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ABSTRACT

A striking feature of many financial crises is the collapse of exports relative to output. In the 2008 financial crisis, real world exports plunged 17 percent while GDP fell 5 percent. This paper examines whether deteriorations in bank health can help explain the large drops in exports relative to output in the recent crisis. Our paper 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.

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1. Introduction

One of the most striking features of the financial crisis of 2008 was the collapse in international trade. Figure 1 plots the ratio of real world exports to real gross domestic product for a sample of the largest economies in the world.¹ As this plot shows, the decline in world exports was much greater than the decline in world GDP. Between the first quarter of 2008 and the first quarter of 2009, the real value of GDP fell 4.6 percent while exports plunged 17 percent, which amounts to a decline of \$761 billion in nominal terms.

This trade collapse 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), Chor and Manova (2010), Haddad et al (2010), and OECD (2009)). While Eaton et al (2010) argue that demand shocks can explain 80 percent of the aggregate decline, these authors find that for China and Japan, which account for 15 percent of world exports, demand shocks only explained 8 to 23 percent of the spectacular declines in their export to GDP ratios. Our paper 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. Indeed, we are the first paper to show a link between the exports of firms and the health of institutions that provide them with finance. Importantly, we also demonstrate that the health of banks providing finance has a much larger effect on exports than on domestic sales, thus establishing that financial shocks affect exports and domestic sales differently.

¹ We used the set of countries that report quarterly seasonally adjusted export and GDP data from national sources. These countries are Australia, Belgium, Canada, France, Germany, Hong Kong, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, Taiwan, the United Kingdom, and the United States. Jointly, they accounted for 66 percent of world GDP and 68 percent of world exports in 2008.

In order to understand how financial shocks get transmitted to exporters, Japan is a particularly interesting case to study because the collapse of Lehman had an immediate impact on several Japanese banks. For instance, Aozora and Mizuho were two of the five largest unsecured creditors to Lehman and had a combined exposure of close to \$1 billion according to the Lehman bankruptcy filing (US Bankruptcy Court (2008)). Japan is also unique in providing detailed data that enables us to match banks with firms so that we can trace how financial shocks are transmitted to the real sector not just in the current crisis but also in the past Japanese financial crises of the 1990s. Moreover, since the collapse in real estate prices in the early 1990s was not accompanied by a global demand shock, we can also estimate our model over time periods where we can be certain that global demand shocks were not a major concern for Japanese exporters.

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 no impact on the exports of firms with foreign affiliates (where default risk is not an issue) or 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).

The need for exporters to hedge against credit default risk and obtain working capital financing has resulted in a system in which virtually every exporter works with a bank or other financial institution to obtain credit or export guarantees.² We will henceforth refer to this nexus of financial arrangements as *trade finance* – that is, the use of financial intermediaries to manage an exporter’s trade credit default risk and terms. The fact that exporters depend so heavily on financial institutions for working capital and risk insurance suggests that if a credit crunch causes banks to limit trade finance, exports are likely to be affected more than domestic sales. Indeed, our results show that a decline in bank health hits firms’ exports 7 times harder than their 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, while 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 paper 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, and 2005) were able to document that when Japanese banks became unhealthy in the 1990s, they lent less in the US and that 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

² For example, Feenstra et al (2010) show that Chinese exporters are more credit constrained than non-exporters.

deteriorations in bank health or increases in the cost of raising capital cause banks to contract lending. Similarly, 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 makes 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 papers 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)). While 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, firm financing decisions are likely affected by expectations of changes in cash flow, and cash flows are positively correlated with exports. Finally, and most seriously, is the deeper problem arising from the fact that trade finance can cause trade credit to rise or fall.³

³ 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

We can see the impacts of trade finance on trade credit by considering the most common form of trade finance: the letter of credit. Since a letter of credit stipulates that a bank, and not the exporter, bears the importer's default risk, making letters of credit more accessible would reduce the transaction risk for exporters. The resulting reduction in risk would make exporters more willing to accept orders and therefore accept trade credits on their balance sheets. This channel provides a mechanism through which an increase in the supply of letters of credit could serve to increase the amount of trade credit. However, letters of credit also typically contain an export working-capital loan that specifies that the exporter will be paid when the goods are shipped as opposed to the usual 30 to 90 days after the goods arrive. The fact that letters of credit result in exporters getting paid earlier means that exporters can remove trade credits from the accounts receivable portion of their balance sheets faster thereby reducing the stock of trade credit.⁴ Thus, even if one believes that trade finance is important, it is not clear whether one should expect increased availability of trade finance to increase or decrease trade credit.

As a result of the complexities involved in measuring fluctuations in the availability of trade finance, much of the international trade literature has followed Kletzer and Bardhan (1987), who have examined how long-term access to external finance affects comparative advantage. This work does not focus on high-frequency shocks to the supply of trade finance *per se* but rather on the more general supply of external finance to firms. Chaney (2005) develops a model

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 that 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. In order to avoid confusing these two senses of *trade credit*, we will 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.

