EXPORTS AND FINANCIAL SHOCKS*

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A striking feature of many financial crises is the collapse of exports relative to output. This article examines whether deteriorations in bank health can help explain the large drops in exports relative to output. Our article is the first to establish a causal link between the health of banks providing trade finance and growth in a firm's exports relative to its domestic sales. We overcome measurement and endogeneity issues by using a unique data set, covering the Japanese financial crises from 1990 through 2010, which enables us to match exporters with the main bank that provides them with trade finance. Our point estimates are economically and statistically significant, suggesting that the health of financial institutions is an important determinant of firm-level exports during crises. *JEL* Codes: E44, E32, G21, F40.

I. INTRODUCTION

The collapse in trade relative to GDP in 2008 has prompted a number of researchers to postulate that trade finance may be partially responsible for the decline (see Auboin 2009; Bricogne et al. 2009; Campbell et al. 2009; OECD 2009; Haddad, Harrison, and Hausman 2010; Chor and Manova 2011). While Eaton et al. (2010) argue that demand shocks can explain 80% of the aggregate decline, these authors find that for China and Japan, which account for 15% of world exports, increasing trade costs were as important as demand shocks. Our article assesses the importance of trade finance by being the first to match exporters with the institutions that provide them with finance and thereby establish a causal link between the health of these banks and the output and export growth of their clients. Importantly, we also demonstrate that the health of banks providing finance has a much larger effect

*We give special thanks to Marc Auboin for carefully reading the draft and providing invaluable insights into the mechanics of trade finance. We also want to give special thanks to Joe Peek for providing us with early comments and data for this paper as well as Keiko Ito for providing us with the concordance between the Japanese HS codes and the IO codes. In addition, Ro Fallon, Fritz Foley, Caroline Freund, Linda Goldberg, Jessie Handbury, Fumio Hayashi, Robert Hodrick, Simon Johnson, Kalina Manova, Paolo Pesenti, and Vivian Yue provided us with insightful comments. JaeBin Ahn, Morgan Hardy, and Seth Werfel provided excellent research assistance. The views expressed in this paper are those of the authors and do not necessarily represent those of the Federal Reserve Bank of New York. This work was supported by the National Science Foundation [0820462] and the Center on Japanese Economy and Business at Columbia Business School.

The Quarterly Journal of Economics (2011) 126, 1841–1877. doi:10.1093/qje/qjr033.
Advance Access publication on October 13, 2011.

on exports than on domestic sales, thus establishing that financial shocks affect exports and domestic sales differently.

Proponents of a trade finance channel between banks and exporters note that exports are more sensitive to financial shocks due to the higher default risk and higher working capital requirements associated with international trade. The need to insure against credit default risk arises because exporters rarely have the capacity or willingness to evaluate default risk and usually turn to banks to provide payment insurance and guarantees. In addition, exporters need more working-capital financing than firms engaged in domestic transactions because of the longer time lags associated with international trade, especially when shipping by sea. Our results provide support for these channels by showing that declines in bank health have a smaller impact on the exports of firms with foreign affiliates (where default risk is not an issue) and no effect on the exports of firms in industries that ship principally by air (where the transit times and therefore working capital needs are not much different than for domestic sales).

Our basic empirical strategy is to exploit the fact that some firms within an industry in a particular year relied on relatively healthy banks for trade finance, whereas others relied on less healthy institutions. We use this within-industry-year variation to identify how a firm's export growth changed with the health of the banks supplying it with trade finance. The use of industry-time fixed effects sweeps out all macro and industry supply-and-demand shocks that are common to all exporters in an industry at a moment in time to ensure that our identification is based on how banks whose health deteriorates affect their export clients within a narrowly defined industry at a moment in time.

Our article builds on and contributes to a number of literatures. The notion that financial shocks and capital constraints matter for loan supply and investment has been well established. In seminal work, Peek and Rosengren (1997, 2000, 2005) were able to document that when Japanese banks became unhealthy in the 1990s, due largely to a collapse in the Japanese real estate market, they lent less in the United States, and this decline resulted in lower construction activity in states that were heavily dependent on Japanese banks. Similarly, Khwaja and Mian (2008) have provided convincing evidence in Pakistan that deteriorations in bank health or increases in the cost of raising capital cause banks to contract lending, while Klein, Peek, and Rosengren (2002) demonstrate that the number of foreign direct

investment flows are sensitive to the financial health of the banks supplying the firm with credit.

Attempts to link bank health to the real economy have relied on aggregate data that make it difficult to know whether the firms borrowing from the troubled institutions were the ones affected. For example, Ashcraft (2005) examined how the failure of healthy bank subsidiaries affected county-level output in Texas and finds a significant link. Similarly, Richardson and Troost (2009) provide convincing evidence that banks experienced serious liquidity constraints during the Great Depression and that the provision of additional liquidity led to higher lending levels. However, none of these publications examine the link between the *output* levels of borrowers and the health of the lenders.

A number of authors in the international finance literature have examined the possibility that trade credit or the availability of dollar-denominated short-term credit might affect exports (see Ronci 2005; Berman and Martin 2009; Iacovone and Zavacka 2009). Although some of these studies have found positive associations, others have found no association or even negative associations. The failure to obtain consistent results is probably partially due to measurement issues. The first measurement issue stems from the fact that firms may obtain dollar-denominated short-term financing for reasons other than financing trade, and not all trade is financed by dollar denominated short-term credit. Moreover, and most seriously, is the deeper problem arising from the fact that trade finance can cause trade credit to rise or fall because while trade finance enables firms to accept more orders, this is often accomplished by selling trade credits to financial intermediaries at a discount, thereby reducing trade credit on the balance sheet (see Ahn, Amiti, and Weinstein 2011 for a more detailed discussion of this point).[1]

1. Although *trade credit* and *trade finance* are sometimes used interchangeably, the terms can be confusing because *trade credit* has a clear definition in accounting and a looser one in finance. In particular, whenever a firm receives an order for goods or services that will be paid later, it records a "trade credit" on the accounts receivable section of its balance sheet. This is true regardless of whether the purchaser is foreign or domestic, so firms with a lot of trade credit on their books may not do any *international* trade. In finance, *trade credit* is also sometimes used to refer to working-capital loans used to finance international trade credits on the balance sheets of exporters. To avoid confusing these two senses of *trade credit*, we always refer to trade credit in the accounting sense and refer to export working-capital loans and other means of financing these trade credits as trade finance.

A second class of papers follows Kletzer and Bardhan (1987) and examines how external finance dependence affects exports. For example, Behrens, Corcos, and Mion (2010), Bricogne et al. (2009), Chor and Manova (2011), Haddad, Harrison, and Hausman (2010), Iacovone and Zavacka (2009), and Levchenko, Lewis, and Tesar (2010) all use the Rajan and Zingales (1998) measure of "external finance dependence."[2] However, Ahn, Amiti, and Weinstein (2011) document that by using "cash flow" to measure the reliance on "internal finance," the Rajan-Zingales measure is, *by construction*, uncorrelated with the level of trade credit and trade finance used by exporters. We therefore agree with Feenstra, Li, and Yu (2010) that trade finance provides a different channel from conventional "external finance" through which financial shocks can be transmitted to firms.

The structure of the remainder of the article is as follows: In Section II, we discuss why exporters use trade finance and how the supply of trade finance can affect exporters. Section III describes our data. Section IV then presents the Japanese firm-level evidence. Section V provides robustness checks. Section VI discusses the economic significance of our results, and Section VII concludes.

II. Why Might Trade Finance Matter?

While trade finance has received scant attention in the academic literature, textbooks on international finance management describe it as "the fundamental problem in international trade" (e.g., Bekaert and Hodrick 2008). The problem stems from two unique issues in international trade. First, international transactions take longer to execute than domestic transactions. Second, exporters (and their banks) often have much less recourse in the event of international trade credit defaults.

2. The Behrens, Corcos, and Mion (2010) results are a bit hard to interpret in the context of our results and the great trade collapse. The key question in the great trade collapse is not why trade fell but rather why it fell so much more than domestic sales in most countries. Behrens, Corcos, and Mion (2010), however, analyze this using data for Belgium, a small open economy whose export to sales ratio actually *rose* during this time period. Thus, the key puzzle that motivated much of the work in this area is absent from their data. This makes it a problematic data set to work with to understand the more global phenomenon. One possible reason that trade finance did not matter in their data is that the economic and/or cultural integration of Belgium with its principal trading partners (Germany, France, and Holland) not to mention Belgium's proximity to these countries meant that trade finance contracts were not so important for Belgian exports.

