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Financial Shocks and Firm Exports: A natural experiment approach with a massive earthquake (Revised)

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Financial Shocks and Firm Exports: A natural experiment approach with a massive earthquake

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Abstract

This paper investigates the effect of financial shocks on firms' exports. To circumvent endogeneity problems, we utilize the natural experiment provided by the Great Hanshin-Awaji earthquake in 1995. Using a unique firm-level dataset, we single out the effect of exogenous financial shocks on firms' exports by focusing on exports of firms that were not directly damaged by the earthquake but that transacted with damaged banks as their main banks. Our main findings are twofold. First, as for the extensive margins of exports, the probabilities of starting exports or of expanding export destination areas were smaller for undamaged firms that transacted with a damaged main bank than for those that transacted with an undamaged main bank. Second, as for the intensive margins of exports, undamaged firms that transacted with a damaged main bank had a lower export-to-sales ratio than those that transacted with an undamaged main bank. These findings lend support to the existence of the financial constraint on firm exports.

JEL Classification: F14, G21

Keywords: Bank lending, Firm exports, Extensive and intensive margin

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1. Introduction

A well-established stylized fact is that there is within-industry heterogeneity of firm- or plant-level export behavior, even within narrowly defined industry.[1] To account for the fact, theoretical studies have tried to clarify the factors that can explain why some firms export and others do not. One of such factors is the difference in firm productivity. This is because only high productivity firms are willing to cover fixed costs to start exports, e.g., costs for constructing sales network, being familiar with local regulations, and acquiring information associated with business activities in foreign countries (Melitz 2003).

Another factor that attracts much more attention in recent studies is *financial constraint*. Financial constraint is generated, for example, by weak lending capacity of lending banks (Amiti and Weinstein 2011; Paravisini et al. 2011) or tighter financial conditions at the aggregate-level (e.g., higher interbank rate: Chor and Manova 2012). Such constraint might matter for the *extensive margins* of exports, because under such constraint, firms might not be able to finance fixed entry costs to start exporting to a foreign market (even if they are highly productive). Financial constraint might also constrain the *intensive margins* of exports for those firms that have already started exporting. This is because such firms usually rely on trade finance, such as letter of credit (L/C), for working capital financing. When the amount of trade finance is reduced due to the reduced lending capacity of banks, firms might not be able to maintain exporting.

Although the theoretical prediction on the relationship between financial constraints and firm exports is clear-cut, its empirical examination is challenging due to identification problems. While lender behavior might affect borrowing firms' performance, the performance of borrowers might also have a significant impact on the financial health, and thereby lending capacity, of lenders. Also, there might be a positive assortative matching mechanism between firms and banks (e.g., Sorensen 2007). Better-performing firms might have a higher likelihood of transacting with better-performing banks, making it difficult to identify the causality running from the financial characteristics of lending banks to the exports of their client firms.

[1] See, for example, Bernard and Jensen (1999).

This paper investigates the effect of financial constraint on firms' export behavior in a manner that can circumvent the identification problems indicated above. In this paper, we take advantage of the natural experiment provided by the Kobe earthquake (also known as the Great Hanshin-Awaji earthquake), a natural disaster that hit the area around Kobe City and Awaji Island in western Japan in January 1995. Devastating natural disasters such as the Kobe earthquake are likely to cause significant financial constraint on firms through sudden financial shocks due to the reduced lending capacity of banks that they borrow from. For example, a natural disaster may obliterate information on borrowers' creditworthiness accumulated at the disaster-affected banks, and thus destroy their managerial capacity to originate loans, including the ability to screen and process loan applications. Natural disaster may also cause damage to borrowing firms located in the disaster-affected areas, which might deteriorate the banks' loan portfolios and thereby risk-taking capacity. Reduction in credit supply from those banks with reduced lending capacity might have a negative impact on borrowing firms' exports through the mechanisms indicated above.

To single out purely exogenous shocks to firms' financing stemming from reduced financial capacities of banks, we focus on those firms that are *not* directly damaged by the disaster but borrowing from *damaged banks*. If we focused on directly damaged firms, we would suffer from the identification problems, because damaged firms might reduce exports simply because their production facility is damaged and so they cannot produce goods to export. However, for non-damaged firms, possible reduction in exports is likely to occur through the damages to their banks that affect the availability and the cost of external funds that they can access. Thus, by focusing on such firms, we are able to extract the effect of purely exogenous financial shocks. Also, by focusing on such a purely exogenous shock, we can circumvent the problem caused by the positive assortative matching mechanism, because it is implausible that better-performing firms choose banks that are less likely to be hit by a natural disaster.

Our firm-level dataset contains information on firm characteristics, on the identity of firms' main banks and their characteristics, and on firms' export activities including destined export regions and volume of exports to each region. Furthermore, information is also available on whether these firms and banks (more precisely their headquarters) were located *inside* or *outside* the earthquake-affected area, and on the fraction of bank branches that are located inside the affected area. Using these pieces of location information, we create proxies for the damaged firms/banks based on whether they are located inside the affected area or on the fraction of bank branches located inside the affected area. We then compare the export behavior of undamaged (outside) firms borrowing from damaged (inside) banks with those borrowing from undamaged (outside) banks.

Our main findings are summarized as follows. First, as for the extensive margins, we find that undamaged (outside) firms transacted with damaged (inside) main banks were less likely to start exports or to expand export regions than those transacted with undamaged (outside) main banks. This finding suggests that damage to banks' lending capacity, which is likely to be exogenous to the firms, had a significant adverse effect on the extensive margins of firm exports. Thus, our finding lends support to the existence of financial constraints on firm exports.

Furthermore, the finding is robust to the use of an alternative proxy for bank damage which is created based on the ratio of the number of branch offices located inside the earthquake-affected area to the total number of branches. While the damage to a bank's headquarters is likely to capture the decline in a bank's managerial capacity to process loan applications at the back office, the damage to a bank's branch network capture the decline in the bank's financial health and risk-taking capacity. Thus, our finding implies that deterioration in banks' lending capacity in either form had an important adverse impact on the extensive margins of exports. However, we also find that the impact of the headquarters damage emerged right after the earthquake and thus earlier than that of the branch damage. This implies that the adverse effect of the bank's managerial capacity on firms' exports appeared in a relatively short period of time, while the effect of the damage to bank's financial health and risk-taking capacity appeared later.

Second, as for the intensive margins, we find that undamaged (outside) firms transacted with a damaged (inside) main bank had a lower export-to-sales ratio than those transacting with an undamaged (outside) main bank. This finding is consistent with the prediction that the exogenous damage to banks' lending capacity had a significant adverse effect on the intensive margins of firm exports through smaller provision of trade finance. However, different from the case for the extensive margins, we do not find this relationship when we use a proxy for the bank damage at the branch level. This implies that not the decline in a bank's financial health but a bank's deteriorated managerial capacity caused the negative impact on the intensive margins of exports due to, for example, a reduced provision of trade finance originating from the deteriorated managerial capacity.

This paper contributes to two strands of literature. First, to the literature on financial constraint and firm exports, we contribute by examining the effects of bank lending on firm exports in a unique manner that circumvents the identification problems that many existing studies face with, i.e., we take advantage of a natural experiment provided by a natural disaster. Also, our matched firm-bank data allow us to examine the effect of financial constraint in a more precise manner than many other studies using aggregate data (e.g., Chor and Manova, 2012).

Second, this paper is closely related to the literature on the effect of natural disasters on firm activities. In this strand of the literature too, many studies use aggregate data (at the country or regional level), while we use micro data. Notable exceptions are Leiter et al. (2009) and De Mel et al. (2010) that examine the recovery of disaster-affected firms using a firm level dataset. However, these studies do not examine firm exports, and examine damaged firms only. To the best of our knowledge, only Hosono et al. (2012) examine both damaged and undamaged firms using micro-data, but again, they focus on firm investments and do not examine firm exports.

The rest of the paper is structured as follows. Section 2 reviews the literature and explains our contribution in greater details. Section 3 provides a brief overview of the Great Hanshin-Awaji earthquake. Section 4 describes our data. Sections 5 and 6 respectively report our methodology and results for the extensive and intensive margins. Section 7 shows evidence that is consistent with our hypothesis that shocks to banks lending capacity tighten firms' credit constraint and thus affect firm exports.. Section 8 summarizes the results and concludes.

2. Literature Review

Since the theoretical work by Melitz (2003), vast literature has examined the effect of firm productivity as a determinant of whether firms export or not, because only high-productivity firms can are willing to pay fixed costs of exports. However, recently much more attention has been paid to another (although related) factor: financial friction faced by firms.[2] The idea is that firms facing financial friction find it difficult to start exports or increase the amount of it, either because they cannot finance the fixed entry cost a la Melitz (2003) to get an access to a new foreign market, or they cannot receive sufficient amount of trade finance from lending banks to cover their export activities. For example, Chaney (2005) augments the Melitz-type model with liquidity constraints, and demonstrates that it is not only high productivity but also large amounts of liquidity that are prerequisites for firms to start exporting. Also, Manova (2013) introduces financial friction to the Melitz-type model and shows that credit constraints affect both the intensive and the extensive margins of exports.

Existing empirical studies have already attempted to test these predictions that financial friction matters for firm exports. By using country and sector level data, Chor and Manova (2012) study the change in U.S. imports from various countries and various sectors during the period of the global financial crisis, and find that countries with tighter credit conditions (e.g., those with higher interbank interest rates) exported to a lesser extent to the U.S., which implies that financial friction plays an important role in international trade. However, because they use data at the aggregate level, so they cannot account for heterogeneity of export behavior due to heterogenous financial constraints faced by individual firms.

[2] Other factors explored by existing studies include spillover effects from neighboring firms, government subsidies, success experience, and informational barriers. See, for example,, Bernard and Jensen (2004).

In this regard, Bellone et al. (2010) use firm-level data in France, including several measures for financial constraints, and find that manufacturing companies that have started exports exhibit more significant ex ante financial advantages. Similarly, using French firm-level data including the information about firms' payment to their creditors, Bricongne et al. (2012) find that for those firms in sectors that are highly dependent on external finance, the occurrence of *payment incident*, i.e., past experiences of failures to make payment to creditors, aggravated a decline in export activities during the period of the global financial crisis.

However, these studies suffer from a serious drawback. The measures of financial constraints used in these studies are based on firms' own characteristics. As discussed in Abel and Eberly (2011) and Gomes (2001) in the context of firm investment, firms' own characteristics are highly likely to be related to their future profitability, which generates an endogeneity problem stemming from reverse causality.

Some of the recent studies try to circumvent such an endogeneity problem by employing proper instruments. For example, using a unique Italian firm level survey data including firms' responses to the questions about the degree of credit rationing, Minetti and Zhu (2011) find that the probability of starting exports and the volume of exports for Italian manufacturing firms are substantially lower when firms are credit-rationed. To disentangle loan supply shocks and loan demand shocks, Minetti and Zhu (2011) employ various variables (e.g., the number of banks in each Italian province in 1930s) when they instrument their measure of financial constraint based on firms' answer to a survey question about credit rationing. Amiti and Weinstein (2011) employ Japanese firm-level data augmented by the information on each firm's main bank to examine the impact of financial crisis in Japan during the 1990s onto firm exports. Amiti and Weinstein (2011) find that banks' financial health, which is measured by banks' market-to-book ratio, plays an important role in determining the intensive margins of exports, which suggests the importance of trade finance. To ascertain that there is no reverse causality running from firm health to bank health, they check the robustness of the results by regressing the change in banks' market-to-book ratio on the change in firms' stock price, and use the residuals as another proxy for the supply-side shock.