⁴ Similarly, "export factoring" (selling a discounted bill, corresponding to the export account receivable to a financial institution) and "forfeiting" (selling medium- to long-term receivables to a financial institution at a discount) are other major forms of trade finance that also have ambiguous effects on trade credit, depending on whether the insurance or the working-capital loan effects dominate. These forces are further complicated by the fact that risk premiums and borrowing costs may vary widely across countries, time, and industries, making it very difficult to assess whether firms with higher or lower levels of trade credit on their balance sheet have better or worse access to trade finance.

in which firms are liquidity constrained and must pay a fixed cost in order to export. As a result, there will be suboptimal entry into the export market. Manova (2008) provides compelling evidence that capital market liberalizations enable export sectors with needs for greater external capital to expand over the long run. Both papers are important in understanding why financing might matter for exporters who require external capital funds to cover fixed costs or other long-term needs, but neither paper addresses the impact of financial shocks on firms that are already engaged in exporting. More recently, Bricogne et al. (2009) use industry measures of external credit dependence to show that French exporters in sectors that were more dependent on external finance tended to contract more in the current crisis than those that were less dependent on external finance. This work is suggestive of a possible link between financial shocks and trade but leaves open the questions of whether external credit usage is endogenous, whether there was a distinct trade finance channel, and indeed whether the exports of these firms behaved differently from their domestic sales, the question at the center of our work.

The structure of the remainder of the paper is as follows: In section 2, we discuss why exporters use trade finance. Section 3 describes how the supply of trade finance can affect exporters. Section 4 discusses some basic facts about the Japanese financial crises. Section 5 describes our data. Section 6 then presents the Japanese firm-level evidence. Section 7 provides robustness checks. Section 8 discusses the economic significance of our results and section 9 concludes.

2. Why Might Trade Finance Matter?

Trade finance encompasses a series of payment methods for exporters and importers that govern the timing and security of payments. 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)). As Bekaert and Hodrick (2008) explain:

Shipping goods across a country as large as the United States poses many complex logistical and financial problems. Shipping goods across international borders creates a host of additional complications... Either the exporter or the importer must engage in some method of financing because the goods cannot be sold immediately after production. When the shipment and sale of goods occur within a single country, there is a common jurisdiction and system of courts that adjudicates contractual disputes between buyers and sellers. When goods are shipped across borders, though, additional legal complexities arise. One such complexity relates to collecting on delinquent accounts.... p. 650.

The letter of credit is the oldest and simplest means of dealing with exporters' special working capital and default insurance needs. Letters of Credit make up about 40 percent of all trade finance contracts (IMF-BAFT 2009). 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 – e.g. price, quantity, delivery terms, payment terms etc. 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 upon 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 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.⁵ 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 and also 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 bills bought" on its balance sheet.⁶ 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 that the banker's acceptance matures.

Banks need to raise funds from external markets at various times during this cycle. For example, the advising bank needs to raise funds to cover the working capital loan whose only collateral is the letter of credit and the exporter's ability to successfully produce and ship the goods. After the goods ship and the advising bank is repaid on the working capital loan, the bank also needs to raise money to cover the cost of payment to the exporter using the banker's acceptance as collateral. Very often it accomplishes this by selling the issuing bank's "banker's acceptance" to other investors.

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 terms of the letter of credit, 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 paper focuses on the third type of problem, i.e. the exporter's bank refusing to extend working capital loans or purchase bankers' acceptances.

⁵ According to a joint International Monetary Fund–Bankers' Association of Finance and Trade survey, in the fourth quarter of 2007 only 19 percent of all international trade transactions were done on a cash-in-advance basis.

⁶ In US accounting, the bank will record a "banker's acceptance."

As Bekaert and Hodrick (2008) argue, one reason why exporters use trade finance is that international trade takes significantly more time to execute than domestic trade. 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 Hummels's (2001) estimate that the typical good imported into the US by sea spends 20 days on a vessel, we can see that it is not uncommon for goods to spend approximately two months in transit. Even in OECD countries, which have the most streamlined procedures, it takes 11 days for a good to reach a port or arrive from a port. 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.

Indeed, the available data suggest that trade finance is extremely important and commonplace as a means of reducing counterparty risk and of securing working-capital funds. Although measurement problems have caused many countries to stop collecting trade finance data, the best evidence, which is based on the 2004 Joint BIS-IMF-OECD-World Bank Statistics on External Debt, suggests that 90 percent of trade transactions involve some form of credit, insurance, or guarantee issued by a bank or other financial institution (Auboin (2007)). It is therefore not surprising that in the Lehman bankruptcy six of the thirty largest unsecured claims against Lehman were letters of credit (US Bankruptcy Court (2008)). Indeed, given that about 80

percent of the providers of trade finance are private banks (Auboin 2009), there are many channels through which the troubles of banks can affect trade flows.⁷

3. The Trade Finance Transmission Channel

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. And 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, since exports are much more dependent on finance than domestic sales for the reasons outlined above, exports are likely to be harder hit by financial shocks. This suggests the existence of a "financial accelerator" for exports akin to that described in Bernanke, Gertler, and Gilchrist (1999) because the initial shocks to the macro economy, in this case in the real estate sector, are amplified and passed on to the rest of the economy through the financial market.

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 this could be seen in the jump in interbank borrowing rates charged to Japanese banks relative to foreign

⁷ Financial innovation played a big role in non-banks like AIG moving into the trade finance arena by writing export credit default insurance to replace the insurance supplied by the issuing banks. These credit default guarantees enable the exporter to sell its trade credits to other financial institutions. This helps explain why export credit insurance is such an enormous business. For example, according to the Berne Union, the leading association of export credit insurance providers, its members had an export credit default insurance exposure of \$1.4 trillion in 2008 (Source, <http://www.berneunion.org.uk/bu-total-data.html>).

institutions (the so-called “Japan Premium”). Similarly, in the 2008 crisis, the standard measure of the risk premium charged to banks (the difference between interbank offer rates charged to banks and the overnight indexed swap rate (OIS)) jumped sharply reflecting higher bank borrowing costs.