There have been a number of papers documenting the added time required for international transactions. Djankov, Freund, and Pham (2006) found in a sample of 180 countries that the median amount of time it takes from the moment the goods are ready to ship from the factory until the goods are loaded on a ship is 21 days. Much of this time is spent dealing with the paperwork and procedures associated with getting goods ready to ship internationally. Similarly, the median amount of time it takes from the moment a typical good arrives in a port until the good arrives in the purchaser's warehouse is 23 days. If we couple this finding with Hummel's (2001) estimate that the typical good imported into the United States by sea spends 20 days on a vessel, we can see that it is not uncommon for goods to spend approximately 2 months in transit. These data suggest that firms engaged in international trade are likely to be more reliant than domestic firms on working-capital financing to cover the costs of goods that have been produced but not yet delivered. Moreover, exporters need additional trade credit insurance to cover the added uncertainty associated with possible trade credit defaults while goods are in transit or by importers who often are not obligated to pay until 90 days after the goods arrive.

The letter of credit is the oldest and simplest trade finance instrument that provides exporters with working capital and default insurance. The letter of credit breaks the payment cycle into a number of stages and substitutes a financial institution's default risk for the importer's default risk. In the first stage of the process, the importer and exporter negotiate a sales contract that specifies all of the key parameters of the transaction—for example, price, quantity, delivery terms, payment terms, and so on. The terms of the sales contract often require the importer to ask its "issuing bank" to issue a letter of credit guaranteeing payment for the imports on certification that the exporter has met the terms of the contract. Second, using the letter of credit as collateral, the exporter will often obtain a working capital loan from its bank (often called the advising bank) to cover the production costs of the goods.

The third step in the process involves the transfer of the goods to the carrier and the title of the goods to the importer's issuing bank. Assuming all of the documents are in order, the issuing bank will issue a "banker's acceptance" to the exporter guaranteeing payment at a future time, often around 90 days after the goods arrive. The exporter typically will then sell the

banker's acceptance to its advising bank at a discount based on the interest rate charged by the bank. This enables the exporter to be paid upon shipping the goods, provides the funds to the exporter to repay the working capital loan from its bank, and removes the trade credit from the exporter's balance sheet. The advising bank will then record a "foreign bill bought" on its balance sheet. After the goods arrive, the title of the goods is transferred to the importer from the issuing bank in exchange for either immediate payment or more frequently a promissory note stating that the importer will pay the issuing bank (with interest) at the same time the banker's acceptance matures.

Payment defaults can occur at any point in this cycle. The importer can default on its payment to the issuing bank, the issuing bank can default on the banker's acceptance, the advising bank can refuse to extend a working-capital loan or refuse to purchase the banker's acceptance, or the exporter can default on the initial working-capital loan. Because of data availability, our article focuses on the third type of problem, that is, the exporter's bank refusing to extend working capital loans or purchase bankers' acceptances.

Given that banks are the principal suppliers of trade finance, the supply of such financing is likely to be closely tied to the health of the banks. In particular, as the health of banks deteriorates, these financial institutions find it increasingly difficult to raise funds either through interbank borrowing or through the issuance of new bonds or equity. As these sources of liquidity diminish, unhealthy institutions cut back on their lending. These cutbacks are likely to have a particularly large impact on trade finance because the short maturities of trade finance and its need for constant renewal make it particularly sensitive to a bank's ability to extend new credit. Moreover, because exports are much more dependent on finance than domestic sales for the reasons already mentioned, exports are likely to be harder hit by financial shocks. These forces may explain the finding by Ahn, Amiti, and Weinstein (2011) that during the 2008 crisis, export prices rose relative to domestic prices and the prices of goods shipped by sea rose relative to the same goods shipped by air.

The discussion so far suggests that financial shocks are likely to be transmitted to exporters through two channels. First, financial institutions that have difficulty raising new funds may increase their rates for trade finance. In the Japanese financial crises of the 1990s and in 2008 this could be seen in the jump

in interbank borrowing rates relative to government bond rates. Second, liquidity may dry up, and banks may simply be unable to borrow and extend sufficient credit causing exporters to be liquidity constrained. For example the Bank of Japan (1998) noted that in the midst of the 1998 Japanese financial crisis, "lending attitudes of financial institutions, however, are becoming increasingly cautious as capital adequacy constraints have become more binding." As a result, many studies have found evidence of a severe credit crunch (see Peek and Rosengren 2000, 2005) despite the fact that lending rates fell in 1998 and 1999.

In sum, our discussion of trade finance suggests a potentially important link between exports and the financial sector. Because of the higher risk and working-capital needs of exporting, firms rely on banks for their exports more than for their domestic sales. As a consequence, financial crises are likely to affect exports more negatively than domestic sales.

III. Banks and Exporters: Data

Our sample of firms is drawn from two sources: the Development Bank of Japan (DBJ) database of unconsolidated corporate reports for early years and Nikkei NEEDS FinancialQuest for later years. Between 1986 and 1999, the DBJ collected data on exports and loans for every firm listed on a stock exchange. Similarly, Nikkei reports exports on a consolidated basis consistently from 2003 onward. The unconsolidated data are richer, so we use the earlier data in most of our specifications and reserve the later data for robustness checks. One other complication is that the merger wave that hit Japanese banking in the aftermath of the banking crisis in 1998 and the legalization of bank holding companies makes it very hard to match banks and firms between 2000 and 2006 because every bank in our sample underwent at least one merger or restructuring, and many of them had several such events. Thus, we cannot sensibly match banks and firms during this period, so we cannot use the consolidated data before 2007.

The manufacturing exporters in our sample (ranging between 540 and 860 firms depending on the year), on average, accounted for 80% of all Japanese merchandise exports over this time period. In general, the Japanese fiscal year runs from April in year t until March in year $t + 1$, with the accounting year of 86% of firms ending in March and 9% of firms ending in November or

December. Figure I shows how well changes in exports of the sample of firms we use in our analysis track those of the overall economy. In this figure, we plot the aggregate export data on a fiscal year basis from the Ministry of Finance, which is on an April–March basis, with the aggregate export data in our sample of firms. As the figure shows, aggregate export growth computed from our sample of firms follows Japanese exports from official sources quite closely. This suggests that our data are likely to capture any aggregate movements in Japanese exports.

To identify which financial institutions are providing these firms with trade finance, we supplement the DBJ and Nikkei data with data obtained from the *Japan Company Handbook,* which provides information on each firm's transactional banks or "reference banks." These banks, listed in order of importance, handle most of the firm's transactions. In cases where a firm's main reference bank was a regional bank, and therefore probably not active internationally, we identified the bank most likely to provide trade finance as the first large commercial bank on the list of reference banks.[3] Although listed Japanese firms often deal with multiple banks, it is generally agreed that the main bank identified in this manner is the bank that typically handles the firm's payment settlement accounts and foreign exchange dealings (see Aoki, Patrick, and Sheard 1994). Nevertheless, we examine alternative ways of identifying the main bank in the robustness section.

Our next task is to measure the health of banks. The major problem we face is that during the 1990s Japanese banks employed a wide variety of techniques to hide losses on their balance sheets. As a result, Peek and Rosengren (2005) argue that stock returns are much better measures of bank health than reported risk-based capital ratios, and we follow their suggested

3. We defined the set of internationally active banks as Japan's "city banks" plus a few other prominent banks, giving us a sample of 15 banks: Asahi Bank, Bank of Tokyo, Bank of Tokyo Mitsubishi, Dai-Ichi Kangyo Bank, Daiwa Bank, Fuji Bank, Hokkaido Takushoku Bank, Industrial Bank of Japan, Long Term Credit Bank of Japan, Saitama Bank, Sakura Bank, Sanwa Bank, Sumitomo Bank, Taiyo-Kobe Bank, and Tokai Bank. During our sample period, some banks merged and others were nationalized: Taiyo-Kobe merged with Sakura Bank in 1990; Saitama Bank merged with Dai-Ichi Kangyo Bank in 1992; Bank of Tokyo merged with Bank of Tokyo-Mitsubishi in 1996; Long Term Credit Bank of Japan was nationalized in 1998; and Hokkaido Takushoku Bank failed in 1998. Thus, we start with 15 banks in 1987, but this number falls to 11 banks by 1999. In the later period we focus on Mizuho Financial Group, MUFJ Financial Group, Sumitomo-Mitsui Financial Group, Resona Holdings, and Shinsei.