Another approach to circumvent the endogeneity problem is to utilize exogenous financial shocks to firms. Paravisini et al. (2011) study the impact of the capital flow reversals during the 2008 financial crisis on Peruvian firms' international trade. By using firm-level data augmented by the information on lender banks, which include each lender's foreign ownership, Paravisini et al. (2011) find that a decline in credit generated by the capital flow reversal reduces the intensive margins of exports, but the decline has no effect on the extensive margins.

The present paper also utilizes an exogenous shock to firms. Unlike Paravisini et al. (2011), however, we take advantage of a natural experiment provided by a natural disaster. Deterioration of the lending capacity of a bank due to damages from the earthquake is a purely exogenous financial shock to its borrowers. Also, the natural experiment enables us to circumvent an endogenous matching problem between banks and firms that earlier studies might suffer from, because it is impossible for firms to choose banks that will not incur damages from the earthquake in the future.

From a border perspective, this paper contributes to the vast literature examining the effects of bank lending on the real economic activities since the seminal work by Bernanke (1983). Resolving identification problems is also challenging in this broader literature. As a prominent study, Peek and Rosengren (2000) resolve the problem by examining the effect of deteriorating financial health of Japanese banks on U.S. state-level construction activities through the reductions in those banks' lending at their US branches.[3] However, Peek and Rosengren (2000) use aggregate data at the U.S. state level, so they cannot control for firm and bank heterogeneity. Our firm-level micro data allow us to fully control such heterogeneity.[4]

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[3] Following Peek and Rosengren (2000), a number of studies find evidence for a negative international transmission of financial shocks through foreign banks' deteriorating asset quality (Van Rijckeghem and Weder 2001; Chava and Purnanandam 2011; Cetorelli and Goldberg 2012; Ivashina et al. 2012; Popov and Udell 2010; Schnabl 2012).

[4] Two other studies also examine a domestic transmission of bank shocks using micro-data (Khwaja and Mian 2008; Berg and Schrader 2012), but they focus on firm exit and loan approvals, and do not focus on export behavior.

3. Brief Summary of the Kobe Earthquake

In this section, we briefly summarize the Kobe Earthquake that we focus in this paper. The earthquake occurred on January 17, 1995. The estimated total physical damage from this devastating natural disaster is 9.9 trillion yen, including 630 billion yen in business sector losses.[5] Table 1 provides an overview of the estimated damage, including the number of casualties and the number of housing units destroyed. There were more than 6,000 casualties, and about 100,000 housing units were completely destroyed. As the table shows, the number of casualties and the extent of damage were geographically concentrated in a relatively narrow area around Kobe city and Awaji Island.[6]

To our research, it is worth mentioning that the Kobe earthquake had a serious adverse impact on the operation of banks located in the disaster-affected area. Table 2 shows that about a quarter of the bank branches located in Hyogo Prefecture were unable to operate immediately after the earthquake. Although information regarding how long such suspension of branch operation continued is not available, we can at least infer that these banks could not resume their operation at their ordinary level because of the physical destruction of the buildings of the branches (and of the headquarters for some banks), and of the loss of human capital. Table 3 provides an overview of the banks headquartered in the earthquake-affected area at the time of the earthquake. The lending capacity of these 18 banks, including 2 relatively large regional banks, was highly likely to be lost to a significant extent. Below we examine how such bank damage affected borrowing firms' export behavior.

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[5] Data provided by Hyogo Prefecture (http://web.pref.hyogo.jp/wd33/wd33_000000010.html).

[6] The ratios of completely destroyed, partly destroyed, and completely or partly destroyed housing units in the table should be treated with a degree of caution, because the Fire Defense Agency and the Ministry of Construction (*Housing and Land Survey*) use slightly different definitions. For example, the ratio of completely or partly destroyed housing units in Nagata-ku is more than 90%, which seems excessively high. For a limited number of cities and towns, we can use alternative survey data collected by the Architectural Institute of Japan, which cover around 80% of the housing in Japan. If we use these data, the ratios of completely, partly, and completely or partly destroyed housing units for Nagata-ku are 25.6%, 22.0%, and 47.6%, respectively.

4. Data

4.1 Data sources

We primarily rely on two firm-level data sources. First, information on firms' export behavior and financial conditions is obtained from the *Basic Survey of Business Structure and Activities* (BSBSA; *Kigyo Katsudou Kihon Chosa* in Japanese) compiled by the Ministry of Economy, Trade and Industry. The main purpose of this survey is to gauge quantitatively the activities of Japanese enterprises, in terms of capital investment, exports, foreign direct investment, investment in research and development, among others. To this end, the survey covers the universe of enterprises in Japan with more than 50 employees and with paid-up capital of over 30 million yen. The most important information from this data source is firm-level data on export volume of each firm destined to seven regions: Asia, Northern America, Southern and Central America, Europe, Africa, Middle East, and Oceania.

Second, we rely on the firm-level database provided by Teikoku Databank LTD. (TDB for short), a leading business credit information provider in Japan. In addition to information on firm characteristics, the TDB database provides a list of banks with which each firm transacts, where firms rank the banks in the order of importance to them. We define the bank at the top of each firm's list as its *main bank*. We further augment the TDB dataset with data from the financial statements of all the main banks, obtained from the Nikkei NEEDS Financial Quest compiled by Nikkei, Inc. (Nihon Keizai Shimbunsha) and two other paper-based sources.[7] This augmented dataset is then merged with the dataset from the BSBSA using firm names and addresses.

4.2 Sample Selection

We compare the firms/banks located inside and outside the earthquake-affected area. The earthquake-affected area is defined as the nine cities and five towns in Hyogo and Osaka prefectures that were targets

[7] These two sources are the *Financial Statements of Shinkin Banks* and the *Financial Statements of Credit Cooperatives*, edited by Kinyu Tosho Konsarutantosha.

of the Japanese Government's Act Concerning Special Financial Support to Deal with a Designated Disaster of Extreme Severity.[8] We first pick those firms whose headquarters are located *inside* this area as damaged firms.[9] As comparison group, we also include those firms located *outside* the earthquake-affected area. To eliminate differences in unobserved characteristics stemming from region-specific factors, we select firms located outside the earthquake-affected area and inside Hyogo and Osaka prefectures. The BSBSA database contains the information of 3,897 firms headquartered in Hyogo and Osaka prefectures, 641 of which were located in the affected area and 3,256 in the non-affected area. When we merge the BSBSA data with the TDB data, the number of firms reduces to 3,212, of which 591 firms were headquartered in the affected area and 2,621 firms in the non-affected area.

To trace the changes over time in the effects of bank damages on firms' export behavior, we focus on a fixed cohort of firms for three years after the earthquake. To this end, we construct a balanced panel dataset which excludes firms that exited from the dataset during the observation period. More precisely, we set our observation period from fiscal year (FY) 1995 to FY 1997. FY 1995, for example, is an accounting year beginning during 1995 and ending during 1996. Typically, FY 1994 begins in April 1994 and ends in March 1995. Therefore, January, 1995, when the Kobe Earthquake occurred is included in FY 1994 for most of the firms in our sample. [10]

Although this restriction may raise concerns about survivor bias, we argue that it does not cause serious problems for the following reasons. First, somewhat surprisingly, the number of firms in the affected area that exited from the sample is not large compared with the equivalent number in the non-affected area.

[8] The nine cities and five towns consist of Toyonaka City, Kobe City, Amagasaki City, Nishinomiya City, Ashiya City, Itami City, Takarazuka City, Kawanishi City, Akashi City, Tsuna Town, Hokutan Town, Ichinomiya Town, Goshiki Town, and Higashiura Town. Goshiki Town later merged with Sumoto City, and Tsuna, Hokutan, Ichinomiya, and Higashiura towns merged to form Awaji City.

[9] We rely on the location of firms' headquarters because our data is at the firm-level and not at the establishment-level. Also, we do not have information on how many establishments of these firms were hit by the earthquake. However, because many of our sample firms are small- and medium-sized enterprises, it is expected that the headquarter-level identification is not very different from the establishment-level one.

[10] For the firms for which fiscal year begins in January, January 1995 is included in FY 1995. But the share of these firms in our sample is only 4.3%.

Looking at the cumulative number of firms who dropped out of the TDB-BSBSA merged dataset as a proportion of the total number of firms that existed in the dataset in fiscal year (FY) 1994, we find that the drop-out rates thus defined in the affected area were 11.1%, 16.8%, and 28.5% respectively in FYs 1995, 1996, and 1997, while those in the non-affected area were 13.9%, 19.6%, and 27.7% respectively in FYs 1995, 1996, and 1997. Second, comparing the drop-out rates between the firms whose main bank was headquartered in the affected area and the non-affected area, we find that the drop-out rate of the former firms was higher (23.1%, 38.5%, and 38.5%, respectively, in FY 1995, 1996, and 1997) than the latter firms (13.3%, 18.9%, and 27.7%, respectively in 1995, 1996, and 1996). This difference causes a bias, if any, towards the direction in which we are less likely to observe a negative effect of bank damage on firm investment. In other words, a possible bias is conservative.[11]

We also restrict our sample firms to those whose main bank survived over the three years after the earthquake. Among the banks headquartered in the affected area, one of them, Hyogo Bank, failed soon after the earthquake (in August 1995). A reported reason for the failure was a large amount of real estate-related loans originated during the 1980s that became non-performing when the Japanese land price bubble burst in the early 1990s. We exclude those firms whose main bank was Hyogo Bank to rule out the possible "sick bank" effect, i.e., the possibility that a client firm of Hyogo Bank did not engage in exports not because its main bank (Hyogo Bank) suffered from the Hanshin-Awaji Earthquake, but because the performance of the bank was poor *irrespectively of the Earthquake*. With this exclusion, the number of firms falls to 2,086, of which 390 were headquartered in the affected area and 1,696 in the non-affected area.

Finally, to exclude outliers, we drop observations when our dependent variable or one of the

[11] To further examine the possibility of sample selection bias, we estimate a Probit model in which the dependent variable is the dummy for drop-out and the explanatory variables are (1) a dummy that takes one if the main bank is headquartered in the affected area (*B_HQDAMAGED*), and (2) a dummy that takes one if the firm is located in the affected area (*F_DAMAGED*) as well as other firm and bank characteristics variables. We find that none of these dummies is significant except for the coefficient of *F_DAMAGED* in FY 1995, which is *negative* and significant at the 10 percent level. Importantly, bank damage does not seem to systematically affect firms' drop-out.

independent variables (explained below) falls in either of the 0.5% tails of its distribution in each observation year. The observation period is the three fiscal years following the earthquake (i.e., t = FY1995, FY1996, and FY1997).[12] Our final dataset consists of 368 firms from the affected area and 1,625 firms from the non-affected area. These 1993 firms make up our sample for the empirical analysis in the following sections.[13] The industrial compositions of these two groups of firms are not qualitatively different.

5. Analysis on Extensive Margins

5.1 Hypothesis

We first examine the effects of bank damage on extensive margins of exports, i.e., whether or not to start exports. To start exports, firms may need to incur fixed entry costs for acquiring information about the foreign market, for modifying products to meet local regulations and to fit local tastes, and for establishing marketing channels. Firms with higher productivity are more likely to earn sufficient profits to cover these fixed costs, and can start exports (Melitz, 2003). Also, if firms do not accumulate sufficient internal funds, they have to resort to external funds to finance fixed costs.[14] By incorporating credit constraints into the heterogeneous firm model of Melitz (2003), studies including Chaney (2005) and Manova (2013) show that credit constraints adversely influence a firm's ability to cover the fixed costs and hence to start exports. Applying this model, we can predict that bank damage that is likely to deteriorate the bank's lending capacity would tighten the credit constraint that the client firm faces. Thus, we test the hypothesis that bank damage has a negative impact on the probability of starting exports with controlling for firm productivity.