Second, liquidity may dry up and banks may simply be unable to borrow and extend sufficient credit. For example the Bank of Japan (1998) noted that in the midst of the 1998 crisis, “lending attitudes of financial institutions, however, are becoming increasingly cautious as capital adequacy constraints have become more binding.” While we don’t know how much of the deterioration in bank capital resulted in higher premiums charged for trade finance in Japan in 1998, there is clear evidence that this happened in the more recent 2008 crisis. An IMF-BAFT Survey (2009) of 88 banks in 44 countries revealed that the average spreads on letters of credit, export credit insurance, and short- to medium-term trade-related lending rose by 70, 107, and 99 basis points respectively in the second quarter of 2009 relative to the fourth quarter of 2007. Probably part of this reflected greater trade finance default rates during the crisis. Jones (2010) reports that the loss ratio for trade credit insurance (i.e. the ratio of claims to gross premiums paid in) doubled from their historic levels in 2008 so that the average insurer was paying out 85 cents in default insurance for every dollar entering the firm. These 100 basis point jumps in the trade finance spreads are particularly striking given that the typical spread on a letter of credit is 10–16 basis points (see Auboin (2009)). The IMF survey also revealed that 57 percent of banks believed that part of the decline in trade finance transactions was caused by a tightening of credit availability at their own institution. The deteriorations in the financial health (or outright bankruptcy) of major players in the trade finance world like Lehman, AIG, CIT Group, Citigroup, Bank of America, and Wells Fargo may have made it difficult for these banks to raise money to

finance their export clients' trade credit default risk. The simultaneous collapse in the commercial paper market may have left exporters with few options other than cutting exports if their trade finance providers ran into trouble.

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 more on banks for their exports than for their domestic sales. As a consequence, financial crises are likely to affect exports more negatively than domestic sales. In order to examine this relationship, we first present an overview of the Japanese financial crises and then turn to the firm-level evidence to identify the connection between exports and the financial market.

4. The Japanese Financial Crises

There are a number of reasons why Japan provides an ideal case for examining the impact of financial crises on exports. First, as the fourth largest exporter in the world, what happens in Japan has a large impact on the global economy. Second, the frequency of financial crises in Japan over the last twenty years provides us with several events to study.⁸ Although not global in scope, the major driving forces behind the crises in the earlier periods were also real estate and stock market bubbles. In Japan, stock prices peaked in December 1989, and real estate prices in Tokyo peaked in the same year. Japanese bank stock prices fell sharply in late 1991 and early 1992 as it was determined that commercial banks would end up absorbing a disproportionate share of the losses suffered by the specialized mortgage lending companies that some of these banks had founded. By 1995, Japanese stock prices had fallen 49 percent from

⁸ The details of Japan's financial crises have been extensively examined elsewhere (see Hoshi and Kashyap (2001) for an excellent discussion), so we will highlight only a few of the relevant details here.

their peak, and commercial and residential real estate prices in the six largest cities of Japan had fallen 60 and 44 percent, respectively. This drop had heterogeneous effects on financial institutions: Japanese banks that had lent heavily in the real estate sectors – the Long-Term Credit Bank (LTCB) and Nippon Credit Bank, for example – were particularly hard hit by a sudden rise in nonperforming real estate loans coupled with big losses in their equity portfolios. Similarly, banks with long-term liabilities suffered heavy losses as Japanese interest rates fell.

Initially, the disclosure of nonperforming loans and other losses was highly imperfect, but bank analysts soon began to realize that many Japanese financial institutions were insolvent. This information became much more public with the emergence of the “Japan premium” in the mid-1990s, which reflected the unwillingness of investors to extend short-term credit to Japanese banks unless the banks paid a substantial risk premium. Hoshi and Kashyap (2001) succinctly describe what happened next:

Slowing growth in 1997 uncovered more bad loans, and in November 1997 a crisis erupted. On 3 November, Sanyo Securities, a mid-sized securities firm famous for having the world’s largest trading floor during the speculative frenzy of the late 1980s, suspended part of its operations and filed for bankruptcy protection. This was the first postwar default in the overnight interbank loan market, a shocking event. Then Hokkaido Takushoku Bank...was no longer able to secure funding in the interbank market. It was forced to close on 17 November, marking the first failure of a major bank in postwar Japan. A week later, on 24 November, Yamaichi Securities, one of the Big Four security houses, collapsed following rumors (which subsequently proved true) that it had suffered huge losses. (p. 276)

Interbank overnight loan rates in Japan skyrocketed, with the Japan premium hitting 100 basis points, as Japan’s short-term credit markets seized up. These events closely mirrored the collapse in interbank liquidity markets in the US in late 2008. As Peek and Rosengren (2000, 2005) convincingly document, in the massive credit crunch that followed Japanese banks were

reluctant to provide new loans. With \$50 billion in bad loans, the LTCB, the ninth-largest bank in the world, had to be nationalized by the end of 1998 (Tett (2004) p. xi).

As the discussion has made clear, there are important similarities between Japan in the 1990s and the crisis of 2008. Both crises were initially caused by collapses in real estate prices that caused bad loans to spread from specialized mortgage lenders to banks and other financial institutions. In both, the proximate cause of the crises came from defaults in markets used by banks to secure short-term funds: Sanyo's default in the Tokyo interbank market in Japan and, more recently, Lehman's default in the money market. And, as we will document next, there was a dramatic decline in Japanese exports after each financial crisis.