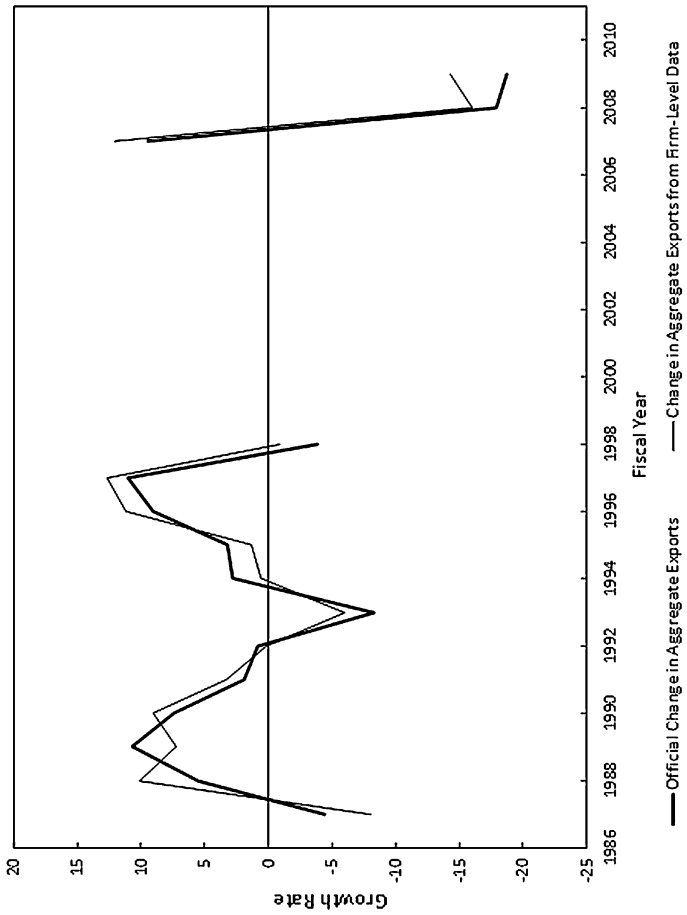

FIGURE I

Firm-Level and Aggregate Export Growth in Japan, 1987–2009

Source: Firm-level data is from the Development Bank of Japan (2004), "Corporate Finance Data Bank." The aggregate official export data for each fiscal year was downloaded from the Japanese Ministry of Finance (http://www.customs.go.jp/toukei/suii/html/time_e.htm).

methodology, although we also use risk-based capital ratios in a robustness check.[4] For each main bank, we computed the monthly market-to-book value as the average monthly share price multiplied by the number of shares outstanding and divided by the book value of its equity.[5] We define the log change in the market-to-book value as the 12-month log difference of this number. All these data were taken from the Pacific Basin Capital Markets database for the early years and from Nikkei in the later years. Finally, we were able to obtain data on "foreign bills bought," which is a measure of the trade finance extended by each bank from Nikkei.

Ultimately, we examine whether changes in a bank's market-to-book value affect its client's future export performance. For that purpose, it is useful to define the lagged change in bank health as the lagged log change in the bank's market-to-book value over the 12-month period before the close of the company's books. This approach lets us examine whether a collapse in the market value of a bank in 1 year is associated with slower export growth in a subsequent fiscal year. For example, if a firm's fiscal year ends in March, we would examine whether the change in the market-to-book value of its main bank between March 1997 and March 1998 was associated with slower growth in exports from fiscal year 1998 to fiscal year 1999.

Figure II shows the dispersion in our measure of bank health over the course of our sample. We portray only the data for March-on-March changes because most of the firms in our sample close

4. Peek and Rosengren (2005) argue that "it is widely believed that Japanese bank capital ratios are substantially overstated.... For example, Bank of Japan Governor Masaru Hayami told Parliament that the capital ratios of Japanese banks in March 2001 would have been only 7 percent rather than the reported 11 percent had they been held to the U.S. standards of capital adequacy. An even lower, and likely more prudent, estimate of the state of capitalization of Japanese banks is that the reported 10-percent capital ratios of the big banks represent a capital ratio of only about 2 percent once the public funds injected into the banks, the value of deferred taxes, and the 'profits' from the revaluation of real estate holdings are subtracted from the banks' capital.... *To the extent that analysts are able to penetrate the veil of reported capital and nonperforming loan ratios, widely viewed as deviating substantially from the true extent of bank problems, stock returns should reflect the best estimates of bank health*" [emphasis added].

5. Generally, book values do not move much, except in one instance where Resona Holdings had an enormous increase in its book value in 2009 that was not achieved through the issuance of equity and had no impact on its market value, so we dropped Resona in 2009 and 2010.

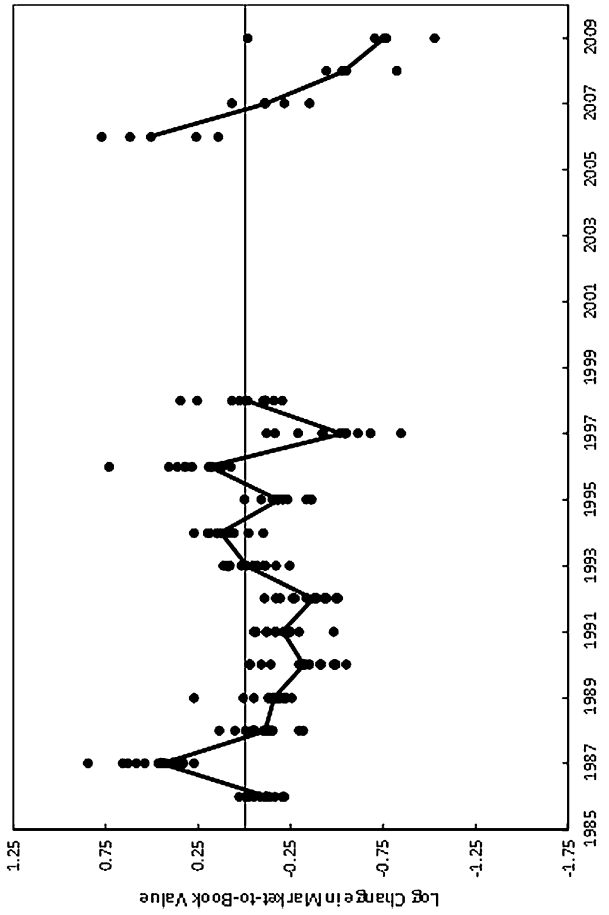

FIGURE II

Change in the Market-to-Book Value of Japanese Banks, 1986–2009

Source: Development Bank of Japan (2004), "Corporate Finance Data Bank."

their books in that month, and this keeps the figure less cluttered. The line indicates the log change in the median market-to-book value in our sample of main banks. As the figure shows, the typical bank saw its market value rise dramatically in the bubble years and fall sharply as nonperforming loans accumulated in the 1990s. The worst years for Japanese banks were 1990 (the year after residential land prices peaked in Tokyo), 1992 (as the first wave of bank failures began), 1997 (as Japan was wracked by another series of bank failures), and of course 2008 and 2009 as the global banking crisis hit Japan.

What is critical for our study, however, is the heterogeneity in the returns of different banks. In most years, the difference between the bank with the highest return and the bank with the lowest return was approximately one-half log unit, which suggests that in the typical year, some banks had returns that were 69 percentage points higher than others. For example, while Mizuho Financial Group and Shinsei Bank, who were the fifth and eighth largest unsecured creditors to Lehman (U.S. Bankruptcy Court 2008), saw their stock prices plunge by 42% and 60%, respectively, between the end of August and the end of December 2008; Resona Holdings, with little exposure, saw its stock price rise by 7% over the same period. In other words, the real estate crash in the 1990s and global financial crisis in 2008–2009 did not affect all banks equally, leading to enormous differences in bank performance. We exploit this cross-bank variation in bank performance in our identification strategy.

Table I presents sample statistics for our key variables. One of the most striking features of this table is the unimportance of trade finance relative to aggregate bank lending. Less than 1% of the typical bank's lending is in the form of trade finance, and no bank extends more than 8% of its credit in the form of trade finance. Given that the typical bank in our sample extends trade finance to more than 50 firms in our sample (and many more firms not in our sample), the data strongly suggest that the export credit exposure of any bank to any particular exporter is likely to be quite small. Similarly, the lending exposure of any bank to an exporter is also quite small. The mean share of a bank's total loans to an individual exporter is 0.01%, and no firm in our sample received more than 0.6% of a bank's loans. These data indicate that the exposure of banks in our sample to either movements in any individual firm's trade finance borrowings or even aggregate borrowings was tiny.