5.2 Specification and dependent variable

[12] The financial year for most firms in Japan is the same as the fiscal year, starting in April and ending in March. For example, FY1995 starts in April 1995 and ends in March 1996. The Kobe Earthquake on January 17, 1995 is thus included in FY1994.

[13] The sample size slightly varies over the three year period since we drop outliers for each year.

[14] Firms with higher productivity are also more likely to accumulate internal funds that enable them to finance the fixed costs required for starting exports.

To test the above hypothesis, we follow a methodology that is similar to the one adopted by Minetti and Zhu (2011) and Koenig et al. (2010). To construct a model to represent the decision to start exporting or not, we first consider the (hypothetical) difference between operating profits of a firm when it starts exports and when it does not. Let us denote this difference as π_{it}^{*}. The firm will start exports when π_{it}^{*} is positive. We assume that this difference depends on firm productivity, bank damages, firm damages, and other firm and bank characteristics, which leads to the following equation.

$$(1)\quad \begin{aligned} \pi_{it}^{*} &= \beta_0 + \beta_1 F\_TFP_{it-1} + \beta_2 F\_DAMAGED_i + \beta_3 B\_DAMAGED_i \\ &+ \beta_4 F\_DAMAGED_i * B\_DAMAGED_i + \beta_5 F\_CONSTRAINTS_{i,t-1} \\ &+ \beta_6 B\_CAPACITY_{it-1} + \beta_7 Industry_i + \varepsilon_{it}, \qquad for\ \ t = 1995, 1996, 1997. \end{aligned}$$

On the right-hand side of the equation, *F_TFP* indicates the firm's total factor productivity. *F_DAMAGED* represents a proxy for firm damage, and *B_DAMAGED* for bank damage. *F_CAPACITY* indicates a vector of other firm characteristics that may influence the firm's credit constraints, and *B_CAPACITY* indicates a vector of other bank characteristics that are related to the banks' lending capacity. Finally, *Industry* represents industry dummies and ε_{it} is an error term. All the variables are at the firm level except for those for banks that are at bank levels. More detailed definitions of these variables are provided below.

Using π_{it}^{*} above, we model the decision of firm *i* to start exporting or not. As a variable to represent the extensive margins of firm export behavior, we define a variable $Start_{it}$ that is a dummy variable taking the value of one if the firm starts exports in year *t*, and zero otherwise. Assuming that ε_{it} in equation (1) is a normally distributed random error with zero mean and unit variance, we can express the probability of firm *i* starting exports conditional on its not exporting in year *t-1* as follows:

$$
\begin{aligned}
\Pr(Start_t = 1) = \Pr ob(&\beta_0 + \beta_1 F\_TFP_{it-1} + \beta_2 F\_DAMAGED_i + \beta_3 B\_DAMAGED_i \\
&+ \beta_4 F\_DAMAGED_i * B\_DAMAGED_i + \beta_5 F\_CONSTRAINTS_{i,t-1} \\
&+ \beta_6 B\_CAPACITY_{it-1} + \beta_7 Industry_i + \varepsilon_{it} > 0) \\
= \Phi \ (&\beta_0 + \beta_1 F\_TFP_{it-1} + \beta_2 F\_DAMAGED_i + \beta_3 B\_DAMAGED_i \\
&+ \beta_4 F\_DAMAGED_i * B\_DAMAGED_i + \beta_5 F\_CONSTRAINTS_{i,t-1} \\
&+ \beta_6 B\_CAPACITY_{it-1} + \beta_7 Industry_i + \varepsilon_{it}) \\
& \qquad for \ \ t = 1995, 1996, 1997.
\end{aligned} \tag{2}
$$

In this model, the dependent variable $\Pr(Start_{it} = 1)$ is the probability of starting exports conditional on the firm's not exporting in the previous period. On the right hand side of equation (2), Φ denotes the standard normal cumulative distribution function. We estimate (2) applying a linear probability model (i.e., OLS) to a sample of firms that did not export in year t-1.[15] Taking into account the possibility that the effects of the earthquake on export decisions changed over time, we run a separate cross-sectional regression for each of the three fiscal years subsequent to the earthquake, i.e., FY1995, FY1996, and FY1997. For all time-varying explanatory variables, we use a one-year lag to eliminate possible endogeneity problems originating from the reverse causality running from the dependent variable to the independent variables. Our main interest lies in the effect of bank damage on the export decision of firms located outside the earthquake-affected area, which is captured by the coefficient of *B_DAMAGED*.

As an alternative dependent variable, we also use the probability of increasing the number of export destination areas. Even if a firm has already been exporting to some regions, it is likely that the firm needs to incur additional fixed costs when entering a new foreign market. Therefore, we also use as an alternative dependent variable for equation (2), the probability of expanding export destination areas, which we denote as $\Pr(Expand_{it} = 1)$, where *Expand* is a dummy variable that takes the value of one if the number of export destination areas increases from year *t*-1 to year *t*. Note that the *Expand* dummy does not depend on whether or not the firm has already exported in the previous year, so that firms with $Start_{it} = 1$ is a

[15] We do not estimate (2) by Probit, because Probit estimation does not directly produce a marginal effect of the interaction term of *F_DAMAGED* and *B_DAMAGED*. Angrist and Pischke (2008) demonstrate that the coefficients estimated by OLS are virtually the same as the marginal effects estimated by Probit.

subset of those with $Expand_{it} = 1$. Thus, the use of $\Pr(Expand_{it} = 1)$ as a dependent variable implicitly assumes that the quantitative impacts of credit constraints are the same for the firms that newly start exporting and for those that expand their export destination areas.

5.3 Explanatory variables

Total factor productivity (TFP)

As indicated above, one of the most important determinants of starting exports is the productivity of the firm. Melitz (2003) theoretically shows that a firm with higher productivity is more willing to incur fixed costs required to start exports since the firm predicts larger profit from exporting than firms with lower productivity. Existing empirical studies such as Bernard and Jensen (2004) corroborate this prediction. We therefore include the firm's total factor productivity (TFP) as an explanatory variable, which is expected to take a positive coefficient in the Start and the Expansion estimations. We calculate the TFP by using the multilateral TFP index method developed by Good et al. (1997).

Firm damage

Although we do not have exact information on whether and to what extent each of our sample firm suffered from the earthquake, we can make use of the information on their geographical location. As a proxy for firm damage, we use a dummy variable indicating that the firms are located inside the earthquake-affected area. We argue that this is a reasonable approach because of the localized but intensive damages from the Kobe earthquake (see Table 1). We define *F_DAMAGED*, which takes the value of one if the firm is located inside the earthquake-affected area as defined above.

Damaged firms are likely to incur losses including a part or all of their physical as well as human capital. Direct damages to the firms might have mixed effects on the probability of starting exports or expanding export destination areas. On the one hand, because losses from the earthquake are sunk costs, they do not affect firms' profits irrespective of whether they start exports or not. In this case, direct damages will not affect the extensive margins of exports. On the other hand, damaged firms might have lost tangible assets that can be pledged as collateral, and so have higher likelihood of facing severer credit constraints. In this case, damaged firms are less likely to start exports or to increase export destination areas. We thus predict that *F_DAMAGED* has either an insignificant or a negative impact on both measures of the extensive margins of exports, i.e., the probabilities of starting exports and of expanding export destination areas.

Bank damage variables

Our main interest lies in examining the effects of bank damages on borrowing firms' exports, because such damages are likely to undermine the bank's lending capacity, and increase financial constraint on its borrowers. Similar to the case of firm damages, we have no exact information to construct variables to indicate bank damage (denoted above as *B_DAMAGED*), i.e., information on whether and to what extent banks suffered from the earthquake. However, we can make use of other information to construct two proxies for *B_DAMAGED*.

The first is *B_HQDAMAGED*, a dummy variable that takes the value of one if the headquarters of the firm' main bank is located inside the earthquake-affected area. This variable captures damages to banks' managerial capacity. For example, this variable might indicate damages to the bank's back-office operations to process applications for large-size loans, because in Japan, banks usually process loans of larger size at the headquarters level. Also, this variable might indicate damages to the bank's risk management capacity, because banks usually manage total risk of their loan or asset portfolio at the headquarter level. These damages to banks' managerial capacity will reduce the bank's lending capacity, so we expect that the variable has a negative impact on the dependent variable.

The second variable is *B_BRDAMAGED*, which denotes the fraction of the main bank's branches that are located inside the earthquake-affected area to the total number of branches. This variable measures the extent of damages to the main bank's branch network. Because banks in Japan usually process loans of smaller size at the branch level under the authority of branch managers, this variable represents the impairment of the main bank's ability to process applications for relatively small loans. The variable may also capture the extent of the main banks' exposure to damaged and possibly non-performing borrowers, because there will be many damaged borrowers around damaged bank branches. Banks with more damaged and non-performing borrowers are likely to have smaller (incremental) risk-taking capacity. In either case, reduced lending capacity of the bank is likely to impose financial constraints on client firms, so we expect that *B_BRDAMAGED* also take a negative impact on the extensive margins of exports.

As explained in section 4.1, we identify the bank at the top of each firm's list of transacting banks as its *main bank*. In doing so, we use information at the time when the earthquake occurred, i.e., information as of FY 1994. This is done in order to properly identify an exogenous shock to the firm, i.e., whether the firm's main bank at the time of the earthquake sustained damage or not. If firms can easily switch their main banks, they might be able to escape collateral damage from the adverse effects suffered by their earthquake-affected main banks; this would reduce the size of the coefficients on *B_HQDAMAGED* and *B_BRDAMAGED*. However, we find that firms in our sample rarely changed their main banks. Looking at the proportion of firms that switched their main banks to the number of firms in FY1994, we find that only 5.9% of all firms, and only 7.7% of the firms in the affected area, switched their main banks for the three years following the earthquake.[16]

Interaction of firm and bank damages

[16] We investigated the characteristics of firms that changed their main banks. Specifically, we conducted a year-by-year Probit analysis using as a dependent variable a dummy that takes one if thte firm's main bank as of FY t is different from that as of FY 1994 and zero otherwise. The explanatory variables we use are *F_DAMAGED* and other firm characteristics variables that we explain below (*F_SALESGROWTH*, *F_LNASSETS*, *F_LEV*, *F_ROA*, and *F_CASH*). We find that *F_DAMAGED* is not significant in any fiscal year. Among the other variables, *F_LNASSETS* and *F_CASH* are negative and significant in FY 1997.

We also add an interaction term between *F_DAMAGED* and *B_DAMAGED*. This is to isolate the impact of bank damage on damaged firms from that on undamaged firms. As mentioned earlier, we are most interested in the effect of bank damage on *undamaged* borrowers, which is captured by the coefficient on *B_DAMAGED*. Including this interaction term in our estimation, we can isolate this effect from the effect of bank damage on *damaged* borrowers, which is measured as the sum of the coefficients on *B_DAMAGED* and on the interaction term.

Firms' financial constraints

Besides *B_DAMAGED*, there may be some firm characteristics that influence the financial constraints that they might face. We denote such variables by *F_CONSTRAINTS*, Specifically, we use measures of firm size (the natural logarithm of total assets: *F_LNASSETS*); leverage (the ratio of total liabilities to total assets: *F_LEV*); and profitability (the ratio of current income to total assets: *F_ROA*); and a proxy for liquidity (the ratio of liquid assets to total assets: *F_CASH*).

Firms with larger size (*F_LNASSETS*), smaller leverage *(F_LEV*), higher profitability (*F_ROA*), and/or more liquidity (*F_CASH*) are less likely to be financially constrained. Thus, we expect a positive impact of *F_LNASSETS*, *F_ROA*, and *F_CASH*, and a negative impact of *F_LEV*, on the extensive margins of exports. Note, however, that these firm characteristics could be also related to future profitability, as discussed by Abel and Eberly (2011) and Gomes (2001) in the context of firm investment. However, even under this interpretation, we expect that the coefficients on these variables to be positive except for *F_LEV*, which we expect to take a negative coefficient. It is notable that unlike these firm characteristics variables, *B_DAMAGED* represents the degree of financial constraints and has little to do with future profitability.