5. 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 onwards. The unconsolidated data is richer, so we will only use the earlier data in some of the 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, and so we restart our sample in 2007.

The manufacturing exporters in our sample (ranging between 540 and 860 firms depending on the year), on average, accounted for 80 percent 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 percent of firms ending in March and 9 percent of firms ending in November or December. Figure 2 shows how well changes in exports of our sample of firms 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.

In order 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.⁹ 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

⁹ 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, The Dai-Ichi Kangyo Bank, The Daiwa Bank, The Fuji Bank, Hokkaido Takushoku Bank, Industrial Bank of Japan, Long Term Credit Bank of Japan, Saitama Bank, Sakura Bank, The Sanwa Bank, Sumitomo Bank, Taiyo-Kobe Bank, and The 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; The Bank of Tokyo merged with the Bank of Tokyo-Mitsubishi in 1996; The 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.

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 standard capital adequacy ratios, and we follow their suggested methodology.¹⁰ 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.¹¹ 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 will 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

¹⁰ 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]."

¹¹ 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.

collapse in the market value of a bank in one 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 of 1997 and March of 1998 was associated with slower growth in exports from fiscal year 1998 to fiscal year 1999.

Figure 3 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 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 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 5th and 8th largest unsecured creditors to Lehman, saw their stock prices plunge by 42 and 60 percent respectively between the end of August and the end of December, Resona Holdings, with little exposure, saw its stock price rise by 7 percent over the same period. In other words, the real estate crash in the 1990s and global financial crisis in 2008-9 did not affect all banks equally, leading to enormous differences in

bank performance. We will exploit this cross-bank variation in bank performance in our identification strategy.

Table 1 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 percent of the typical bank's lending is in the form of trade finance and no bank extends more than 9 percent of its credit in the form of trade finance. Given that the typical bank in our sample extends trade finance to over fifty firms in our sample (and many more firms that are 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 percent, and no firm in our sample accounted for more than 0.6 percent 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.

Although trade finance is a very small share of aggregate lending by our sample of banks, the volume of this lending 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 2 are in line with those in Peek and Rosengren (1995) showing that banks whose health declines cut back on lending.

In column 2 of table 2, 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 one percent decline in a

bank's market value is associated with 0.46 percent decline in trade finance, but only a 0.14 percent 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 that are 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 percent 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. In order 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 2 indicate that the exports of

client firms *within an industry* are positively correlated with trade finance provision of their banks. While this does not establish causality, table 2 makes clear that there is a link between bank health and trade finance as well as between trade finance and exports.

6. 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.¹²

Our basic estimating equation is:

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

where Exports_{ft} corresponds to the exports of firm f at time t , IND_{fit} is an indicator variable that is one if firm f is in industry i in time t , $\text{BANK}_{fb,t}$ is an indicator variable that is one 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

¹² The data divide manufacturing into over 100 sectors depending on the year, which comprise our industry dummies in the period 1987 to 1999. In the later period, the consolidated data use a different industry coding comprising 81 categories. All standard errors are clustered at the bank level.

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 3 presents the results from these regressions. We drop firms whose export growth is in the top and bottom one percentile.¹³ 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 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 percent decline in its market-to-book value, the firm's annual exports declined 2.7 percent relative to a firm whose bank's health did not decline.

In column 4 of table 3, 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 a two-period lagged change in market-to-book value has no effect on exports.¹⁴ 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.

¹³ Including these outliers tends to magnify the effect of bank health on exports.

¹⁴ The contemporaneous change in market-to-book value is also insignificant.

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. In order to test whether we have identified an export-specific effect or merely a general effect applicable to all sales, we replaced the dependent variable with the log change in domestic sales for the same sample of firms in column 5 of table 3. This sample includes all firms that exported at any time during the sample period – in 10 percent of the observations domestic sales account for 100 percent of the firm’s total sales and the median share of domestic sales in total sales is 70 percent. As the table shows, firms whose main bank became unhealthy tend to sell less in the domestic market, but the effect is much smaller than the effect on exports.¹⁵ The results in columns 3 and 5 indicate that the decline in the health of the bank providing trade finance causes exports to decline about 7 times more than domestic sales. This indicates that declines in bank health are associated not only with declines in the supply of trade finance to firms, but also with exports by client firms. In column 6, we replace the dependent variable with the log change in the ratio of exports to domestic sales. The results clearly show that the export to domestic sales ratios of firms fell after the health of banks supplying trade finance declined. 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. Column 6 in table 3 suggests that it is highly unlikely that our results are being driven by reverse

¹⁵ We dropped observations where domestic sales growth is in the top and bottom one percentile. Including these outliers leads to an insignificant positive effect of bank health on domestic sales.

causality as it seems hard to argue that the health of a bank is systematically related to changes in a borrower's export to domestic sales ratio.

Nevertheless, in table 4 we implement a number of additional robustness checks to show that endogeneity is not driving the results. One such 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 4 and show that the coefficient on the market-to-book value remains unchanged. This 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 that is 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. Similarly, one may worry that the 2008 financial crisis was driven by anticipated declines in Japanese export opportunities that also affected banks. To ensure this is not driving our results, we 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.

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. We have already seen from the summary statistics that our sample of banks only had trivial levels of loan exposure to the firms in this sample, so it is unlikely that movements in client borrowing would dramatically affect a bank's profits. However, one could imagine a correlation arising from a number of different sources. For example, future exports might be correlated with the probability of a firm loan default and hence bankruptcy.¹⁶ Alternatively, since banks may own up to 5 percent 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. In order to make sure that 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.¹⁷ 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

¹⁶ 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 percent per year over our sample period (see Xu and Zhang (2009)). This, coupled with the fact that these banks had very little loan exposure to any firm in the sample, suggests that it is highly unlikely that defaults by exporters, in general the most profitable firms in the market, should be driving our results.