TABLE I
SUMMARY STATISTICS

By banks (1987–1999)	N	Mean	Median	sd	Min	Max
$\ln(\text{foreign bills bought})_{b,t}$	170	12.06	12.30	0.84	10.13	13.66
$\Delta \ln(\text{foreign bills bought})_{b,t}$	170	−0.05	−0.06	0.19	−0.55	0.48
$\ln(\text{totloans})_{b,t}$	170	16.76	16.84	0.55	15.38	17.56
$(\text{foreign bills/totloans})_{b,t}$	170	0.01	0.01	0.01	0.00	0.08
$\ln(\text{foreign bills/totloans})_{bt}$	170	−4.70	−4.70	0.72	−6.45	−2.56
$\ln(\text{market-to-book value})_{b,t-1}$	170	1.33	1.35	0.52	−0.16	2.61
$\Delta\ln(\text{market-to-book value})_{b,t-1}$	170	−0.07	−0.12	0.28	−0.84	0.84
By firms (1987–1999)						
Number of firms_t	7,173	632	636	46	539	716
$\Delta\ln(\text{exports})_{ft}$	7,173	0.01	0.03	0.26	−1.23	0.95
$\Delta\ln(\text{domestic sales})_{ft}$	7,050	0.01	0.01	0.11	−0.43	0.37
$\Delta\ln(\text{exports/domestic sales})_{ft}$	7,050	0.00	0.01	0.26	−1.35	1.18
$\Delta\ln(\text{market-to-value})_{f,t-1}$	7,173	−0.07	−0.12	0.29	−1.26	1.11
$\Delta\ln(\text{assets})_{f,t-1}$	6,909	0.04	0.02	0.11	−1.03	0.88
$\Delta(\text{profits})_{f,t-1}$	6,909	0.00	0.00	0.06	−1.77	2.23
$\Delta\ln(\text{share price})_{f,t-1}$	6,902	−0.03	−0.02	0.30	−3.06	1.55
$\text{Total loan}_{fbt}/\text{Total loan}_{bt}$	5,723	0.0001	0.00004	0.0003	0	0.006
By firms (2008–2010)						
$\Delta\ln(\text{exports})_{ft}$	1,619	−0.08	−0.09	0.23	−0.94	0.70
$\Delta\ln(\text{market-to-value})_{f,t-1}$	1,619	−0.53	−0.53	0.27	−1.03	0.07

Notes. Profits are defined as the ratio of after-tax net income to total assets.

Although it is difficult to measure all elements of trade finance supplied by banks, an important element of this lending—foreign bills bought—is very closely tied to the health of these institutions. Leaving aside issues of causality for now, it is straightforward to show that when banks become unhealthy, they lend less. We demonstrate this by regressing the log of a bank's total loans in a year on the log of its market-to-book ratio in the previous year as well as bank and year fixed effects. The results presented in Table II are in line with those in Peek and Rosengren (1997) showing that banks whose health declines cut back on lending.

In column (2) of Table II, we estimate an analogous equation using the log of foreign bills bought as the dependent variable. The elasticity of foreign bills bought with respect to changes in bank health is three times larger than the elasticity of total lending. A 1% decline in a bank's market value is associated

TABLE II

ASSOCIATIONS BETWEEN BANK HEALTH, TRADE FINANCE, AND EXPORTS

Dependent variable	ln (totloans)$_{b,t}$	ln(foreign bills bought)$_{b,t}$	ln(bills/totloans)$_{b,t}$	Δln(exports)$_{b,t}$	Δln(exports)$_{bi,t}$
	(1)	(2)	(3)	(4)	(5)
				By bank	By bank/ industry
ln(market-to-book value)$_{b,t-1}$	0.144***	0.456***	0.311**		
	(0.054)	(0.142)	(0.137)		
Δln(trade finance loan)$_{b,t}$				0.155***	0.073***
				(0.062)	(0.020)
Fixed effects					
Year	yes	yes	yes	yes	yes
Bank	yes	yes	yes	yes	yes
Industry	no	no	no	no	yes
Observations	185	185	185	138	2,336
Adjusted R^2	0.95	0.92	0.91	0.19	0.10

Notes. Notes. Robust standard errors are in parentheses. ***Significant at the 1% level. **Significant at the 5% level. Columns (1)–(3) include the 15 city banks in our sample: Asahi Bank, Bank of Tokyo, Bank of Tokyo Mitsubishi, Dai-Ichi Kangyo Bank, Daiwa Bank, Fuji Bank, Hokkaido Takushoku Bank, Industrial Bank of Japan, Long Term Credit Bank of Japan, Saitama Bank, Sakura Bank, Sanwa Bank, Sumitomo Bank, Taiyo-Kobe Bank, and Tokai Bank. Column (4) aggregates firm-level exports by first reference bank. Column (5) aggregates firm-level exports by first reference bank within an industry. In columns (4) and (5), we drop the first year that a bank mergers to avoid big jumps in exports due to mergers, we drop any firm that switches their main bank, and we keep the sample balanced so it only includes firms that were in the sample for the whole sample period.

with 0.46% decline in trade finance, but only a 0.14% decline in aggregate lending. Similarly, column (3) shows that banks whose health declined saw dramatic drops in their trade finance lending relative to their domestic lending lines. One interpretation of this is that financially stressed Japanese banks could not easily raise money and therefore could not roll over short-maturity financial instruments like foreign bills. Regardless of the interpretation, the results make clear that there is a positive correlation between the health of financial institutions and the amount of trade finance they supply. Moreover, deteriorations in bank health are associated with much larger declines in the supply of trade finance than in other types of lending.

Another important correlation we highlight is the strong link between trade finance provided by a bank and the exports of firms that identify that institution as a reference bank. One of the problems in conducting this analysis is that the number of exporters associated with a reference bank can change as firms enter or leave our sample or change banks. We therefore restricted the sample to the subset of exports conducted by a balanced panel of firms with March closing dates that were tied to a particular main bank over the full sample period, which eliminates about 30% of the firms in the full sample.

In column (4), we aggregate the exports of these firms together by their main bank and regress the change in aggregate exports associated with a bank on the change in the bank's foreign bills bought, as well as bank and year fixed effects. Here we see that exports are positively associated with that bank's provision of trade finance. To make sure that these results are not driven by particular banks serving particular industries, we summed together the exports of firms that are clients of a particular bank in each industry and reran the regression with industry fixed effects. The results reported in column (5) of Table II indicate that the exports of client firms *within an industry* are positively correlated with trade finance provision of their banks. Although this does not establish causality, Table II makes clear that there is a link between bank health and trade finance as well as between trade finance and exports.

IV. Bank Health and Exports: Estimation

The links between bank health and trade finance as well as trade finance and exports beg the question of whether we can

discern a direct effect of bank health on exports. Obviously, a large number of other factors are related to export growth. However, most of these—industry demand, factor endowments, exchange rates, and factor prices, for example—can be thought of as common to all exporters within an industry at a moment in time. We therefore include industry-year dummies in our specifications to eliminate any bias arising from these sources.[6]

Our basic estimating equation is:

$$\Delta \ln(\text{Exports}_{ft}) = \sum_{i,t} \alpha_{it}\text{IND}_{fit} + \sum_{b} \gamma_b \text{BANK}_{fb,t-1} + \beta \sum_{b} \Delta \ln(\text{MTB}_{bt-1}) \times \text{BANK}_{fb,t-1} + \varepsilon_{fit}, \quad (1)$$

where Exports_{ft} corresponds to the exports of firm f at time t, IND_{fit} is an indicator variable that is 1 if firm f is in industry i in time t, BANK_{fbt} is an indicator variable that is 1 if the firm is a client of bank b in time t, MTB_{bt} is the market-to-book value of bank b in time t, and all Greek symbols are parameters to be estimated. In other words, we will be estimating the impact of bank health on client exporters with a full set of bank and industry-time fixed effects. We include the γ_b's to control for endogeneity problems that might arise because firms that have higher average export growth rates might match with banks whose market-to-book values tend to rise on average. Thus, the correlation between export growth and growth in the market-to-book value might simply reflect the possibility that good exporters match with good banks rather than the year-to-year covariation in exports and bank health. Our identification strategy, then, is based on how the export growth of firms within a narrowly defined industry in a particular year varies with the health of the banks providing those firms with trade finance.

Table III presents the results from these regressions. All standard errors are clustered at the bank level. We drop firms whose export growth is in the top and bottom 1st percentile.[7] The first two columns present regressions of the change in log exports on the lag change in the log market-to-book value of the bank most likely to be supplying trade finance. In the first

6. The data divide manufacturing into over 100 sectors depending on the year, which comprise our industry dummies in the period 1987 to 1999.