Banks' lending capacity

The most important variable that represents banks' lending capacity is B_DAMAGED, which is exogenous to borrowing firms. However, we control for other bank characteristics variables that may affect the main bank's lending capacity, and denote such varaiables by *B_CAPACITY*. We control for the size, financial health, and profitability of each firm's main bank. For size, we use the natural logarithm of the bank's total assets (*B_LNASSETS*). Banks a larger size (*B_LNASSETS*) are more likely to have larger lending capacity. As proxies for the financial health and profitability of the main bank, we use the bank's risk-unadjusted capital-asset ratio (*B_CAP*) and the ratio of operating profits to total assets (*B_ROA*). Banks with higher profitability (*B_ROA*) and greater financial health (*B_CAP*) are less likely to be constrained by regulatory capital requirements or capital shortages, and are thus more likely to have larger lending capacity. Because increased lending capacity is likely to promote firms' exports, these variables are expected to have a positive impact on the extensive margin of exports.

Note, however, that it has been widely recognized that during the 1990s, i.e., the period that we examine, Japanese banks manipulated their balance sheets and reported inflated profits and capital by, for example, underreporting loan loss reserves, double-gearing subordinated debt with affiliated life insurance companies, and rolling over loans to non-performing borrowers (see, e.g., Ito and Sasaki, 2002; Shrieves and Dahl, 2003; Peek and Rosengren, 2005; Caballero et al., 2008). To the extent that this claim is valid, the coefficients on these regressors may be insignificant.

Industry dummy

To control for industry-level differences that might affect firms' export decisions, we also use industry dummies. We classify the firms into 5 industries (mining and construction; manufacturing; wholesale, retail and restaurant; finance, insurance, real estate, transportation, and communications; and others). We thus add four industry dummies in all the regressions, although we do not report the details of the results for these variables.

5.4 Summary statistics

Tables 4(a) and 4(b) report the summary statistics of the variables for each sample year, depending on whether *F_DAMAGED* = 1 or 0. On balance, there are little differences between firms with *F_DAMAGED*=1 and those with *F_DAMAGED*=0. When we test the difference in means between firms with *F_DAMAGED*=1 and those with *F_DAMAGED*=0, the null hypothesis of equal means is not rejected for most variables even at a 10 percent level of significance. The only significant differences that we find are for *B_HQDAMAGED* and *B_BRDAMAGED* in all three years – a natural finding if we consider the geographical proximity of banks and firms, and for lower *B_CAP* and higher *B_ROA* for firms with *F_DAMAGED*=1 – which are inconsistent with each other.

5.5 Regression results

5.5.1 Starting exports

The results for the probability of starting exports, conditional on the firm's not exporting in the previous period, are shown in Table 5. For each year, we report the results for two specifications: one using (i) *B_HQDAMAGED* and the other using (ii) *B_BRDAMAGED* as the bank damage variable (referred to as *B_DAMAGED*).

We find that *B_HQDAMAGED* has negative and significant coefficients in all of the three years subsequent to the earthquake. On the other hand, *B_BRDAMAGED* does not have significant coefficients except for FY 1996 when the coefficient is negative and marginally significant. These results imply that the probability of starting exports for undamaged firms was adversely affected if the headquarters of their main bank suffered from damages due to the earthquake.

The corresponding effect for *damaged* firms (those located outside the earthquake-affected area) is represented by the sum of the coefficients for *B_HQDAMAGED* and its interaction with *B_HQDAMAGED* for specification (1), which is negative and significant for FY 1995 and FY1997. This result suggests that bank headquarter damages had negative impacts on the probability of start exporting for damaged firms as well, although the impacts on damaged firms are not significant in FY 1996.

Among these findings, the most important one is that bank damage has a negative impact on the probability of starting exports for *undamaged* firms, i.e., those located outside the earthquake-affected area. Since damage to banks is an exogenous financial shock for undamaged firms, this result strongly suggests existence of financial constraint on firm exports, i.e., that exogenous shocks to bank lending capacity generally affect the client firm's starting exports.

This impact of bank damage on undamaged firms is economically significant as well. For specification (1) in FY1995, the probability of starting exports for undamaged firms is smaller by 4.5 percentage points when associated with damaged main banks than when associated with undamaged ones. Given that the average probability of starting exports for undamaged firms in FY1995 was 4.4%, this impact is economically significant. The negative impact increases to 6.7 percentage points in FY1996, and then turns down to 3.3 percentage points in FY1997.

As for the effect of bank branch damage (specification (ii)) in FY1996, when we compare undamaged firms that transacted with main banks with *B_BRDAMAGED* equals to its sample mean (which is *B_BRDAMAGED* = 0.068 in FY1996 for undamaged firms) and those transacted with undamaged main banks (i.e., *B_BRDAMAGED* = 0), the probability of exports was lower by 0.33 (-0.0665*0.068) percentage points. Thus the impact of damage to bank branch network is not negligible either, although the impact is much smaller than the impact of damages to bank headquarters. It should also be noted (again) that the impact of branch damage is found in FY1996 only.

Turning to other variables, *F_TFP* is not significant, which is not consistent with the prediction of Melitz (2003) and a number of empirical evidences, although some empirical studies show that the impact of firm productivity on exports is quantitatively negligible (e.g., Todo, 2011). As expectedly, *F_LNASSETS* and *F_CASH* have positive and significant coefficients for most of the cases, which is consistent with the hypothesis that financial constraints affect the extensive margins. On the other hand, *B_CAP* and *B_ROA* often have negative and significant coefficients. These results might imply that banks' balance sheet variables available in our sample period did not reflect banks' true financial conditions as some studies claim (e.g., Ito and Sasaki, 2002; Shrieves and Dahl, 2003; Peek and Rosengren, 2005; Caballero et al., 2008).

5.5.2 Expanding export destination areas

The results for expanding export destination areas are shown in Table 6. Similar to the results for the probability of starting exports, *B_HQDAMAGED* has negative and significant coefficients in all the three years subsequent to the earthquake. *B_BRDAMAGED* also has negative and significant coefficients in FY1996 and FY1997. These results imply that the probability of expanding export destination areas for firms that were not hit by the earthquake was adversely affected by damages to their main banks, which is an exogenous shock to the firms. The adverse impact is robust to two measures of bank damages: not only damages to the headquarters of their main banks but also damages to the branch networks of them.

Specification (i) for FY1995 suggests that the probability of expanding export destination areas for undamaged firms transacted with damaged main banks is smaller by 6.6 percentage points than that of undamaged firms transacted with undamaged main banks. Given that the average probability of expanding export destination areas for undamaged firms in FY1995 is 10.7%, this impact is economically significant. For specification (ii), the probability of expanding export destination areas for undamaged firms associated with damaged main banks whose value of *B_BRDAMAGED* equals to its sample mean (which is 6.9 % for undamaged firms in FY1996) is lower by 0.78 (-0.1141*0.068) percentage points compared with firms with undamaged main banks (i.e., *B_BRDAMAGED* = 0). Thus the impact of damages to bank branch network is not negligible, although much smaller than that to bank headquarters.

The results of specification (1) show that the sum of the coefficients on *B_HQDAMAGED* and its interaction with *F_DAMAGED* is significant and negative in FY1996 and FY1997, suggesting that damage to bank headquarters had a negative impact on the probability of damaged firms' expanding export destination areas.

As for other variables, the coefficients on *F_TFP* are insignificant in FY1995 and FY1996, but are positive and significant in FY1997 for both specifications (i) and (ii). *F_LNASSETS* and *F_CASH* also have positive and significant coefficients for both specifications in all years, while *F_LEV* has negative coefficients for both specifications in FY1997 only. These results are consistent with the hypothesis that financial constraints affect the extensive margins. Finally, *B_CAP* has negative and significant coefficients, and *B_ROA* has positive and significant coefficients, in FY1997 for both specifications. These opposite impacts of *B_CAP* and *B_ROA* are consistent with the claim in the existing literature that in Japan, banks' balance sheet variables might not reflect banks' true financial conditions

5.6. Controlling for Unobservable Firm Characteristics

The analyses we have implemented thus far assume that unobservable firm characteristics that affect the firm's export decision is not correlated with the explanatory variables. While the list of firm variables in the estimations reasonably covers the key characteristics of firms as compared with previous studies, there might still be some concern about an omitted variables problem which could generate the bias on the estimated coefficients. To address this concern, in this section, we control for firm-level fixed effect with the same specification as in the previous section.

To estimate the model with unobservable firm-level fixed effect, we estimate the following equation in which we take first-order differences of independent variables between period t-1 and t-2 except for B_DAMAGED and F_DAMAGED to eliminate the time-invariant firm-level fixed effect.

$$\begin{aligned} \Pr ob(Start_{i,t} = 1) &= \beta_0 + \beta_1 \Delta F\_TFP_{it-1} + \beta_2 F\_DAMAGED_i + \beta_3 B\_DAMAGED_i \\ &+ \beta_4 F\_DAMAGED_i * B\_DAMAGED_i + \beta_5 \Delta F\_CONSTRAINTS_{i,t-1} \\ &+ \beta_6 \Delta B\_CAPACITY_{it-1} + \varepsilon_{it}, \qquad for \;\; t = 1996, 1997. \end{aligned} \tag{3}$$

The Expand regression is similar to (3). Due to our data limitation, we could not implement this estimation for t=FY1995, and hence we estimate (3) for t=FY1996 and FY1997. The results of these regressions taking into account firm-level fixed effects are shown in Table 7 (START regression) and Table 8 (EXPAND regression)

First, as for the probability of start exporting, Table 7 shows that both *B_HQDAMAGED* and *B_BRDAMAGED* had adverse impacts in FY1996. These findings confirm the robustness of the results in Table 5 that both of the bank damage variables had a negative impact on the extensive margins of export (starting exports) in FY 1996. On the other hand, the adverse impact of *B_HQDAMAGED* in FY1997 that we found in Table 5 turns out not to be robust to the inclusion of the firm fixed effect. This implies that the actual impact of bank damage may have decayed more quickly than as found in Table 5. Most of the firm and bank characteristics do not show any significant coefficients, presumably because the variation of these variables in the time-series dimension is small.

Second, as for the probability of expanding export destination areas, Tables 8 confirm that the adverse impact of the damages to main banks that we obtained in Table 6 (i.e., EXPAND) are robust to the inclusion of firm-fixed effect. In sum, we confirm that our baseline results for the extensive margins are robust to the inclusion of time-invariant firm-fixed effect.

6. Analysis on Intensive Margins

6.1 Hypothesis

In addition to the extensive margins, bank damage may affect the intensive margins of exports, that is, how much a firm exports (conditional on already started exporting). Assuming that a part of variable costs associated with exports must be financed by outside capital, Manova (2013) predicts that credit constraints will decrease the volume of exports. Because bank damage is likely to tighten credit constraints that the client firm faces, her theory suggests that bank damage will reduce the intensive margins of exports.

On the other hand, however, exporters may obtain funds required to incur variable costs of exports by resorting to trade financiers in foreign countries. In that case, damages to main banks in the disaster-affected area will not affect the intensive margins of exports.