¹⁷ 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.

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 4 of table 4, 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.¹⁸ In column 5, 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.

7. Robustness

In table 5, 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. In order 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 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 5, we identify the main bank as the city bank providing the largest loan to each exporter.¹⁹ Then, in column 2 of table 5, 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 early sample of banks

¹⁸ Similarly, including the exporter's share price as an independent variable in equation 1 does not qualitatively affect the bank health coefficient.

¹⁹ The matched bank-firm lending data is unavailable for the latter period thus this robustness check only includes the sample from 1987 to 1999. In the earlier sample, 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.

from 15 to 43 and in later years from 5 to 28. 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.

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 5 as the average of the market-to-book value in the last three 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 5).

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.²⁰ In order to test for this effect,

²⁰ 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 examine carefully the risk of the exporter, the importer, the purchaser's financial institutions, and the reasons why 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.

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), and 2008 and 2009. As one can see from column 1 of table 6, 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.

A second concern might be that the lessons from earlier Japanese crises might not be applicable to the current crisis either because the epicenter of the crisis was abroad or because of the global demand shocks hitting the Japanese economy. In order to test if the "Lehman Shock" was different, we reran our estimation using only data from 2007. The coefficient estimates reported in column 2 of table 6 are quite similar to what we observed earlier. Clients of banks that became unhealthy exported less than those of healthier institutions.

Thus far, we have been arguing that there are two principle reasons why firms use trade finance: international trade takes longer than domestic trade and international trade involves greater risk. We now turn to investigating these two links. Since Japan is an island, Japanese firms export goods either by air or sea. Since 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.²¹ We generated an air dummy variable that equaled one if a firm was in a sector in which more than 50 percent of the value of exports was shipped by air. In column 3 of table 6, 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. 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. Since approximately half of the firms in our sample have foreign affiliates, we split the sample according to whether a firm has foreign affiliates and re-estimate our basic equation. In columns 4 and 5 of table 6, we show that exporters that transact with foreign affiliates (and therefore face no default risk on these transactions) do not experience export declines when their banks run into trouble. However, there are powerful effects for firms engaged exclusively in arms length transactions, presumably because they need the risk insurance provided by their financial institutions. These results indicate that trade finance matters principally for firms whose goods remain in transit for long periods and face trade credit default risk.

In table 7, 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), and Hoshi and Kashyap (2001)). In order to show this in our data, we define “switchers” as firms that change their main banks when not forced by a

²¹ 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 matched this with the industry definitions in the DBJ database.

bank merger. The mergers between 2000 and 2005 dramatically reduced the number of Japanese banks resulting in only 1 percent of firms switching banks between 2007 and 2010, but even in the earlier period only 8 percent of our sample of firms 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 7. 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 zero. 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 zero. The results in column 2 of table 7 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, since 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 that 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.²² 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 probit. The results of this selection equation (see the bottom of column 3 in table 7) indicate that the probability of exporting 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 3. 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

²² 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. Value added per worker data was unavailable for the consolidated exporters in the later period.

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.

8. 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 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. As figure 2 illustrates, the banking crisis of 2008-9 coincided with a substantial decline in Japanese exports. The median market-to-book ratio for our sample of Japanese banks fell 0.53 log units between March of 2007 and March of 2008 and another 0.76 log units between March of 2008 and March of 2009. Those declines were followed by very sharp drops in Japanese exports. Japanese exports fell 18 percent in FY2008 (which ended in March of 2009) and 19 percent in FY 2009. If we multiply the log change in median bank's market-to-book values by the estimated impact of bank health in column 4 of table 4, gives us an implied reduction in exports due to financial shocks of 4 percent in the early period and 6 percent – about one-quarter of the aggregate drop in exports. Although macroeconomic factors obviously played an important role as well, our results indicate that the partial effect of trade finance on exports identified in this paper are quantitatively large even relative to the aggregate decline.

9. 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.

The main contribution of our paper 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 paper 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 quantitatively large relative to 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 vs. sea shippers may ultimately help us to understand why some countries experienced much steeper declines in their exports than others. Finally, our estimates also provide strong support for an international financial accelerator that helps explain how financial shocks affect the real sector and are propagated internationally.