7. Including these outliers tends to magnify the effect of bank health on exports.

TABLE III

EXPORTS AND TRADE FINANCE

Dependent variable	$\Delta\ln(\text{exports})_{f,t}$				$\Delta\ln(\text{domestic sales})_{f,t}$		$\Delta\ln(\text{exports/domestic sales})_{f,t}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				MTB lag structure	Non-exporters	Exporters	Exporters
$\Delta\ln(\text{market-to-book value})_{f,t}$				−0.024			
				(0.018)			
$\Delta\ln(\text{market-to-book value})_{f,t-1}$	0.080***	0.084***	0.082***	0.074***	0.022***	0.005	0.072***
	(0.014)	(0.018)	(0.018)	(0.017)	(0.007)	(0.007)	(0.020)
$\Delta\ln(\text{market-to-book value})_{f,t-2}$				−0.016			
				(0.025)			
Fixed effects							
Year–industry	no	yes	yes	yes	yes	yes	yes
Year	yes	no	no	no	no	no	no
Bank	no	no	yes	yes	yes	yes	yes
Observations	7,173	7,173	7,173	7,114	5,506	7,050	7,050
Adjusted R^2	0.07	0.15	0.15	0.15	0.40	0.42	0.13

Notes. Robust standard errors corrected for clustering at the bank level are in parentheses. ***Significant at the 1% level. **Significant at the 5% level. Estimation is for the period 1987 to 1999. There are 108 industry codes in manufacturing corresponding to the DBJ industry classification. In column (3) and all subsequent columns, the industry dummies are multiplied by each year dummy. The sample in column (5) includes all observations where exports in period t or $t-1$ were 0. In columns (6) and (7), the sample includes all observations where exports in period t and $t-1$ were nonzero.

column, we report results with just year dummies, and in the second column, we report results with just industry-year fixed effects. In the third column we add bank fixed effects, so the regression corresponds exactly to the specification in Equation (1). The estimated coefficient with industry-year and bank dummies is about 0.08, which means that when a firm's bank suffers a 30% decline in its market-to-book value, the firm's annual exports declined 2.7% relative to a firm whose bank's health did not decline.

In column (4) of Table III, we check whether we have the correct lag structure in the change in the market-to-book value. The results indicate that a change in the market-to-book value from, say, December 1996 to December 1997, will affect export growth from the calendar year 1997 to calendar year 1998. Thus, the fall in exports occurs in the year following the slump in bank health. Column 4 shows that the contemporaneous change in the market-to-book value and a two-period lagged change in market-to-book value have no effect on exports. All the effects appear to be contained within the year following the change in bank health. This implies that the effects of a decline in bank health are short term, as one would expect if a decline in bank health immediately led to a decline in the ability of the bank to raise financing.

An important part of our argument supporting a link between the financial sector and exports is that exporters depend on trade finance to make sales abroad because of the greater risks associated with exporting coupled with the higher need for working-capital financing. To test whether we have identified an export-specific effect or merely a general effect applicable to all sales, we check whether there is an effect from lagged change in the market-to-book value on domestic sales. In column (5), where we include the set of firms that do not export any of their sales, which we define as a firm that does not export at all in period t and $t-1$, we see that there is a positive significant coefficient equal to 0.02: only a quarter of the magnitude of that for the effect on exports. Moreover, if we consider the effect on domestic sales of firms that do export in period t and $t-1$, as in column (6), the coefficient on bank health becomes insignificant. In column (7), we replace the dependent variable with the log change in the ratio of exports to domestic sales, for the subset of exporters. The results indicate that a 25% decline in the market-to-book value in a bank leads to a drop in domestic sales of 0.1% ($\ln(0.75) * 0.005$), much smaller than the implied drop in

exports of 2.4% (ln(0.75) * 0.082). This strongly suggests that these results are driven by the additional financing needs of exporting relative to selling domestically *even within the same set of firms*.

One potential concern about this methodology is that there may be an endogeneity problem either through reverse causality, if export performance were driving bank performance, or through an omitted variable that might be affecting both bank health and a firm's exports. In Table IV we implement a number of additional robustness checks to show that endogeneity is not driving the results. One possibility is that there may be some correlation between changes in exports and changes in a bank's market-to-book value that we have not considered. For example, if changes in contemporaneous exports are correlated with changes in a bank's market-to-book value and changes in exports are serially correlated, we might observe a spurious correlation. To check that persistence in export growth is not driving the results, we included a lagged dependent variable in column (1) of Table IV and reestimate using an Arellano–Bond estimator. The coefficient on the lagged dependent variable is negative and significant, but the coefficient on the market-to-book value remains unchanged. This result indicates that even if one believes in a contemporaneous correlation between a firm's exports and a bank's health, that correlation cannot be driving our results. Instead, a deterioration in bank health is leading to a future decline in exports independent of what is happening to contemporaneous export growth.

In principle, it is possible that bank health may be correlated with other firm performance variables. Although we have argued that it is highly unlikely, we check that our results are robust to this possibility by following Klein, Peek, and Rosengren (2002) and include lagged firm performance measures other than exports in the second column. We include the one-period lag change in a firm's log total assets and the lagged change in a firm's profitability, measured as the ratio of net income to assets. The coefficient on total assets is positive and significant, whereas the coefficient on profits is insignificant. Moreover, the point estimate on the change in the market-to-book value is unaffected by the inclusion of these measures of firm performance. Another omitted variable issue could arise if exposure to countries hit by the Asian crisis, such as South Korea, simultaneously affected a bank's health and a firm's exports. To ensure this is not driving our results, we

TABLE IV
ENDOGENEITY

Dependent variable	Δ ln(exports)$_{f,t}$					Δ ln(exports/ domestic sales)$_{f,t}$
	(1)	(2)	(3)	(4)	(5)	(6)
	With lagged dependent variable (Arrellano–Bond)	With lagged firms' profits	Pre-Asian crisis years (1987 to 1996)	With destination GDP growth	IV Instrument adjusted for firms' share prices	IV Instrument adjusted for firms' share prices
Δln(market-to-book value)$_{f,t-1}$	0.084***	0.082***	0.079***	0.091**	0.078***	0.088***
	(0.021)	(0.019)	(0.026)	(0.037)	(0.017)	(0.023)
Δln(exports)$_{f,t-1}$	−0.093***					
	(0.022)					
Δln(assets)$_{f,t-1}$		0.223***				
		(0.032)				
Δ(profits)$_{f,t-1}$		−0.006				
		(0.059)				
Δln(wGDP)$_{f,,t}$				0.019**		
				(0.008)		
Δln(wGDP)$_{f,,t-1}$				0.021**		
				(0.008)		
Fixed effects						
Year–industry	yes	yes	yes	yes	yes	yes
Bank	yes	yes	yes	yes	yes	yes

TABLE IV
(CONTINUED)

Dependent variable	Δ ln(exports)$_{f,t}$					Δ ln(exports/ domestic sales)$_{f,t}$
	(1)	(2)	(3)	(4)	(5)	(6)
	With lagged dependent variable (Arrellano–Bond)	With lagged firms' profits	Pre-Asian crisis years (1987 to 1996)	With destination GDP growth	IV Instrument adjusted for firms' share prices	IV Instrument adjusted for firms' share prices
First-stage:						
Δln(adjusted market-to-book value)$_{f,t-1}$					1.000***	1.000***
					(0.001)	(0.001)
F-stat					1.6e+06	1.6e+06
Observations	5,925	6,909	5,417	985	6,902	6,902
Adjusted R^2		0.16	0.16	0.17		

Notes. Robust standard errors corrected for clustering at the bank level are in parentheses. ***Significant at the 1% level. **Significant at the 5% level. Profits are defined as the ratio of after-tax net income to total assets. The variable Δln(wGDP) is the weighted foreign GDP growth where the weights are given by the firm's export share to that destination. Exports by destination are only available for 1998 and 1999, so we use the average of those two years for the period 1997 to 1999. The instrument in columns (5) and (6) is the residual from a regression of the change in the bank's market-to-book value on the change in the firm's share price.

reestimate Equation (1) for the pre-Asian crisis years up to 1996—a period during which there was no major foreign downturn—so that our bank health shocks arise largely from the housing and loan crisis in Japan and see from column (3) that the estimates remain unchanged.