6.2 Specification

To examine the impact of bank damage on the intensive margins of exports, we estimate the following equation:

$$\begin{aligned}(4)\quad & Export_{it}/Sales_{it} = \beta_0 + \beta_1 F\_TFP_{it-1} + \beta_2 F\_DAMAGED_i + \beta_3 B\_DAMAGED_i \\ & + \beta_4 F\_DAMAGED_i * B\_DAMAGED_i + \beta_5 F\_CONSTRAINTS_{i,t-1} \\ & + \beta_6 B\_CAPACITY_{it-1} + \beta_7 Industry_i + \varepsilon_{it}, \qquad for\ \ t = 1995, 1996, 1997.\end{aligned}$$

The dependent variable is the amount of exports as a ratio to total sales, and the explanatory variables are the same as those used in the analysis of the extensive margins. We use the ratio of exports to total sales to standardize the export volume as in the existing studies (e.g., Bellone et al. 2010; Amiti and Weinstein 2013)[17]. We run a cross-sectional regression of (4) separately for each fiscal year. The expected signs of each of the explanatory variables in (4) are the same as those in the case of extensive margins. *B_BRDAMAGED*, among others, is expected to take a negative sign. Note, however, that the type of the credit constraint we assume in this regression (3) differs from the one in regressions (1) and (2). The credit constraint in this case (in the case of intensive margins) is primarily on working capital in increasing export volumes, while that in the case of extensive margins is on financing fixed costs in starting exports or expanding destination areas.

[17] Amiti and Weinstein (2011) stress that if sales activities in foreign countries require larger working capital than domestic ones, as then bank damage will decrease exports more significantly than domestic sales. This is another reason we use the ratio of exports to sales as the dependent variable.

6.3 Regression results

The results for the factors to determine the export volume (intensive margin) are shown in Table 9. *B_HQDAMAGED* (specification (i)) has negative and significant coefficients in all the three years subsequent to the earthquake. The export volume for undamaged firms transacted with damaged main banks is respectively smaller by 6.5, 7.4, and 6.5 percentage points in FY1995, FY1996, and FY1997 than that of undamaged firms transacted with undamaged main banks. Given that the average export/sales shares for undamaged firms in FY1995, FY1996, and FY1997 were respectively 9.1%, 9.2%, and 9.7%, this impact is economically significant. On the other hand, *B_BRDAMAGED* (specification (ii)) does not have a significant coefficient.

Focusing on other variables, while *F_DAMAGED* does not have a significant coefficient, the sum of *B_HQDAMAGED* and its interaction term with *B_HQDAMAGED* has a negative and significant coefficient in FY1995. This suggests that damages to bank headquarters had a negative impact on the export-to-sales ratio of *damaged* firms right after the earthquake. *F_LNASSETS* (only in FY1997) and *F_LEV* (in all years) respectively have positive and negative coefficients that are both statistically significant, which is consistent with the credit constraint hypothesis. Finally, *B_CAP* and *B_ROA* often have negative and significant coefficients.

6.4 Controlling for Unobservable Firm Characteristics

To check the robustness of our baseline results for the intensive margin above, we control for firm-level fixed effect by estimating the following,

$$
\begin{aligned}
(5)\quad \Delta\, Export_{it}/Sales_{it} &= \beta_0 + \beta_1 \Delta F\_TFP_{it-1} + \beta_2 F\_DAMAGED_i + \beta_3 B\_DAMAGED_i \\
&+ \beta_4 F\_DAMAGED_i * B\_DAMAGED_i + \beta_5 \Delta F\_CONSTRAINTS_{i,t-1} \\
&+ \beta_6 \Delta B\_CAPACITY_{it-1} + \varepsilon_{it}, \qquad for\ \ t = 1996, 1997.
\end{aligned}
$$

Table 10 shows the results for FY 1996 and FY 1997, confirming that the adverse impact of the damages to main banks that we obtained in Table 7 is robust to the inclusion of firm-fixed effect.[18][19] In sum, we confirm that our baseline results for the intensive margin are robust to the inclusion of time-invariant firm-fixed effect.

6.5 Mode of Transport and Intensive margins

As mentioned above, one of the important channels through which financial frictions adversely affect the intensive margins of exports is insufficient provision of working capital. In the case of international trade, trade finance by banks is of particular importance among different sources of working capital (Bellone et al. 2010). To investigate the relevance of this *trade finance channel*, it is useful to focus on the mode of transport. Shipping by sea involves a longer time and greater risk than shipping by air, so trade finance is likely to play a more important role in the former mode of transport than in the latter. Thus, the effect of the lending capacity of banks on exports might be greater when the product of the firm is shipped by sea than when shipped by air.

Consistent with this prediction, Amiti and Weinstein (2011) find that changes in bank health matter to a greater extent for firms in industries in which products are predominantly shipped by sea than for those where products are shipped by air. We follow this approach and split our sample into two subsamples. We define "small" product industries as those to which both the shares of shipping by sea measured by the number of shipment for exports and the weights of goods shipped for exports are less than the median shares for the whole industry, and a "bulky" product industry as those to which one of the shares (i.e., number of shipment or volume of shipped goods) is greater than the median.[20] We use the data on the

[18] Due to our data limitation, we could not estimate (5) for FY1995.
[19] One interesting feature is that bank characteristics variables show reasonable signs in the case of t=FY1996 in Table 10: the intensive margins are larger for client firms of larger, better capitalized, and more profitable banks. This might reflect the fact that although the variation in measured bank financial variables across banks at one point of time did not reflect the variation in true bank financial conditions, the changes in measured financial variables of each bank immediately after the earthquake did reflect the changes in true financial conditions of the bank over time. Note, however, that the positive effects of bank financial variables are insignificant in Table 8 and for t=FY1997 in Table 10.
[20] Industies are classified by Japan Standard Industrial Classification (two digit level). Examples of the "small" product industry include electric devices, information and telecommunication devices, cloths, and chemical products.

mode of transportation provided by the Transportation Statistics compiled by the Ministry of Land, Infrastructure, Transport and Tourism based on a survey conducted from October 2010 to January 2011.

Table 11 shows the estimated results for the bulky and small product industries, where we use *B_HQDAMAGED* as a proxy for bank damage.[21] In the case of the bulky product industries, *B_HQDAMAGED* has significantly negative coefficients for all of the three years following the earthquake. However, in the case of the small product industries, it does not have a significant coefficient in any of the three years. Although we do not control for the effects of severe damage to the Kobe Port on shipping by sea, these findings are consistent with our conjecture that firms in the bulky product industries are more vulnerable to the tightened working capital constraint caused by the deterioration of the main banks' lending capacity. These findings suggest that main banks play an important role in providing trade finance, and that the trade finance channel is important.

7. Finanical versus Real Linkages

We interpret our results as suggesting that banks' lending capacity affects firms' credit constraints and thus export behavior. In other words, financial linkages matter. However, one may worry about real linkage. Firms that are located outside the affected area but have a main bank inside the affected area may also have customers and/or suppliers in the affected areas. If this is the case, our proxies for bank damages may capture such real linkages. Although we do not completely exclude this possibility, we present evidence that is consistent with the financial linkages using a method similar to the one developed by Khawaja and

[21] We also used *B_BRDAMAGED* as a proxy for bank damage, but it does not have a significant coefficient either for the bulky or small good industries.

Mian (2008) and Schnabl (2012).

Using loan-level data, Khwaja and Mian (2008) regress the change in loans to firm j from bank i on bank i's liquidity shocks controlling for firm j's fixed effect, which they intend to capture firm i's demand for loans. They find that bank i's liquidity shock significantly decreased loans to firm j. Unfortunately, we do not have information on the amounts of loans each bank provides each firm. However, we do have information on the order of importance of banks among the banks that the firm transacts with.[22] Given this data limitation, we construct a dummy, *BANKSTATUS*, that takes one if the firm j's associated bank i is ordered at a lower place than its position before the earthquake (in FY 1994) and zero if bank i kept or raised its position as compared to the pre-earthquake position. For example, if bank i used to be firm j's main (i.e., top-ordered) bank before the earthquake but now is second or lower-ordered bank, then *BANKSTATUS* takes one. Firm are likely to place their banks according to the amounts of loans they borrow. Therefore, if bank i lost its position, it suggests that bank i's loans decreased relative to the other banks. If an earthquake-affected main bank decreased loans to firm j due to its damaged lending capacity, then we expect that that main bank becomes the second or lower-ordered bank. To see if this is the case, we estimate the following equation with firm fixed effects using the within transformation :

$$(3)\quad Bankstatus_{ijt} = \alpha_j + \beta B\_HQDAMAGED_i + \varepsilon_{ijt} \qquad for\ \ t = 1995, 1996, 1997\,.$$

Note that the sample covers all the reported banks that the firm transacts with. Thus,

[22] The number of the banks that the firm reports that it transacts with is ten at maximum.

$B\_HQDAMAGED$ is measured for all the bank i lending to firm j. α_j is a firm-fixed effect, which we intend to capture firm j's demand for loans. If bank damage really harms lending capacity, we expect the coefficient on $B\_HQDAMAGED$ to be positive.

Table 12 shows the results, indicating that the coefficient on $B\_HQDAMAGED$ is positive and significant in FY1995. This result suggests that damaged banks tended to decrease their lending relative to undamaged banks.

8. Conclusion

This paper examined the effects of credit constraints caused by banks' impaired lending capacity on firms' exports. To this aim, we utilized the natural experiment provided by Japan's Kobe (Great Hanshin-Awaji) earthquake, which enabled us to identify exogenous shocks to firms' credit constraints. The most important finding in this paper is that both in terms of the extensive and intensive margins, exports of firms located *outside* the earthquake-affected area but transacted with a main bank *inside* that area were smaller than those of firms located *outside* the area and transacted with a main bank *outside* the area. This result shows that exogenous shocks to firms' credit constraints had adverse impacts on firm exports, suggesting that credit constraints matter for exports. This result was robust to controlling for firms' unobservable fixed-effects.

We also found that the negative impact of bank damages on the intensive margins of client firms' exports is mainly found for firms in the industries that heavily rely on shipping by sea. Because these firms are likely to depend on trade finances provided by damaged banks for their working capital, the result underlines the importance of trade finance channel of financial constraints on firm exports.

Reference

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Table 1. Estimated damage caused by the Kobe earthquake

		No. of deaths	No. of housing units completely destroyed	No. of housing units partly destroyed	Death rate	Rate of housing units completely destroyed	Rate of housing units partly destroyed	Rate of housing units completely or partly destroyed
Regions in designated disaster area		**6,405**	**104,455**	**140,681**	**0.17%**	**16.50%**	**22.23%**	**38.73%**
Kobe City	Higashinada-ku	1,470	12,832	5,085	0.77%	50.50%	20.01%	70.51%
	Nada-ku	931	11,795	5,325	0.72%	54.13%	24.44%	78.57%
	Hyogo-ku	553	8,148	7,317	0.45%	35.55%	31.92%	67.47%
	Nagata-ku	917	14,662	7,770	0.67%	60.21%	31.91%	92.12%
	Suma-ku	401	7,466	5,344	0.21%	27.68%	19.81%	47.50%
	Tarumi-ku	25	1,087	8,575	0.01%	2.78%	21.95%	24.73%
	Kita-ku	13	251	3,029	0.01%	0.63%	7.67%	8.31%
	Chuo-ku	243	5,156	5,533	0.21%	33.39%	35.84%	69.23%
	Nishi-ku	9	403	3,147	0.01%	1.19%	9.28%	10.46%
Amagasaki City		49	5,688	36,002	0.01%	7.60%	48.07%	55.67%
Nishinomiya City		1,126	20,667	14,597	0.26%	31.30%	22.11%	53.41%
Ashiya City		443	3,915	3,571	0.51%	31.67%	28.89%	60.57%
Itami City		22	1,395	7,499	0.01%	4.39%	23.57%	27.96%
Takarazuka City		117	3,559	9,313	0.06%	9.12%	23.86%	32.98%
Kawanishi City		4	554	2,728	0.00%	1.56%	7.70%	9.26%
Akashi City		11	2,941	6,673	0.00%	5.51%	12.51%	18.02%
Sumoto City		4	203	932	0.01%	1.71%	7.83%	9.54%
Awaji City		58	3,076	3,976	0.11%	NA	NA	NA
Toyonaka City		9	657	4,265	0.00%	1.12%	7.27%	8.39%
Regions outside designated area		**22**	**445**	**3,427**	**0.00%**	**0.04%**	**0.30%**	**0.33%**

