)_{i(t-1)}$		0.690***		-0.03		0.095*		-0.084
		(0.218)		(0.048)		(0.050)		(0.056)
$Log(Employment)_{i(t-1)}$	0.500***	0.500***	0.503***	0.504***	0.486***	0.486***	0.515***	0.518***
	(0.038)	(0.038)	(0.044)	(0.044)	(0.043)	(0.043)	(0.040)	(0.040)
$Log(Firm\ Age)_{i(t-1)}$	0.177***	0.175***	0.116***	0.117***	0.092**	0.092**	0.200***	0.200***
	(0.046)	(0.046)	(0.043)	(0.043)	(0.046)	(0.046)	(0.045)	(0.045)
$Log(Labor\ Productivity)_{i(t-1)}$	0.238***	0.239***	0.194***	0.193***	0.208***	0.208***	0.204***	0.202***
	(0.052)	(0.052)	(0.050)	(0.050)	(0.053)	(0.053)	(0.053)	(0.053)
$Chaebol_i$	0.271***	0.271***	0.229***	0.229***	0.245***	0.245***	0.272***	0.272***
	(0.078)	(0.078)	(0.076)	(0.077)	(0.079)	(0.078)	(0.079)	(0.079)
Constant	-6.409***	-6.393***	-6.085***	-6.088***	-5.118***	-5.116***	-6.563***	-6.547***
	(1.105)	(1.106)	(1.081)	(1.081)	(1.182)	(1.182)	(1.107)	(1.107)
Observations	5,957	5,957	6,357	6,357	6,098	6,098	6,216	6,216
R-Squared	0.2450	0.2454	0.2275	0.2277	0.1957	0.1957	0.2781	0.2788

Notes: All estimates in table D.4 are obtained from the Pooled Probit model with Panel data. The pre-crisis dummy takes the value of one for the period of 1994-1996 and zero otherwise, while the post-crisis dummy takes the value of one for the period of 1997-2011 and zero otherwise. Lagged values are used as independent variables while contemporaneous values are used as a dependent variable. Robust standard errors are reported in parentheses. Time dummies and Industry dummies are included but not reported. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Appendix E: Robustness Checks on Ex-Ante Analysis

Table E.1: **Ex-ante leverage of future exporters**

	No Control (1)	**Industry Control (2)**	**Industry and Size Control (3)**	**Observations (4)**
	Panel A: High-Interest-Coverage Firms[a]			
Pre-Crisis (1994-1997)	-0.317***	-0.584***	-0.777***	36
	(0.098)	(0.116)	(0.059)	
Post-Crisis (1998-2011)	-0.002	-0.130***	-0.222***	200
	(0.058)	(0.050)	(0.031)	
All Period (1994-2011)	0.057	-0.116***	-0.173***	194
	(0.059)	(0.044)	(0.022)	
	Panel B: Low-Interest-Coverage Firms			
Pre-Crisis (1994-1997)	0.915***	0.381*	0.353*	36
	(0.154)	(0.222)	(0.198)	
Post-Crisis (1998-2011)	0.337***	0.247***	0.241***	200
	(0.075)	(0.048)	(0.044)	
All Period (1994-2011)	0.365***	0.147***	0.287***	194
	(0.041)	(0.045)	(0.035)	

Notes: Table E.1 examines the ex-ante effects of leverage on export participation for high interest-coverage-firms in Panel A and for low-interest-coverage firms in Panel B, using the cross-sectional approach. The numbers reported in Table E.1 represent the coefficients on $EXPDUM_{iT}$, which is the exporting status of the firm in the last year T (1997, 2011, 2011) for each sample (1994-1997; 1998-2011; 1994-2011), in Equation 4. The dependent variable is the average leverage of firms before starting export. Industry dummies are included in the second column of Table E.1. The third column in this table includes not only industry dummies but also the log of the number of employees in the first year (1994, 1998, 1994) of each period, which captures the firm's initial size. Robust standard errors are reported in parentheses. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

[a] we define a firm whose interest coverage ratio is higher (lower) than the median value in the initial year as a high (low) interest coverage firm.