We also may face an omitted variables bias if banks have loan exposure in the same countries that are the major export destinations for their client firms. This could cause a bias if foreign demand declines drive down a firm's exports while at the same time driving down a bank's share price. This suggests that we should try to control for GDP growth in the countries that constitute the major export destinations of each firm. The DBJ contains exports by destination at the firm level for 1998 and 1999, and so we evaluate the impact of this bias for 1997–1999, where we add the earlier year so that we have 2 years of export changes.[8] If our results are driven by a correlation between the exposure of banks to particular markets and exports of their clients to those markets, one should expect that controlling for country-level demand shocks should diminish the magnitude of the estimated coefficient on bank health. When we include the export-destination demand variable in column (4), however, we find that firms that export to markets with fast growth have higher export growth, as one might suspect, but this has no impact on the relationship between bank health and exports.[9]

A skeptic might still worry that a client firm's health might affect both its ability to export and the health of the bank providing it with credit. For example, future exports might be correlated with the probability of a firm loan default and hence

8. We know exports by destination at the firm level for the following regions: North America, Europe, Asia, and the Middle East, but we don't know the share of exports within each of those regions. For example, the data might indicate that 50% of a firm's exports go to North America but not how much of that goes to the United States versus Canada and Mexico. Thus to construct a destination weighted GDP growth variable for each firm, we use Japan's aggregate export weights for within regions, that is, to construct a "North America" GDP growth variable, and then the firm-level weights to construct a destination weighted GDP growth variable. Note that we only estimate this for the period 1997 to 1999 because we do not want to impose the same export shares by destination for earlier years.

9. To be rigorous, we should compare the coefficient on lagged market-to-book in the specification in column (4) with the same coefficient in a specification without the GDP growth variable run over the same sample period. The coefficient on lagged MTB in this sample period when we do not include the GDP term is 0.093 (s.e. 0.039) which is almost identical to the 0.091 coefficient reported in Table IV.

bankruptcy.[10] Alternatively, because banks may own up to 5% of a firm's shares in Japan, it may be the case that the bank's share price is correlated with the firm's share price. To make sure there is no reverse causality arising from the health of the firm affecting the health of the bank, we use the residuals from a regression of changes in bank market-to-book values on firm share price changes (with industry-time dummies) as an instrument.[11] These residuals are uncorrelated with the health of the firm or its expected profits by construction, and we relegate the proof of the validity of this instrument to an appendix. The strong fit of the first stage indicates that changes in bank health are largely driven by forces unconnected with the health of their exporting clients, so while one might worry about theoretical correlations, in reality the driving forces behind Japan's financial crises had nothing to do with the health of exporters. As one can see in column (5) of Table IV, using these residuals as an instrument hardly affects the impact of bank health on firm exports. In other words, the health of the bank has an impact on the firm's exports that is independent of the firm's health.[12] In column (6), we replace the dependent variable with the log change in the ratio of exports to domestic sales and use the same instrument. Again, we see that the instrumental variable estimation produces almost the same results as the OLS estimate.

V. Robustness

In Table V, we show that the results are robust to alternative bank-matching methods and to different measures of bank health. Other researchers have used the bank providing the largest loan to a firm as the means of identifying the main bank. To examine the sensitivity of the results to our method of matching firms and banks, we identified the main bank as the largest lender to

10. If a decline in exports is associated with a greater probability of bankruptcy, a bank's share price might decline when a firm's exports decline. However, the bankruptcy rate of listed companies was extremely low during this period, less than 0.1% a year over our sample period (see Xu and Zhang 2009). This suggests that it is highly unlikely that defaults by exporters, in general the most profitable firms in the market, should be driving our results.

11. We used change in firm share price instead of change in firm market-to-book value, because the DBJ data did not report the number of shares issued of each firm. In practice, these two measures are very highly correlated.

12. Similarly, including the exporter's share price as an independent variable in Equation (1) does not qualitatively affect the bank health coefficient.

TABLE V
ALTERNATIVE MEASURES OF MAIN BANK AND MARKET TIMING

Dependent variable: $\Delta\ln(\text{exports})_{f,t}$	(1)	(2)	(3)	(4)	(5)
	Alternative bank matching		MTB value: 3 months	March accounting	Alternative bank health
	Largest lender	Ref banks	average	period	measure
$\Delta\ln(\text{market-to-book value})_{f,t-1}$	0.074***	0.065***	0.060***	0.063***	
	(0.018)	(0.015)	(0.021)	(0.020)	
$\Delta\ln(\text{risk-based capital ratio})_{f,t-1}$					0.201**
					(0.096)
Fixed effects					
Year−industry	yes	yes	yes	yes	yes
Bank	yes	yes	yes	yes	yes
Observations	7,090	7,049	7,089	6,021	2,905
Adjusted R^2	0.13	0.15	0.15	0.20	0.13

Notes. Robust standard errors corrected for clustering at the bank level are in parentheses. ***Significant at the 1% level. **Significant at the 5% level. In column (1), we use an alternative method for matching firms to banks: we assign a city bank that was the largest loan provider that year. If the exporter had no loans from a city bank that year, we assign the previous year's city bank. In column (2), we use the first listed reference bank from the company handbooks, even if the first reference bank is not a city bank. In column (3), we define the market-to-book value as the average of the last three months of the accounting period. In column (4), we only keep observations where the accounting period ended in March. In column (5), we measure bank health using the risk-based capital ratio instead of the market-to book ratio.

the firm among "city banks," that is, commercial banks. Because Japanese city banks are known to be involved in trade finance, firms that borrow heavily from city banks are likely to obtain trade finance from them as well. In the first column of Table V, we identify the main bank as the city bank providing the largest loan to each exporter.[13] Then, in column (2) of Table V, we rerun the regression identifying the trade finance bank as any first-listed reference bank in the *Japan Company Handbook*,even if it is a regional bank, expanding the sample of banks from 15 to 43. The results are not qualitatively different from those in our baseline specification, indicating that other reasonable methods of identifying which bank handles most of the firm's trade finance transactions seem to yield similar results.

13. Firms sometimes did not report the sources of their loans in some years. If there was no loan listed in a year, we used the main bank in the previous year. If there were no loans over the whole sample period, we dropped the firm from the estimation in this column.

Our measure of bank health relies on share and equity values in the closing month of each accounting year. To address concerns that a particular month may be atypical, we define the market-to-book value in column (3) of Table V as the average of the market-to-book value in the last 3 months of each accounting period, to smooth out any unusual fluctuations. We see that the results are robust to this alternative definition.

Another potential problem is that we use the same industry-year dummies for firms whose accounting years end in different months. This could potentially cause problems because not all the months fall within the same 12-month period. To make sure this variation is not causing a problem, we reestimated the baseline equation with only those observations in which the accounting year ends in March, and again we see that the results are robust (see column (4), Table V).

In column (5), we test the robustness of our results to an alternative measure of bank health: the combined Tier 1 and Tier 2 risk-based capital ratio conforming to the Basel II agreement.[14] This measure of bank capital relative to risk assets started to be used in Japan in 1993 and served as an important reported measure of bank health used by bank regulators. Although this measure has been criticized in the literature as being much more subject to manipulation than our preferred measure (see note 4), we can test whether we observe an impact from deteriorations in reported bank health. The results indicate that declines in reported bank health are associated with drops in exports by client firms. The result is statistically significant. A 10% decline in reported bank capital is associated with a 2% decline in client firm exports.

If trade finance does matter for the response of exporters to financial shocks, then one should expect to see certain kinds of firm heterogeneity in the data in which some firms at some times are more affected than other firms. First, it is probably much harder for a firm to find alternative forms of trade finance when a bank runs into trouble in a crisis period and many other institutions are troubled than if only the firm's bank is in trouble.[15]

14. These data were taken from Peek and Rosengren (2005).

15. Obviously, if firms can easily switch between sources of trade finance, problems in one financial institution need not create difficulties for an exporter. However, there is good reason to believe that it is difficult to find another source of financing quickly in the event that an exporter is cut off. In particular, any new financial institution interested in providing trade finance would need to

To test for this effect, we interacted the change in the bank's market to book value with a dummy that equals 1 for the crisis years: 1990 (the year bank share prices started to fall), 1992 (the year the *jusen* [Japan's specialized housing and loan companies] losses were tied to the banks), 1997 (the year many Japanese banks began failing). As one can see from column (1) of Table VI, the effect that we identify is particularly strong during banking crises. In other words, although bank health always matters, it matters much more for exports during financial crisis than when banks are healthy in general. This may reflect the difficulty of finding alternative sources of funding in the middle of a financial crisis. To test whether the recent crisis was different, we reran our estimation using only data from 2007 to 2010. The coefficient estimates reported in column (2) of Table VI are quite similar to what we observed earlier. Clients of banks that became unhealthy exported less than those of healthier institutions.

One might suspect that large declines in bank share prices are more likely to affect a bank's willingness to lend than increases in share prices from already high levels. We explore this possible nonlinearity in columns (3) and (4) of Table VI. In column (3), we interact the bank health measure with a dummy equal to 1 if the bank's market-to-book value declined. We show that almost all of the effect of bank health on exports arises from observing a relationship between declines in bank health and export declines of client firms. The coefficient on reductions in the market-to-book value is statistically different from the coefficient on increases in the market-to-book value at the 10% level. To explore richer forms of nonlinearities, we check whether the coefficient on the top quartile of the distribution of the banks' lagged changes in their market-to-book values is different to the bottom quartile, and we see from column (4) that these coefficients are also statistically different at the 10% level.