Note: "Regions outside designated area" refers to regions that are in Hyogo and Osaka prefectures but were not included in the Act Concerning Special Financial Support to Deal with a Designated Disaster of Extreme Severity. All rates for these regions are the averages of all cities and towns in these regions. The Act Concerning Special Financial Support to Deal with a Designated Disaster of Extreme Severity covered nine cities and five towns. One of the towns has since been merged into Sumoto City, while the other four have been merged together to form Awaji City. The table here shows the casualties and housing damage for the merged entities. The number of deaths and the numbers of destroyed housing units were compiled by the Fire and Disaster Management Agency and are as of May 19, 2006. To calculate the rates, we used data from the 1990 *Population Census* and the 1993 *Housing and Land Survey*. The figures on the losses of housing units are taken from <http://web.pref.hyogo.jp/pa20/pa20_000000006.html>. The table covers all cities and towns in Hyogo Prefecture as well as some in Osaka Prefecture (for a total of nine cities and five towns in the two prefectures combined), which were included in the Act Concerning Special Financial Support to Deal with a Designated Disaster of Extreme Severity.To calculate the ratio of the number of casualties to the total population and the ratios of the numbers of completely and partly destroyed housing units to the total number of housing units, we used data from the 1990 Population Census (Ministry of Internal Affairs and Communications, Government of Japan) and the 1993 Housing and Land Survey (Ministry of Construction).

Table 2. Bank branch operations after the earthquake

Type of banks	No. of banks	No. of branches	As of Jan 18, 1995	
			Operated	Did Not Operate
City banks	11	227	125	102
Long-term banks	2	2	0	2
Trust banks	6	17	10	7
Regional banks	13	122	72	50
Regional banks 2	12	254	106	148
Shinkin banks	15	422	325	97
Credit Cooperatives	15	111	77	34
Total	74	1155	715	440

Note. The sample is limited to those financial institutions whose branches were located in Hyogo prefecture. "Regional banks 2" refers to member banks of the Second Association of Regional Banks. Shinkin banks (shinyo kinko in Japanese) and credit cooperatives (shinyo kumiai in Japanese) are small credit unions. The data source is the Bank of Japan.

Table 3. Banks headquartered in the earhtquake-affected area

Prefecture	Name and type of financial institution		Loans outstanding (100 million yen)	No. of branches
Osaka	Suito Shinkin	Shinkin bank	1,720	19
	Howa Shinso	Credit cooperative	377	8
Hyogo	Hyogo Bank	Regional bank 2	27,443	147
	Hanshin Bank	Regional bank 2	8,772	80
	6 Shinkins (total)		19,752	192
	8 credit unions (total)		4,381	66

Note: Regional bank 2 refers to a member bank of the Second Association of Regional Banks. Shinkin banks (shinyo kinko in Japanese) and credit cooperatives (shinyo kumiai in Japanese) are small credit unions.The earthquake-affected area comprises 8 cities and 5 towns (among them Kobe City itself) in Hyogo prefecture and 1 city (Toyonaka City) in Osaka prefecture. The data sources are Nikkei NEEDS Financial Quest, Financial Statements of Shinkin Banks in Japan, and Financial Statements of Credit Cooperatives in Japan.

Table 4(a). Summary statistics for sample firms

FY1995

	Whole sample			*F_DAMAGED* =1			*F_DAMAGED* =0		
Variable	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.
Start	1,993	0.046	0.210	368	0.054	0.227	1,625	0.044	0.206
Expand	1,993	0.111	0.314	368	0.128	0.334	1,625	0.107	0.309
Export/Sales	650	0.091	0.143	110	0.093	0.013	540	0.091	0.006
F_TFP	1,993	-0.035	0.144	368	-0.033	0.141	1,625	-0.036	0.145
F_LNASSETS	1,993	8.649	1.278	368	8.516	1.294	1,625	8.680	1.273
F_LEV	1,993	6.692	12.377	368	5.475	9.425	1,625	6.968	12.938
F_CASH	1,993	0.635	0.166	368	0.626	0.167	1,625	0.637	0.166
F_DAMAGED	1,993	0.185	0.388	368	1.000	0.000	1,625	0.000	0.000
B_LNASSETS	1,993	24.155	1.088	368	24.228	1.062	1,625	24.138	1.093
B_CAP	1,993	0.036	0.005	368	0.036	0.004	1,625	0.036	0.005
B_ROA	1,993	0.003	0.004	368	0.003	0.003	1,625	0.004	0.004
B_HQDAMAGED	1,993	0.008	0.086	368	0.030	0.171	1,625	0.002	0.050
B_BRDAMAGED	1,993	0.077	0.087	368	0.111	0.135	1,625	0.069	0.070

FY1996

	Whole sample			*F_DAMAGED* =1			*F_DAMAGED* =0		
Variable	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.
Start	1,917	0.035	0.184	354	0.031	0.174	1,563	0.036	0.186
Expand	2,009	0.069	0.254	373	0.070	0.255	1,636	0.069	0.254
Export/Sales	663	0.092	0.140	110	0.090	0.146	553	0.092	0.139
F_TFP	2,009	-0.037	0.156	373	-0.040	0.140	1,636	-0.036	0.159
F_LNASSETS	2,009	8.676	1.269	373	8.526	1.296	1,636	8.710	1.260
F_LEV	2,009	6.691	13.149	373	5.763	11.738	1,636	6.903	13.444
F_CASH	2,009	0.637	0.168	373	0.626	0.172	1,636	0.639	0.167
F_DAMAGED	2,009	0.186	0.389	373	1.000	0.000	1,636	0.000	0.000
B_LNASSETS	2,009	24.172	1.104	373	24.215	1.100	1,636	24.162	1.105
B_CAP	2,009	0.032	0.005	373	0.031	0.006	1,636	0.032	0.005
B_ROA	2,009	0.007	0.008	373	0.009	0.010	1,636	0.007	0.008
B_HQDAMAGED	2,009	0.007	0.086	373	0.029	0.169	1,636	0.002	0.049
B_BRDAMAGED	2,009	0.076	0.087	373	0.111	0.136	1,636	0.068	0.069

FY1997

	Whole sample			*F_DAMAGED* =1			*F_DAMAGED* =0		
Variable	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.
Start	1,953	0.022	0.147	364	0.027	0.164	1,589	0.021	0.143
Expand	2,020	0.052	0.223	375	0.051	0.220	1,645	0.053	0.224
Export/Sales	650	0.097	0.151	113	0.098	0.159	532	0.097	0.150
F_TFP	2,020	-0.037	0.152	375	-0.049	0.142	1,645	-0.034	0.154
F_LNASSETS	2,020	8.701	1.276	375	8.541	1.287	1,645	8.737	1.271
F_LEV	2,020	6.597	12.919	375	5.113	9.277	1,645	6.935	13.593
F_CASH	2,020	0.635	0.170	375	0.616	0.174	1,645	0.640	0.169
F_DAMAGED	2,020	0.186	0.389	375	1.000	0.000	1,645	0.000	0.000
B_LNASSETS	2,020	24.222	1.120	375	24.264	1.129	1,645	24.213	1.118
B_CAP	2,020	0.032	0.005	375	0.031	0.005	1,645	0.032	0.005
B_ROA	2,020	0.003	0.005	375	0.003	0.003	1,645	0.003	0.005
B_HQDAMAGED	2,020	0.007	0.086	375	0.029	0.169	1,645	0.002	0.049
B_BRDAMAGED	2,020	0.077	0.088	375	0.111	0.136	1,645	0.069	0.070

Note: *Start and Expand* are the dummy taking a value of one if firms start export and expand the number of destined regions, respectively. *F_TFP* is firms' total factor productivity, *F_LNASSETS* is the natural logarithm of firms' total assets, *F_LEV* is the ratio of firms' liabilities to equity, *F_CASH* is the ratio of firms' liquid assets to total assets, *F_DAMAGED* is a dummy variable taking a value of one if the firm is located in one of the cities or towns identified as affected by the earthquake in the Act on Special Financial Support to Deal with a Designated Disaster of Extreme Severity, *B_LNASSETS* is the natural logarithm of the total assets owned by a firm's main bank, *B_CAP* is the equity to assets ratio of a firm's main bank, *B_ROA* is the ratio of operating profit to total assets of a firm's main bank, *B_HQDAMAGED* is a dummy variable taking a value of one if the headquarters of a firm's main bank is located in the earthquake-affected area, and *B_BRDAMAGED* is the ratio of the number of branches of a firm's main bank located in the earthquake-affected area to the total number of branches of that bank.

Table 4(b). Summary statistics for sample banks

FY1995	Whole sample			*B_HQDAMAGED* =1			*B_HQDAMAGED* =0		
Variable	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.
B_LNASSETS	70	21.755	1.554	4	21.024	0.700	66	21.799	1.583
B_CAP	70	0.041	0.014	4	0.033	0.022	66	0.041	0.014
B_ROA	70	0.007	0.015	4	0.001	0.001	66	0.008	0.015

FY1996	Whole sample			*B_HQDAMAGED* =1			*B_HQDAMAGED* =0		
Variable	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.
B_LNASSETS	70	21.769	1.565	4	21.020	0.677	66	21.814	1.594
B_CAP	70	0.040	0.016	4	0.027	0.033	66	0.041	0.014
B_ROA	70	0.003	0.004	4	0.005	0.006	66	0.003	0.004

FY1997	Whole sample			*B_HQDAMAGED* =1			*B_HQDAMAGED* =0		
Variable	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.
B_LNASSETS	70	21.770	1.556	4	20.998	0.666	66	21.817	1.585
B_CAP	70	0.035	0.023	4	0.008	0.071	66	0.037	0.017
B_ROA	70	0.010	0.016	4	0.024	0.039	66	0.009	0.013

FY1995	*B_BRDAMAGED* > Med(+)			*B_BRDAMAGED* < Med(+)		
Variable	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.
B_LNASSETS	22	22.704	1.388	48	21.320	1.438
B_CAP	22	0.035	0.007	48	0.044	0.016
B_ROA	22	0.013	0.020	48	0.005	0.011

FY1996	*B_BRDAMAGED* > Med(+)			*B_BRDAMAGED* < Med(+)		
Variable	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.
B_LNASSETS	22	22.730	1.437	48	21.329	1.429
B_CAP	22	0.035	0.007	48	0.042	0.018
B_ROA	22	0.003	0.003	48	0.003	0.005

FY1997	*B_BRDAMAGED* > Med(+)			*B_BRDAMAGED* < Med(+)		
Variable	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
B_LNASSETS	22	22.716	1.442	48	21.336	1.420
B_CAP	22	0.031	0.010	48	0.037	0.027
B_ROA	22	0.014	0.021	48	0.008	0.012

Note: B_BRDAMAGED is the ratio of the number of branches of a bank that were located in the earthquake-affected area to that bank's total number of branches. Med(+) is the median of B_BRDAMAGED conditional on B_BRDAMAGED being positive. B_LNASSETS is the natural logarithm of the total assets owned by the bank, B_CAP is the equity to assets ratio of the bank, and B_ROA is the bank's ratio of operating profit to total assets.