Appendix F: Robustness Checks on Ex-Post Analysis

Table F.1: **High-Liquidity Firms**

High-Liquidity Sample		**All Period(1994-2011)**	**Pre-Crisis(1994-1997)**	**Post-Crisis (1998-2011)**
t-1/t	**Treated**	0.128	0.235	0.142
	Controls	0.202	-0.029	0.257
	Difference	**-0.074**	**0.264***	**-0.115**
		(0.097)	(0.128)	(0.099)
	P-value	0.382	0.051	0.276
t-1/t+1	**Treated**	0.111	0.060	0.127
	Controls	0.210	0.076	0.338
	Difference	**-0.099**	**-0.016**	**-0.211****
		(0.096)	(0.106)	(0.084)
	P-value	0.230	0.869	0.012
t-1/t+2	**Treated**	0.185	0.036	0.214
	Controls	0.047	-0.064	0.245
	Difference	**0.138****	**0.100****	**-0.031**
		(0.064)	(0.059)	(0.087)
	P-value	0.029	0.026	0.714
	# of control firms	**974**	**29**	**909**
	# of treatment firms	**45**	**8**	**31**

Notes: Difference is calculated as: Difference=$(after - before)_{treated}$-$(after - before)_{control}$. we construct the counterfactual with the propensity score matching, in particular the nearest neighbor matching algorithm. 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 F.2: **High-Interest-Coverage Firms**

High-Interest-Coverage Firms				
		All Period(1994-2011)	**Pre-Crisis(1994-1997)**	**Post-Crisis (1998-2011)**
t-1/t	**Treated**	-0.066	0.278	-0.051
	Controls	-0.087	0.113	0.010
	Difference	**0.021**	**0.166**	**-0.061**
		(0.101)	(0.188)	(0.120)
	P-value	0.825	0.242	0.600
t-1/t+1	**Treated**	-0.077	0.108	-0.132
	Controls	-0.078	0.345	0.122
	Difference	**0.001**	**-0.237**	**-0.255****
		(0.117)	(0.321)	(0.128)
	P-value	0.992	0.204	0.042
t-1/t+2	**Treated**	-0.147	-0.219	-0.167
	Controls	-0.067	0.022	0.059
	Difference	**-0.081**	**-0.241**	**-0.226***
		(0.107)	(0.254)	(0.140)
	P-value	0.434	0.254	0.099
	# of control firms	**972**	**34**	**882**
	# of treatment firms	**64**	**8**	**43**

Notes: Difference is calculated as: Difference=$(after - before)_{treated}$-$(after - before)_{control}$. we construct the counterfactual with the propensity score matching, in particular the nearest neighbor matching algorithm. 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 F.3: **Low-Interest-Coverage Firms**

Low-Interest-Coverage Firms				
		All Period(1994-2011)	**Pre-Crisis(1994-1997)**	**Post-Crisis (1998-2011)**
t-1/t	**Treated**	-0.076	-0.019	-0.093
	Controls	0.184	-0.063	-0.329
	Difference	**-0.260***	**0.043**	**0.237**
		(0.151)	(0.191)	(0.160)
	P-value	0.064	0.831	0.159
t-1/t+1	**Treated**	-0.103	-0.033	-0.118
	Controls	0.235	-0.218	0.139
	Difference	**-0.338****	**0.185**	**-0.257**
		(0.147)	(0.128)	(0.194)
	P-value	0.012	0.222	0.131
t-1/t+2	**Treated**	0.002	0.069	-0.022
	Controls	0.111	0.164	-0.078
	Difference	**-0.109**	**-0.096**	**0.056**
		(0.139)	(0.162)	(0.166)
	P-value	0.356	0.586	0.725
	# of control firms	**1,151**	**21**	**1,091**
	# of treatment firms	**26**	**3**	**20**

Notes: Difference is calculated as: Difference=$(after - before)_{treated}$-$(after - before)_{control}$. we construct the counterfactual with the propensity score matching, in particular the nearest neighbor matching algorithm. Standard errors are reported in parentheses. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Appendix G: Figures