Thus far, we have been arguing that there are two principal reasons firms use trade finance: international trade takes longer than domestic trade, and international trade involves greater

examine carefully the risk of the exporter, the importer, the purchaser's financial institutions, and the reasons the original financier refused credit. While this analysis can certainly be done, it may take some time and is likely to delay the exports. Moreover, it may be hard to find a new source of trade finance in the midst of a financial crisis when many institutions are under stress. Thus, the mere fact that exporters can find alternative sources of finance does not mean that they can do so rapidly enough to prevent an interruption in their shipments.

TABLE VI

HETEROGENEOUS EFFECTS

Dependent variable: $\Delta\ln(\text{exports})_{f,t}$	Crisis interaction	Subsample 2008–2010	Asymmetric effects	Non-linearities	With air interaction	With foreign interaction
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\ln(\text{MTB})_{f,t-1}$	0.038	0.091***	0.030	0.063**	0.120***	0.135***
	(0.027)	(0.034)	(0.041)	(0.030)	(0.022)	(0.025)
Crisis* $\Delta\ln(\text{market-to-book value})_{f,t-1}$	0.110***					
	(0.036)					
Down*$\Delta\ln(\text{MTB})_{f,t-1}$			0.079*			
			(0.044)			
Up_q1_* $\Delta\ln(\text{MTB})_{f,t-1}$				−0.032		
				(0.059)		
Down_q4* $\Delta\ln(\text{MTB})_{f,t-1}$				0.046		
				(0.036)		
Air*$\Delta\ln(\text{MTB})_{f,t-1}$					−0.130***	
					(0.037)	
Foreign affiliate$_f$* $\Delta\ln(\text{MTB})_{f,t-1}$						−0.077***
						(0.019)
Foreign affiliate$_f$						0.024
						(0.015)

TABLE VI
(CONTINUED)

Dependent variable: $\Delta\ln(\text{exports})_{f,t}$						
	Crisis interaction	Subsample 2008–2010	Asymmetric effects	Non-linearities	With air interaction	With foreign interaction
	(1)	(2)	(3)	(4)	(5)	(6)
Joint significance tests						
Ho: $\beta_{\Delta ln(MTB)}+$ $\beta_{AIR*\Delta ln(MTB)} = 0$					−0.010	
					(0.038)	
Ho: $\beta_{\Delta ln(MTB)}$ + $\beta_{ForeignAffiliate*\Delta ln(MTB)} = 0$						0.058*
						(0.029)
F-test: $\beta_{Up\_q1*\Delta ln(MTB)}$ = $\beta_{Down\_q4*\Delta ln(MTB)}$				3.36*		
(p-value)				(0.078)		
Fixed effects						
Year–industry	yes	yes	yes	yes	yes	yes
Bank	yes	yes	yes	yes	yes	yes
Observations	7,173	1,619	7,173	7,173	4,933	1,756
Adjusted R^2	0.15	0.19	0.15	0.15	0.14	0.14

Notes. MTB is "market-to-book value." Robust standard errors corrected for clustering at the bank level are in parentheses. ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level. Crisis dummy equals 1 for years 1990, 1992, 1997. In column (3), down is defined as equal 1 if the market-to-book value falls. In column (4), up_q1 is defined as the top quartile of the change in the market-to-book value, and down_q4 is the bottom quartile. In column (5), the air dummy is defined as equal to 1 if the share of trade exported by air is greater than 50% within that industry. Miscellaneous industries were dropped because of concordance difficulties. The foreign affiliate data was only available for 1998 and 1999. Foreign affiliate is equal 1 if the firm reported nonzero foreign assets during these years, which we apply to the sample period 1997 to 1999.

risk. We now turn to investigating these links. Since Japan is an island, Japanese firms export goods either by air or sea. Because goods shipped by air arrive at their destinations much more rapidly than goods shipped by sea, one should expect that working-capital considerations to be larger for firms shipping goods by sea relative to those exporting by air. Since we do not know the mode of transport of each firm's exports, we relied on the firm's sector.[16] We generated an air dummy variable that equaled 1 if a firm was in a sector in which more than 50% of the value of exports was shipped by air. In column (5) of Table VI, we interact that dummy with our bank health measure. The results indicate that changes in bank health matter a lot for firms in industries in which goods are predominantly shipped by sea but not for firms in industries in which goods are shipped by air.[17] The different effects for air and sea shipping are consistent with the notion that firms whose goods are shipped more rapidly have lower working-capital needs than firms whose goods remain in transit longer.

We next investigate the role played by default risk. When firms export to foreign affiliates, they do not face a default risk and therefore one should expect their trade finance needs to be less. Because approximately half of the firms in our sample have foreign affiliates, we split the sample according to whether a firm has foreign affiliates and reestimate our basic equation. In column (6) we interact the change in market-to-book value with a foreign affiliate dummy equal to 1 if the exporter had any foreign assets. Note that this information is only available in 1998 and 1999, so we use the average of this information and apply it to the sample beginning in 1997. We show that exporters that transact with foreign affiliates (and therefore face no default risk on these transactions) experience lower export declines when their banks run into trouble than firms without foreign affiliates, consistent with the finding in Manova, Wei, and Zhang (2009). The effects for firms engaged exclusively in arm's-length transactions are much stronger, presumably because they need the risk insurance provided by their financial institutions. These results indicate that trade finance matters principally for

16. Data on Japanese exports by mode of transport are from the Japanese Ministry of Finance website (http://www.customs.go.jp/toukei/info/tsdl_e.htm), and we matched this with the industry definitions in the DBJ database.

17. The joint significance test indicates that the coefficient on air is not significantly different from 0.

TABLE VII
SELECTION

Dependent variable	$\Delta\ln(\text{exports})_{f,t}$			Percentage change in exports	Change in exports/total sales
	No bank switchers	Percentage change in MTB value	Heckman selection	Tobit (random effects)	Tobit (random effects)
	(1)	(2)	(3)	(4)	(5)
$\Delta\ln(\text{market-to-book value})_{f,t-1}$	0.084***	0.065***	0.086***	0.079***	0.008***
	(0.018)	(0.019)	(0.020)	(0.021)	(0.003)
Inverse mills ratio			−0.756		
			(0.565)		
Fixed effects					
Year–industry	yes	yes	yes	no	no
Bank	yes	yes	yes	yes	yes
Year	no	no	no	yes	yes
First stage					
Relative value added per $\text{worker}_{f,t-1}$			0.384***		
			(0.070)		
$\Delta\ln(\text{market-to-book value})_{f-1}$			−0.056		
			(0.108)		
Fixed effects:					
Year			yes		
Bank			yes		
Observations	6,616	7,179	8,380	7,277	8,250
R-squared	0.16	0.15			

Notes. Robust standard errors corrected for clustering at the bank level are in parentheses. ***Significant at the 1% level. **Significant at the 5% level. In column (1), we drop any firm that switches its main bank during the sample period. In column (3), the selection is a function of relative value added (relative to three-digit industry by year), the change in market-to-book value, year effects, and bank effects. There are 1,212 censored observations and 7,168 uncensored observations in column (3). The random effects in the tobit specification are at the industry level, and there are 104 left-censored observations.

firms whose goods remain in transit for long periods and face trade credit default risk.

In Table VII, we address various sources of possible selection biases. One possible concern is that firms with higher export growth might switch to healthier banks. This is unlikely to be a problem in our data because bank relationships tend to be extremely stable over time (Aoki, Patrick, and Sheard 1994; Yafeh 1995; Hoshi and Kashyap 2001). To show this in our data, we define "switchers" as firms that change their main banks when not

forced by a bank merger. There were only 8% of our sample of firms that changed main banks between 1987 and 1999. Nevertheless, to make sure that those few firms that changed main banks were not driving our results, we kept the bank dummies in the specification to control for each bank's unobserved health at the start of the sample and restricted our sample of firms to those that stayed with the same main bank throughout the sample period. We report the results from this exercise in column (1) of Table VII. The results are unchanged from those with the full sample, indicating that whatever selection process is at work to link firms and banks, it is not driving our results.

Another selection issue arises from the fact that by measuring bank health as the change in the log market-to-book value, we have no measure of bank health when banks fail and their share price goes to 0. This may be desirable because it is not clear that market-to-book values are relevant if banks are nationalized. To test whether our results are sensitive to this sample selection, however, we replaced our measure of bank health with the percentage change in market-to-book value. This measure is bounded below at –1 when a bank's share price goes to 0. The results in column (2) of Table VII are almost identical to those in our main specification, indicating that the inclusion or exclusion of bank failures does not qualitatively affect our conclusions.