Table 5. Year-by-year cross-sectional regressions for extensive margin (starting export)

Dependent variable: *Prob(Start(t)=1)*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*
	FY1995		FY1996		FY1997	
F_TFP (t-1)	-0.0501	-0.0491	0.0044	0.0072	0.0291	0.0286
	(0.0407)	(0.0407)	(0.0374)	(0.0371)	(0.0270)	(0.0267)
F_DAMAGED	0.0103	0.0160	-0.0041	-0.0217	0.0102	0.0148
	(0.0175)	(0.0214)	(0.0145)	(0.0172)	(0.0136)	(0.0150)
B_DAMAGED †	-0.0453 **	-0.0545	-0.0665 ***	-0.1103 *	-0.0327 ***	0.0375
	(0.0179)	(0.0707)	(0.0210)	(0.0652)	(0.0097)	(0.0548)
F_DAMAGED ×*B_DAMAGED* †	-0.0066	-0.0431	0.0277	0.1801	0.0037	-0.0631
	(0.0148)	(0.0893)	(0.0200)	(0.1143)	(0.0159)	(0.0612)
F_LNASSETS (t-1)	0.0243 ***	0.0241 ***	0.0161 ***	0.0159 ***	0.0112 **	0.0113 **
	(0.0070)	(0.0071)	(0.0060)	(0.0060)	(0.0048)	(0.0048)
F_LEV (t-1)	-0.0003	-0.0003	0.0001	0.0001	0.0000	0.0000
	(0.0004)	(0.0004)	(0.0006)	(0.0005)	(0.0003)	(0.0003)
F_CASH (t-1)	0.0890 ***	0.0878 **	0.1264 ***	0.1244 ***	0.0289	0.0293
	(0.0342)	(0.0343)	(0.0323)	(0.0321)	(0.0231)	(0.0231)
B_LNASSETS (t-1)	0.0019	0.0010	-0.0055	-0.0048	-0.0018	-0.0013
	(0.0057)	(0.0059)	(0.0070)	(0.0069)	(0.0036)	(0.0038)
B_CAP (t-1)	-0.7381	-0.8719	-1.5321	-1.5523	-0.9030 *	-0.8583 *
	(1.1859)	(1.1814)	(1.0373)	(1.0472)	(0.4945)	(0.4974)
B_ROA (t-1)	-2.8594 *	-3.0008 *	-0.5716	-0.4774	-1.1486	-1.2200
	(1.6241)	(1.6337)	(0.4437)	(0.4354)	(1.5221)	(1.5292)
Constant	-0.2583	-0.2255	-0.0506	-0.0574	-0.0474	-0.0636
	(0.1823)	(0.1890)	(0.1952)	(0.1941)	(0.1068)	(0.1141)
Sum of coefficients on *B_HQDAMAGED* and *F_DAMAGED*B_HQDAMAGED*	-0.0519 **		-0.0388		-0.0290 *	
	(0.0238)		(0.0235)		(0.0154)	
Obs	1,409	1,409	1,358	1,358	1,353	1,353
F-value	6.09	4.72	4.55	3.71	2.86	2.64
p-value	***	***	***	***	***	***
R-squared	0.0285	0.0289	0.0212	0.0223	0.0132	0.0132
Root MSE	0.2448	0.2448	0.2155	0.2153	0.1752	0.1752
Industry dummies	yes	yes	yes	yes	yes	yes

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The significance level of the sum of the coefficients on *B_DAMAGED* and *F_DAMAGED×B_DAMAGED* is based on the F-values under the null hypotheses that the sum is zero.

† The *B_DAMAGED* variable is either *B_HQDAMAGED* or *B_BRDAMAGED* as indicated in the column heading.

Table 6. Year-by-year cross-sectional regressions for extensive margin (expanding destination)

Dependent variable: *Prob(Expand(t)=1)*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*
	FY1995		FY1996		FY1997	
F_TFP (t-1)	-0.0071	-0.0074	0.0280	0.0298	0.0680 *	0.0701 **
	(0.0449)	(0.0448)	(0.0298)	(0.0298)	(0.0349)	(0.0348)
F_DAMAGED	0.0210	0.0253	0.0024	-0.0171	0.0018	-0.0006
	(0.0190)	(0.0245)	(0.0151)	(0.0178)	(0.0129)	(0.0151)
B_DAMAGED †	-0.0657 ***	0.0464	-0.0545 ***	-0.1141 *	-0.0547 ***	-0.1233 **
	(0.0231)	(0.0794)	(0.0160)	(0.0616)	(0.0132)	(0.0528)
F_DAMAGED ×*B_DAMAGED* †	0.0895	-0.0489	0.0192	0.2078 *	0.0110	0.0566
	(0.0884)	(0.1427)	(0.0187)	(0.1072)	(0.0217)	(0.0633)
F_LNASSETS (t-1)	0.0477 ***	0.0477 ***	0.0146 ***	0.0144 ***	0.0181 ***	0.0178 ***
	(0.0065)	(0.0065)	(0.0051)	(0.0051)	(0.0046)	(0.0046)
F_LEV (t-1)	-0.0005	-0.0005	-0.0002	-0.0002	-0.0005 **	-0.0005 **
	(0.0004)	(0.0004)	(0.0005)	(0.0005)	(0.0002)	(0.0002)
F_CASH (t-1)	0.0959 **	0.0962 **	0.1391 ***	0.1375 ***	0.0764 ***	0.0752 ***
	(0.0387)	(0.0387)	(0.0329)	(0.0329)	(0.0272)	(0.0272)
B_LNASSETS (t-1)	0.0080	0.0083	0.0042	0.0051	-0.0011	-0.0025
	(0.0063)	(0.0064)	(0.0059)	(0.0058)	(0.0047)	(0.0050)
B_CAP (t-1)	0.6996	0.7601	-0.0490	-0.1113	-1.1330 *	-1.4154 **
	(1.4208)	(1.4153)	(0.9888)	(0.9788)	(0.6470)	(0.6752)
B_ROA (t-1)	-0.1120	-0.0553	0.8758	0.9489	2.9994 *	2.9148 *
	(1.8965)	(1.9003)	(0.8492)	(0.8460)	(1.6535)	(1.6402)
Constant	-0.6513 ***	-0.6670 ***	-0.3377 **	-0.3466 **	-0.1554	-0.1007
	(0.2009)	(0.2044)	(0.1697)	(0.1698)	(0.1342)	(0.1429)
Sum of coefficients on *B_HQDAMAGED* and *F_DAMAGED***B_HQDAMAGED*	0.0238		-0.0354 *		-0.0437 **	
	(0.0888)		(0.0209)		(0.0210)	
Obs	1,993	1,993	2,009	2,009	2,020	2,020
F-value	8.96	7.56	8.45	7.38	5.76	5.32
p-value	***	***	***	***	***	***
R-squared	0.0581	0.0581	0.0221	0.0231	0.0277	0.0289
Root MSE	0.3059	0.3059	0.2519	0.2518	0.2207	0.2206
Industry dummies	yes	yes	yes	yes	yes	yes

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The significance level of the sum of the coefficients on *B_DAMAGED* and *F_DAMAGED×B_DAMAGED* is based on the F-values under the null hypotheses that the sum is zero.

† The *B_DAMAGED* variable is either *B_HQDAMAGED* or *B_BRDAMAGED* as indicated in the column heading.

Table 7. Difference-in-Difference estimation for extensive margin (starting exports)

Dependent variable: ⊿ Prob(Start(t)=1)	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*
	FY1996 - FY1995		FY1997 - FY1996	
ΔF_TFP (t-1)	-0.0872	-0.0850	-0.0236	-0.0240
	(0.0801)	(0.0806)	(0.0299)	(0.0301)
ΔF_DAMAGED	-0.0027	-0.0188	0.0038	0.0104
	(0.0152)	(0.0181)	(0.0134)	(0.0152)
ΔB_DAMAGED †	-0.0528 ***	-0.1020 *	-0.0053	0.0367
	(0.0095)	(0.0610)	(0.0125)	(0.0499)
Δ(F_DAMAGED ×B_DAMAGED) †	-0.0198	0.1516	-0.0278 *	-0.0820
	(0.0266)	(0.1218)	(0.0160)	(0.0608)
ΔF_LNASSETS (t-1)	-0.0124	-0.0148	-0.0463	-0.0466
	(0.0544)	(0.0549)	(0.0495)	(0.0495)
ΔF_LEV (t-1)	0.0001	0.0002	-0.0008	-0.0008
	(0.0003)	(0.0003)	(0.0007)	(0.0007)
ΔF_CASH (t-1)	-0.0437	-0.0374	-0.0253	-0.0267
	(0.1418)	(0.1419)	(0.1005)	(0.1001)
ΔB_LNASSETS (t-1)	0.0560 *	0.0520	-0.0067	-0.0066
	(0.0334)	(0.0334)	(0.0045)	(0.0045)
ΔB_CAP (t-1)	0.2069	-0.1911	1.5218	1.5336
	(2.2477)	(2.2063)	(1.0414)	(1.0363)
ΔB_ROA (t-1)	-0.3430	-0.3882	-0.0203	-0.0185
	(0.8120)	(0.8076)	(0.2766)	(0.2743)
Constant	0.0529 ***	0.0586 ***	0.0319 ***	0.0293 ***
	(0.0100)	(0.0114)	(0.0058)	(0.0065)
Sum of coefficients on Δ*B_HQDAMAGED* and Δ(*F_DAMAGED*B_HQDAMAGED)*	-0.0725 ***		-0.0331 ***	
	(0.0259)		(0.0126)	
Obs	1,323	1,323	1,329	1,329
F-value	6.40	1.05	3.25	1.13
p-value	***		***	
R-squared	0.0092	0.0095	0.0048	0.005
Root MSE	0.2176	0.2176	0.1753	0.1752

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The significance level of the sum of the coefficients on *B_DAMAGED* and *F_DAMAGED×B_DAMAGED* is based on the F-values under the null hypotheses that the sum is zero.

† The *B_DAMAGED* variable is either *B_HQDAMAGED* or *B_BRDAMAGED* as indicated in the column heading.

Table 8. Difference-in-Difference estimation for extensive margin (expanding destination)

Dependent variable: *Δ Prob(Expand(t)=1)*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*
	FY1996 - FY1995		FY1997 - FY1996	
ΔF_TFP (t-1)	-0.0210	-0.0188	0.0357	0.0358
	(0.0518)	(0.0519)	(0.0287)	(0.0289)
ΔF_DAMAGED	0.0057	-0.0103	-0.0015	-0.0032
	(0.0157)	(0.0185)	(0.0131)	(0.0155)
ΔB_DAMAGED †	-0.0679 ***	-0.1290 **	-0.0527 ***	-0.1212 **
	(0.0093)	(0.0593)	(0.0138)	(0.0490)
Δ(F_DAMAGED	-0.0215	0.1690	-0.0046	0.0474
×B_DAMAGED) †	(0.0230)	(0.1123)	(0.0182)	(0.0634)
ΔF_LNASSETS (t-1)	-0.0227	-0.0245	-0.0591	-0.0597
	(0.0491)	(0.0496)	(0.0408)	(0.0408)
ΔF_LEV (t-1)	-0.0002	-0.0002	0.0003	0.0003
	(0.0005)	(0.0005)	(0.0003)	(0.0003)
ΔF_CASH (t-1)	0.0115	0.0157	0.0546	0.0594
	(0.1222)	(0.1224)	(0.0877)	(0.0875)
ΔB_LNASSETS (t-1)	0.0498 *	0.0460	0.0029	0.0008
	(0.0293)	(0.0292)	(0.0148)	(0.0147)
ΔB_CAP (t-1)	0.2255	-0.2681	0.9860	1.0796
	(2.6246)	(2.5963)	(1.3595)	(1.3488)
ΔB_ROA (t-1)	0.6000	0.5245	0.7134	0.6766
	(1.1045)	(1.1007)	(0.7714)	(0.7674)
Constant	0.0675 ***	0.0745 ***	0.0582 ***	0.0663 ***
	(0.0103)	(0.0114)	(0.0069)	(0.0083)
Sum of coefficients on Δ*B_HQDAMAGED* and Δ(*F_DAMAGED***B_HQDAMAGED)*	-0.0894 ***		-0.0573 ***	
	(0.0228)		(0.0132)	
Obs	1,968	1,968	1,990	1,990
F-value	14.25	0.91	9.98	1.84
p-value	***		***	**
R-squared	0.0041	0.0044	0.0028	0.0039
Root MSE	0.2547	0.2547	0.2239	0.2238

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The significance level of the sum of the coefficients on *B_DAMAGED* and *F_DAMAGED×B_DAMAGED* is based on the F-values under the null hypotheses that the sum is zero.