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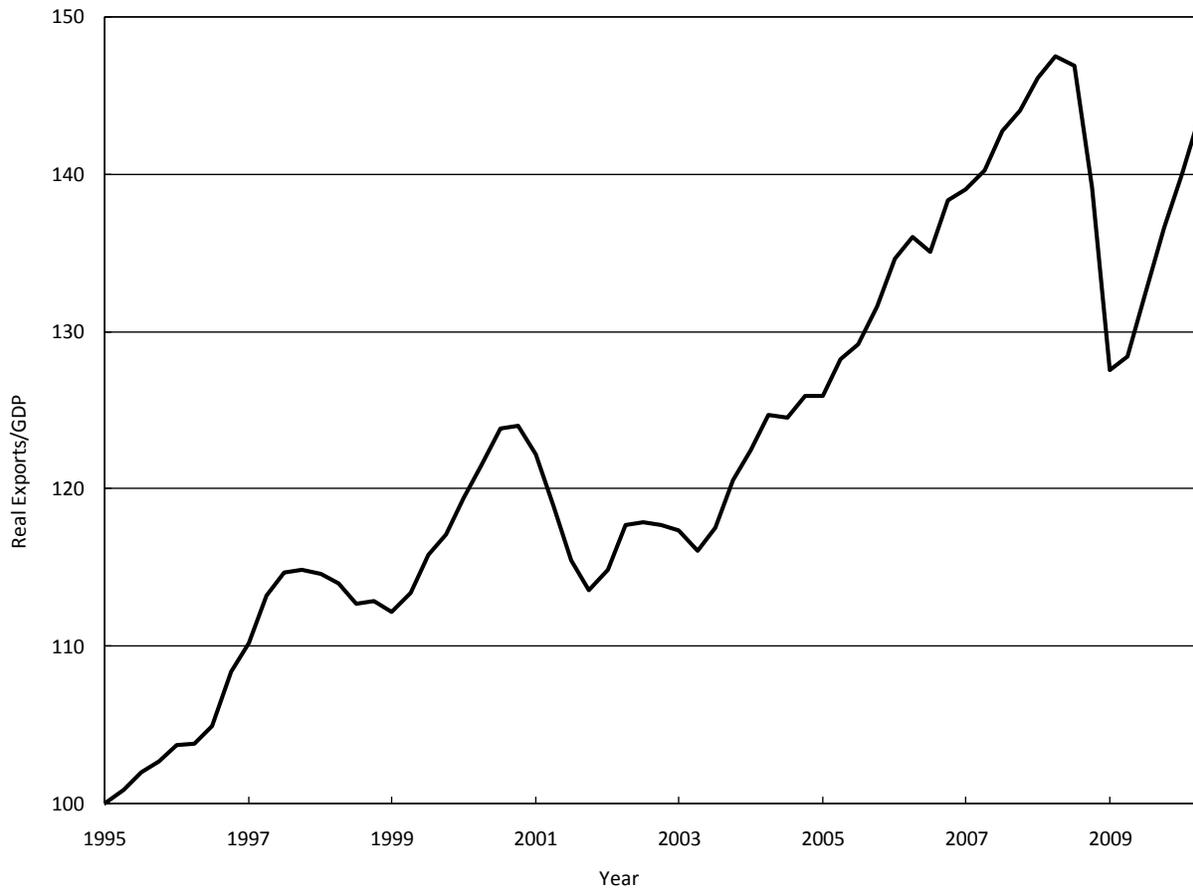
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Figure 1

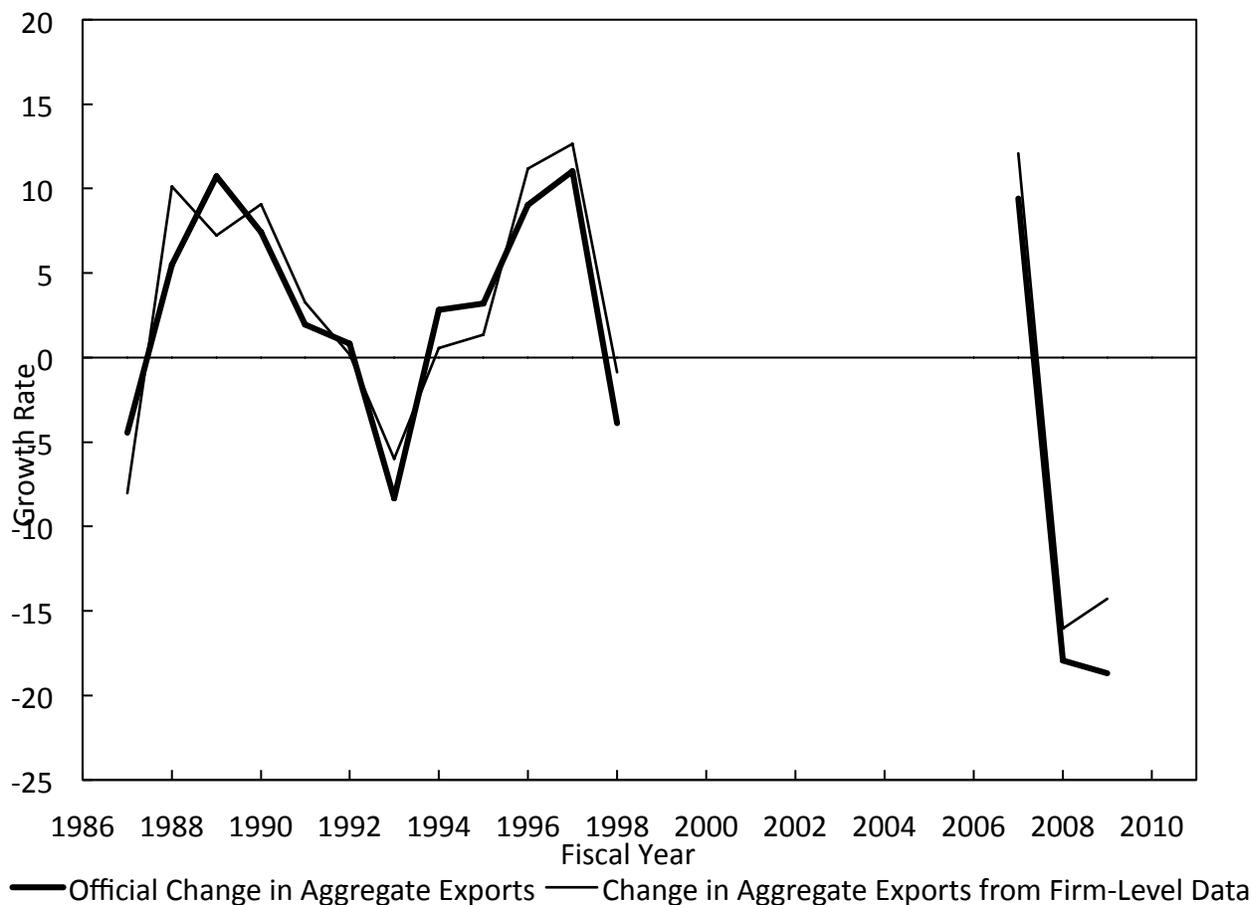
Quarterly Movements in the Ratio of World Exports to GDP, 1995–2009