Figure G.1: Density Distribution of Propensity Score

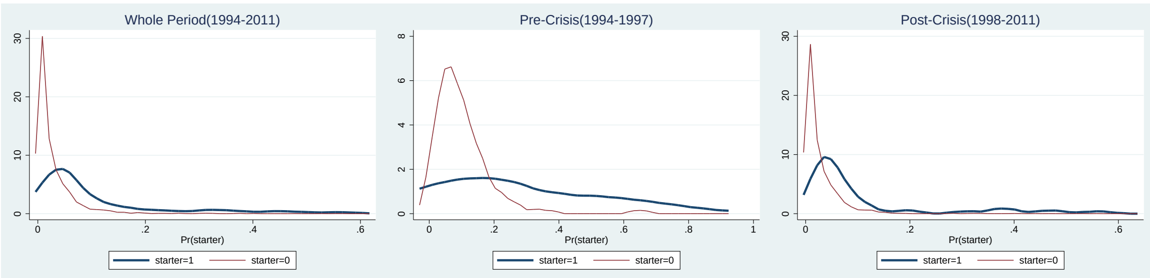

Figure G.2: Histograms of Propensity Scores: High-Liquidity Firms

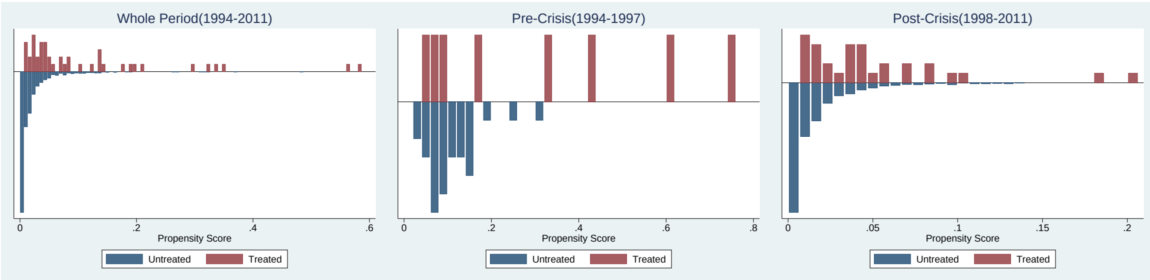

Figure G.3: Histograms of Propensity Scores: Low-Liquidity Firms

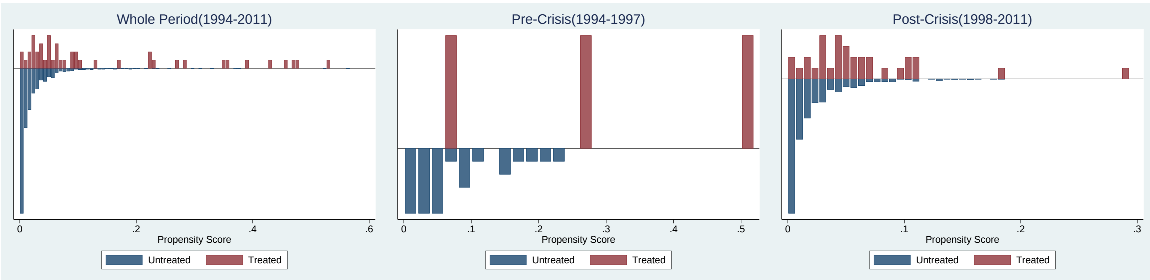

Figure G.4: Histograms of Propensity Scores: High-Interest-Coverage Firms

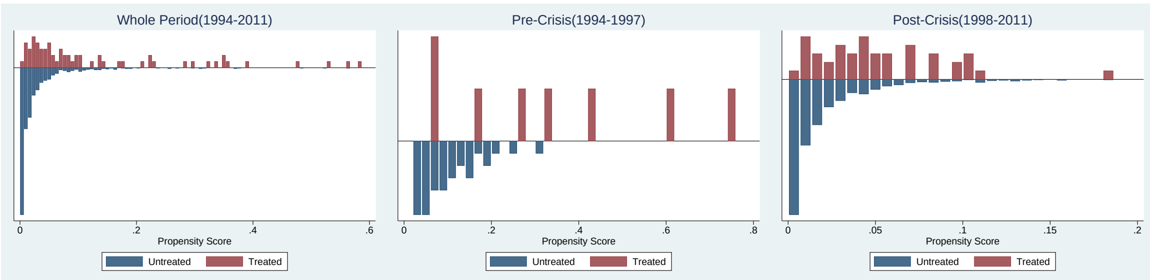

Figure G.5: Histograms of Propensity Scores: Low-Interest-Coverage Firms