A final possible selection issue arises from firms that enter or exit the export market. Again, we have several reasons to believe, ex ante, that this factor will not be important for understanding our results. First, because the firms in our sample are all listed, they tend to be larger than the typical firm, and hence there is much less entry and exit than in samples drawn from census data. Second, it is hard to imagine that the inability to obtain short-term export financing from a *particular* bank would be a reason for a firm to alter a long-term decision about whether to enter an export market. Third, the inability of a firm to obtain export financing from a particular bank at a moment in time might cause a firm to lose some contracts, but it is unlikely it would cause the firm to make the long-term decision to exit the export market altogether.

These arguments notwithstanding, we checked to see if our results were robust to the possibility that trade finance affected entry and exit by estimating a two-stage Heckman correction. We model the probability of exporting as being related to the firm's

productivity since high productivity is likely to induce entry and low productivity is likely to induce exit (see Melitz 2003) whereas the *level* of productivity is unlikely to affect the *growth* in exports. We measure the productivity of the firm by using the firm's value added per worker relative to the industry maximum each year, where the industry is defined at the three-digit level, comprising 52 industries.[18] We also include the log change in the market-to-book value of its main bank, year dummies to account for macro shocks, and bank fixed effects in the first-stage probit estimation. The results of this selection equation (see the bottom of column (3) in Table VII) indicate that the probability of exporting in both years (i.e., being in our sample) rises with productivity as one would expect. The point estimate for the coefficient on the change in the bank's market-to-book ratio in column (3), however, is almost identical to that in column (3) of Table III. Thus, selection into and out of exporting does not seem to be biasing our results. Another way to see whether selection effects due to exit might be affecting our results is to redefine the dependent variable as the percentage change in exports instead of the log change, thus including the firms that exit from exporting. Of course, this truncates the dependent variable in the left distribution at –1. We therefore estimate the equation using a tobit procedure in column (4) with the full sample using random effects at the industry level. Again, we see that the coefficient on the lagged market to book value is hardly affected. Finally, in column (5) we redefine the dependent variable as the change in the ratio of exports to total sales, but not logged so that firms that enter and exit from exporting remain in the sample, using the tobit procedure. The coefficient on bank health is positive and significant, indicating that a decline in the health of the main bank reduces the export to sales ratio.

VI. Economic Significance

Thus far, we have been largely concerned with the statistical significance and robustness of our results, but we have given scant attention to the economic significance. Our results can be thought of as the partial effect of a financial shock to banks on exports

18. We did not define the maximum productivity at the more disaggregated four-digit level because in many years and many industries there would be only one exporting firm, leading to a relative productivity measure equal to 1.

through the trade finance channel. Nevertheless, it is useful to get a sense of the magnitudes of our estimated changes relative to the aggregate changes in exports.

To gauge the magnitude of the shocks, we need to have a plausible counterfactual for what export growth would have been without the financial crisis. To do this, we assume that in the absence of a crisis, export growth in 1991 and 1993 would have been the same average growth rate in 1989 and 1990 (i.e., 10% a year). Similarly, we assume exports in 1998 would have grown at the same rate as the average in 1996 and 1997 (also 10% a year). This methodology suggests that Japanese export growth was 8 percentage points below its recent historic rate in 1991, 17 percentage points below this rate in 1993, and 14 percentage points below the rate of 1995–1997 in 1998.

Our next task is to assess the impact of the banking crisis on these growth rates. In order to do this we use the coefficients from Table VI column (3) (asymmetric effects) and multiply the coefficient on lagged market-to-book value by the movement in that variable for each firm's bank. We then weight each growth rate by the share of that firm's exports in total exports in our data. This exercise indicates that the partial effect of bank share price declines can account for 46% of the drop in export growth in 1991, 22% in 1993, and 34% in 1998. If we use the coefficients from Table VI column (1) (crisis interactions) we obtain quite similar results: 56% in 1991, 30% in 1993, and 46% in 1998. Finally, if we use the coefficients from Table VI column (5) (air interactions), the results are a little more muted — 35% (1991), 20% (1993), and 31% (1998) — but we still find that the partial effect of financial shocks accounts for 20–35% of the decline in exports. Thus, it appears that the partial impacts of financial shocks on exports is on the order of 20–50% of the observed deviation of export growth from its trend in the early period.

Alternatively, we can use the results from Table VI column (2) to assess the impact of the 2008–2009 crisis on Japanese exports using a benchmark growth rate of 12% for 2005 and 2006. Japanese export growth was 28 and 29 percentage points below the average rate in 2005 and 2006 in the first 2 years of the recent crisis. The partial effect that we identify in our article can account for 19% and 20% of this decline, which is in line with the earlier results. In other words, although macroeconomic factors obviously played an important role as well, our results indicate that the partial effect of trade finance on exports identi-

fied herein are quantitatively large even relative to the aggregate declines.

VII. Conclusion

Traditional macro and trade models have not been able to explain why exports fall so much faster than domestic output during financial crises. This has created a puzzle regarding why exports might respond to financial crises differently than domestic output. We address this question by first providing a number of arguments explaining why one might expect exports to be more sensitive to financial sector shocks than domestic sales. In particular, the greater credit default risks and longer time lags associated with international trade make exporters more dependent on financing for their exports than for their domestic sales.

Our main contribution is that we test these hypotheses using matched bank-firm data that enable us to identify the transmission mechanism from the banks that supply firms with trade finance to the export behavior of those firms, thus overcoming the measurement and endogeneity issues that have plagued previous studies. Our article is the first to establish a causal link from shocks in the financial sector to exporters that result in exports declining much faster than output during banking crises. Moreover, we show that these effects are smaller for multinationals and firms that export mostly by air, which is precisely the type of heterogeneity that one would expect if trade finance were driving the results.

Finally, we also demonstrate that the drops in exports due to financial factors are typically at least 20% as large as the aggregate drops in Japanese exports in crisis years. Since the evidence indicates that exporters in many countries are highly dependent on trade finance, these results suggest that financial shocks are likely to play important roles in export declines in other countries as well.

Our results have a number of implications for future research. First, they point to important links between the often separate fields of international trade and international finance. In addition, the important connections between exporters and their financiers may have particular relevance for countries that often suffer from financial crises. For example, the differences in the behavior of multinationals and air versus. sea shippers may ultimately help us understand why some countries experienced much steeper declines in their exports than others.

APPENDIX: VALIDITY OF INSTRUMENTAL VARIABLES APPROACH

To keep the notation simple, we suppress all of the exogenous variables and firm and bank subscripts. Suppose that we can write the log change in exports, ΔE as:

$$\Delta E = \alpha \Delta S + \theta Z + \xi, \tag{2}$$

where ΔS is the change in firm health, Z is a set of exogenous variables that affect exports, Greek letters are parameters to be estimated, and ξ is an error term. We next postulate that the change in bank health ΔM is correlated with the change in firm health, so we can write:

$$\Delta M = \beta \Delta S + \lambda Z + \eta. \tag{3}$$

We assume that the η and ξ are uncorrelated, so that the only reason that exports and bank health are correlated (after controlling for all the variables in Equation [2]) is that they both are correlated with firm health.

Clearly η will be correlated with ΔM if that bank and firm health are not perfectly correlated. This establishes the residual from a regression of bank health on firm health as a potential instrument. The next step is to establish the instrument's validity. We can rewrite Equation (3) as

$$\Delta S = \frac{\Delta M - \lambda Z - \eta}{\beta} \tag{4}$$

and Equation (2) as

$$\Delta E = \frac{\alpha(\Delta M - \lambda Z - \eta)}{\beta} + \theta Z + \xi \tag{5}$$

or

$$\Delta E = \frac{\alpha \Delta M}{\beta} + \left(\theta - \frac{\lambda}{\beta}\right) Z + \left(\xi - \frac{\eta}{\beta}\right). \tag{6}$$

To test the validity of our instrument we need to demonstrate that our estimate of α/β will equal 0 under the hypothesis that bank health does not independently affect exports. If we use instrumental variables to obtain an estimate of the coefficient on bank health, the probability limit of the coefficient can be written as

$$p \lim \left(\frac{\widehat{\alpha}}{\beta}\right) = \frac{\text{cov}(\eta, \Delta E)}{\text{cov}(\eta, \Delta M)}. \tag{7}$$

By Equation (3), the denominator of this expression can be written as var(η). By Equations (2) and (3) the numerator can be written as cov (η, ξ) = 0, which establishes the validity of the instrument.

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