Source: This figure was constructed using national sources: *Australia*, Australian Bureau of Statistics; *Belgium*, the Banque Nationale de Belgique; *Canada*, Statistics Canada; *France*, National Institute of Statistics and Economic Studies; *Germany*, Deutsche Bundesbank; *Hong Kong*, Hong Kong Census and Statistics Department; *Italy*, Istituto Nazionale di Statistica; *Japan*, Cabinet Office; *Netherlands*, Centraal Bureau voor de Statistiek; *Norway*, Statistik Sentralbyra; *Spain*, Instituto Nacional de Estadística; *Sweden*, Statistiska Centralbyran; *Switzerland*, State Secretariat for Economic Affairs; *Taiwan*, Directorate General of Budget, Accounting and Statistics; *United Kingdom*, Office of National Statistics; and *United States*, Bureau of Economic Analysis.

Figure 2

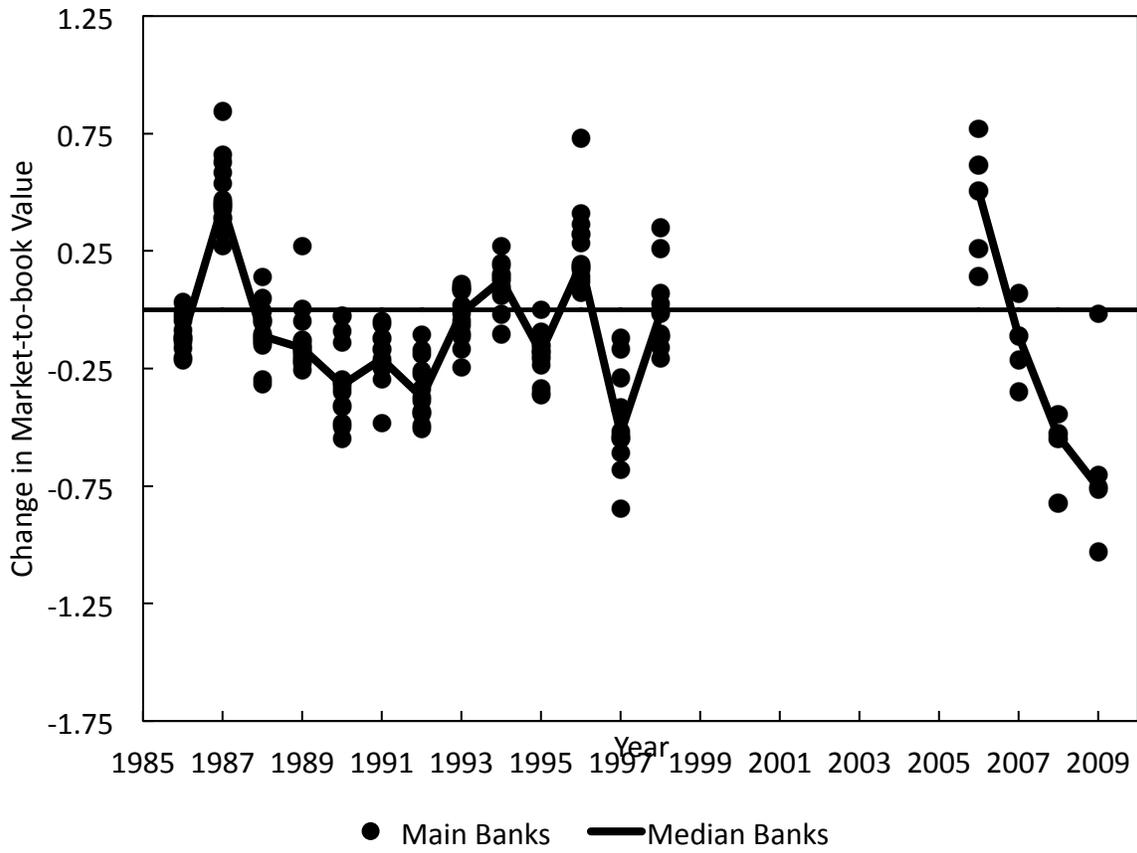
Firm-Level and Aggregate Export Growth in Japan, 1987–2009



Source: Firm-level data is from the Development Bank of Japan database of unconsolidated corporate reports. 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).