† The *B_DAMAGED* variable is either *B_HQDAMAGED* or *B_BRDAMAGED* as indicated in the column heading.

Table 9. Year-by-year cross-sectional regressions for intensive margin

Dependent variable: *Export/Sales* *(t)*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*
	FY1995		FY1996		FY1997	
F_TFP (t-1)	-0.0237	-0.0242	0.0109	0.0107	0.0174	0.0182
	(0.0412)	(0.0411)	(0.0246)	(0.0246)	(0.0475)	(0.0473)
F_DAMAGED	-0.0042	0.0010	-0.0097	-0.0325	-0.0033	0.0130
	(0.0148)	(0.0173)	(0.0154)	(0.0219)	(0.0171)	(0.0219)
B_DAMAGED †	-0.0645 **	-0.0023	-0.0743 ***	-0.0712	-0.0647 *	-0.0401
	(0.0263)	(0.0653)	(0.0259)	(0.0627)	(0.0367)	(0.0738)
F_DAMAGED	-0.0145	-0.0591	0.0516 ***	0.2509	0.0025	-0.1612
×*B_DAMAGED* †	(0.0263)	(0.1436)	(0.0166)	(0.2492)	(0.0255)	(0.1282)
F_LNASSETS (t-1)	0.0065	0.0066	0.0028	0.0028	0.0090 **	0.0089 *
	(0.0049)	(0.0049)	(0.0042)	(0.0042)	(0.0046)	(0.0046)
F_LEV (t-1)	-0.0010 **	-0.0010 **	-0.0006 **	-0.0007 **	-0.0009 ***	-0.0009 ***
	(0.0005)	(0.0005)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
F_CASH (t-1)	0.0314	0.0304	-0.0048	-0.0033	0.0500	0.0492
	(0.0465)	(0.0466)	(0.0393)	(0.0395)	(0.0408)	(0.0411)
B_LNASSETS (t-1)	-0.0049	-0.0041	-0.0092	-0.0065	-0.0061	-0.0078
	(0.0061)	(0.0061)	(0.0080)	(0.0060)	(0.0065)	(0.0066)
B_CAP (t-1)	-2.0300	-2.2488	-4.1728 ***	-4.3428 ***	-2.0224	-3.0970
	(1.5606)	(1.5650)	(1.3042)	(1.4377)	(2.9653)	(2.7893)
B_ROA (t-1)	-2.1420	-2.2502	-0.9469 **	-0.8976 **	-1.3116 **	-1.4918 **
	(1.5387)	(1.5528)	(0.3843)	(0.3571)	(0.6627)	(0.6477)
Constant	0.1447	0.1336	0.3528	0.2972 *	0.1030	0.1842
	(0.1816)	(0.1867)	(0.2145)	(0.1756)	(0.1985)	(0.2127)
Sum of coefficients on *B_HQDAMAGED* and *F_DAMAGED*B_HQDAMAGED*	-0.0790 ***		-0.0227		-0.0622	
	(0.0212)		(0.0338)		(0.0926)	
Obs	650	650	663	663	645	645
F-value	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
p-value	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
R-squared	0.0369	0.0362	0.0428	0.0462	0.029	0.0318
Root MSE	0.1414	0.1415	0.1381	0.1378	0.1506	0.1504
Industry dummies	yes	yes	yes	yes	yes	yes

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The significance level of the sum of the coefficients on *B_DAMAGED* and *F_DAMAGED×B_DAMAGED* is based on the F-values under the null hypotheses that the sum is zero.

† The *B_DAMAGED* variable is either *B_HQDAMAGED* or *B_BRDAMAGED* as indicated in the column heading.

Table 10. Difference-in-Difference estimation for intensive margin

Dependent variable: ⊿ Export/Sales (t)	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*	(i) *B_DAMAGED* = *B_HQDAMAGED*	(ii) *B_DAMAGED* = *B_BRDAMAGED*
	FY1996 - FY1995		FY1997 - FY1996	
ΔF_TFP (t-1)	0.0060	0.0060	0.0113	0.0063
	(0.0128)	(0.0127)	(0.0184)	(0.0160)
ΔF_DAMAGED	-0.0066	-0.0369 **	0.0051	0.0464 *
	(0.0110)	(0.0181)	(0.0158)	(0.0251)
ΔB_DAMAGED †	-0.0312 **	-0.0528 **	-0.0068	-0.0127
	(0.0138)	(0.0227)	(0.0150)	(0.0361)
Δ(F_DAMAGED ×B_DAMAGED) †	0.0692 ***	0.3246	-0.0484 **	-0.4262
	(0.0157)	(0.2579)	(0.0225)	(0.2787)
ΔF_LNASSETS (t-1)	-0.0285	-0.0295 *	0.0363	0.0241
	(0.0174)	(0.0176)	(0.0329)	(0.0303)
ΔF_LEV (t-1)	-0.0007	-0.0008	0.0003	0.0003
	(0.0005)	(0.0005)	(0.0005)	(0.0005)
ΔF_CASH (t-1)	0.0510	0.0475	0.0466	0.0518
	(0.0431)	(0.0450)	(0.0456)	(0.0465)
ΔB_LNASSETS (t-1)	0.0321 *	0.0320 *	0.0083	0.0043
	(0.0173)	(0.0170)	(0.0119)	(0.0111)
ΔB_CAP (t-1)	2.0459 **	1.6918 **	1.3369	1.2725
	(0.9773)	(0.8451)	(2.0754)	(1.8816)
ΔB_ROA (t-1)	0.6499 **	0.5773 **	0.2004	0.2877
	(0.2768)	(0.2647)	(0.2498)	(0.2925)
Constant	0.0136 ***	0.0156 ***	0.0065 **	0.0083 **
	(0.0040)	(0.0036)	(0.0030)	(0.0039)
Sum of coefficients on *ΔB_HQDAMAGED* and *Δ(F_DAMAGED*B_HQDAMAGED)*	0.0380 ***		-0.0552 ***	
	(0.0118)		(0.0154)	
Obs	656	656	640	640
F-value	N.A.	2.16	N.A.	0.55
p-value	N.A.	**	N.A.	
R-squared	0.0221	0.0705	0.007	0.05767
Root MSE	0.0583	0.0568	0.0884	0.0861

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The significance level of the sum of the coefficients on *B_DAMAGED* and *F_DAMAGED×B_DAMAGED* is based on the F-values under the null hypotheses that the sum is zero.

† The *B_DAMAGED* variable is either *B_HQDAMAGED* or *B_BRDAMAGED* as indicated in the column heading.

Table 11. Year-by-year cross-sectional regressions for intensive margin (sub-sample analysis)

Dependent variable: *Export/Sales* *(t)*	*B_DAMAGED* = *B_HQDAMAGED*		*B_DAMAGED* = *B_HQDAMAGED*		*B_DAMAGED* = *B_HQDAMAGED*	
	Bukly product industry	Small product industry	Bukly product industry	Small product industry	Bukly product industry	Small product industry
	FY1995		FY1996		FY1997	
F_TFP (t-1)	-0.0036	-0.0434	-0.0332	0.0694	-0.0404	0.0522
	(0.0631)	(0.0530)	(0.0257)	(0.0642)	(0.0576)	(0.0725)
F_DAMAGED	-0.0093	-0.0039	-0.0014	-0.0208	-0.0150	0.0093
	(0.0240)	(0.0199)	(0.0240)	(0.0171)	(0.0203)	(0.0270)
B_DAMAGED †	-0.1235 ***	-0.0056	-0.1367 ***	-0.0236	-0.1142 ***	-0.0249
	(0.0301)	(0.0214)	(0.0500)	(0.0206)	(0.0437)	(0.0497)
F_DAMAGED ×*B_DAMAGED* †	0.0170		0.0513 **		0.0333	
	(0.0235)		(0.0250)		(0.0238)	
F_LNASSETS (t-1)	0.0076	0.0060	0.0073	-0.0006	0.0110	0.0070
	(0.0075)	(0.0064)	(0.0064)	(0.0057)	(0.0071)	(0.0061)
F_LEV (t-1)	-0.0014	-0.0005	-0.0010 **	0.0003	-0.0009 ***	-0.0007
	(0.0009)	(0.0006)	(0.0004)	(0.0006)	(0.0003)	(0.0008)
F_CASH (t-1)	0.0795	-0.0189	0.0766	-0.0865	0.0946 *	0.0091
	(0.0670)	(0.0652)	(0.0579)	(0.0535)	(0.0561)	(0.0577)
B_LNASSETS (t-1)	-0.0104	0.0009	-0.0268 *	0.0048	-0.0090	-0.0046
	(0.0107)	(0.0069)	(0.0157)	(0.0058)	(0.0107)	(0.0081)
B_CAP (t-1)	-2.5844	-1.2810	-6.3077 ***	-3.2426 **	-2.9364	-0.8415
	(2.6095)	(1.8977)	(2.2825)	(1.5624)	(3.5900)	(4.5544)
B_ROA (t-1)	-1.9732	-1.8578	-1.9355 ***	-0.2871	-1.4021 **	-3.1971
	(2.4583)	(1.9271)	(0.7100)	(0.4303)	(0.6524)	(2.0917)
Constant	0.2851	0.0128	0.7995 *	0.0546	0.2089	0.0801
	(0.3137)	(0.1988)	(0.4135)	(0.1748)	(0.3180)	(0.2602)
Sum of coefficients on *B_HQDAMAGED* and *F_DAMAGED*B_HQDAMAGED* ††	-0.1065 ***		-0.0854		-0.0854	
	(0.0349)		(0.0627)		(0.0627)	
Obs	293	357	301	362	292	353
F-value	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
p-value	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
R-squared	0.0683	0.0238	0.1074	0.031	0.079	0.016
Root MSE	0.1470	0.1372	0.1413	0.1329	0.1491	0.1516
Industry dummies	yes	yes	yes	yes	yes	yes

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% level, respectively. The significance level of the sum of the coefficients on *B_DAMAGED* and *F_DAMAGED×B_DAMAGED* is based on the F-values under the null hypotheses that the sum is zero.

† The *B_DAMAGED* variable is *B_HQDAMAGED*.

†† There are no firms producing small goods and twith *B_HQDAMAGED*=1 and *F_DAMAGED*=1 in our sample.

Table 12. Estimation results for bank order

Dependent variable: Bankstatus (ijt)	*B_DAMAGED* FY1995		*B_DAMAGED* FY1996		*B_DAMAGED* FY1997	
B_DAMAGED †	0.0554	**	-0.0155		0.0208	
	(0.0259)		(0.0203)		(0.0281)	
Constant	0.1087	***	0.0839	***	0.1051	***
	(0.0003)		(0.0002)		(0.0003)	
Obs	12,532		12,446		12,538	
F-value	4.56		0.58		0.55	
p-value	0.0329		0.4453		0.4596	
R-squared	0.0003		0.0001		0.0001	
Fixed effects	yes		yes		yes	

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate

† The B DAMAGED variable is B HQDAMAGED.