Figure 3

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



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

Table 1: Summary Statistics

| | N | mean | median | sd | min | max |
|---------------------------------------------------------|-------|--------|---------|--------|---------|--------|
| By banks | | | | | | |
| $\ln(\text{foreign bills bought})_{b,t}$ | 200 | 12.017 | 12.330 | 1.131 | 5.011 | 13.661 |
| $\Delta \ln(\text{foreign bills bought})_{b,t}$ | 200 | -0.071 | -0.076 | 0.189 | -0.555 | 0.483 |
| $\ln(\text{totloans})_{b,t}$ | 200 | 16.745 | 16.817 | 0.613 | 15.298 | 18.117 |
| $(\text{foreign bills}/\text{totloans})_{b,t}$ | 200 | 0.013 | 0.009 | 0.013 | 0.000 | 0.088 |
| $\ln(\text{foreign bills}/\text{totloans})_{bt}$ | 200 | -4.728 | -4.689 | 0.972 | -10.447 | -2.426 |
| $\ln(\text{market-to-book value})_{b,t-1}$ | 200 | 1.296 | 1.348 | 0.551 | -0.426 | 2.612 |
| $\Delta \ln(\text{market-to-book value})_{b,t-1}$ | 182 | -0.034 | -0.105 | 0.311 | -0.844 | 1.050 |
| By firms | | | | | | |
| Number of firms _t | 8,679 | 661 | 644 | 78 | 539 | 858 |
| $\Delta \ln(\text{exports})_{ft}$ | 8,679 | -0.009 | 0.009 | 0.254 | -1.232 | 0.949 |
| $\Delta \ln(\text{domestic sales})_{ft}$ | 8,553 | -0.012 | 0.002 | 0.128 | -0.825 | 0.378 |
| $\Delta \ln(\text{exports}/\text{domestic sales})_{ft}$ | 8,553 | 0.005 | 0.014 | 0.255 | -1.348 | 1.189 |
| $\Delta \ln(\text{market-to-value})_{f,t-1}$ | 8,679 | -0.160 | -0.151 | 0.339 | -1.261 | 1.112 |
| $\Delta \ln(\text{assets})_{f,t-1}$ | 8,415 | 0.025 | 0.019 | 0.109 | -1.027 | 1.000 |
| $\Delta(\text{profits})_{f,t-1}$ | 8,292 | -0.004 | -0.001 | 0.026 | -0.162 | 0.118 |
| $\Delta \ln(\text{share price})_{f,t-1}$ | 8,289 | -0.064 | -0.051 | 0.287 | -0.870 | 0.730 |
| Total loan _{fbt} /Total loan _{bt} | 5,523 | 0.0001 | 0.00004 | 0.0002 | 0 | 0.006 |

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

Table 2: Associations between Bank Health, Trade Finance, and Exports

| Dependent variable | $\ln(\text{totloans})_{b,t}$ | $\ln(\text{foreign bills bought})_{b,t}$ | $\ln(\text{bills/totloans})_{b,t}$ | $\Delta \ln(\text{exports})_{b,t}$ | $\Delta \ln(\text{exports})_{bi,t}$ |
|-----------------------------------------------|------------------------------|------------------------------------------|------------------------------------|------------------------------------|-------------------------------------|
| | (1) | (2) | (3) | By bank (4) | By bank/industry (5) |
| $\ln(\text{market-to-book value})_{b,t-1}$ | 0.143*** (0.054) | 0.457*** (0.142) | 0.313** (0.137) | | |
| $\Delta \ln(\text{trade finance loan})_{b,t}$ | | | | 0.143*** (0.057) | 0.087*** (0.018) |
| Fixed effects: | | | | | |
| Year | Yes | Yes | Yes | Yes | Yes |
| Bank | Yes | Yes | Yes | Yes | Yes |
| Industry | No | No | No | No | Yes |
| Observations | 197 | 197 | 197 | 164 | 3,043 |
| Adjusted R ² | 0.96 | 0.96 | 0.82 | 0.32 | 0.20 |

Notes: Robust standard errors are in parentheses. ***Significant at the 1 percent level. **Significant at the 5 percent level. Columns 1 to 3 include the 15 city banks in our sample: Asahi Bank, Bank of Tokyo, Bank of Tokyo Mitsubishi, The Dai-Ichi Kangyo Bank, The Daiwa Bank, The Fuji Bank, Hokkaido Takushoku Bank, Industrial Bank of Japan, Long Term Credit Bank of Japan, Saitama Bank, Sakura Bank, The Sanwa Bank, Sumitomo Bank, Taiyo-Kobe Bank, and The Tokai Bank. In the later period the city banks comprise Mizuho Financial Group, MUFJ Financial Group, Sumitomo-Mitsui Financial Group, Resona Holdings, and Shinsei. 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 merges 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.

Table 3: Exports and Trade Finance

| Dependent variable | $\Delta \ln(\text{exports})_{f,t}$ | | | | $\Delta \ln(\text{domestic sales})_{f,t}$ | $\Delta \ln(\text{exports}/\text{domestic sales})_{f,t}$ |
|---------------------------------------------------|------------------------------------|---------------------|---------------------|---------------------|-------------------------------------------|----------------------------------------------------------|
| | (1) | (2) | (3) | (4) | | |
| | Lag MTB | | | | | |
| $\Delta \ln(\text{market-to-book value})_{f,t-1}$ | 0.068*** (0.013) | 0.073*** (0.016) | 0.080*** (0.017) | 0.081*** (0.017) | 0.012* (0.007) | 0.072*** (0.019) |
| $\Delta \ln(\text{market-to-book value})_{f,t-2}$ | | | | 0.008 (0.023) | | |
| Fixed effects: | | | | | | |
| Year-industry | no | yes | yes | yes | yes | yes |
| Year | yes | no | no | no | no | no |
| Bank | no | no | yes | yes | yes | yes |
| Observations | 8,679 | 8,679 | 8,679 | 8,417 | 9,755 | 8,553 |
| Adjusted R ² | 0.11 | 0.19 | 0.19 | 0.18 | 0.45 | 0.12 |

Notes: Robust standard errors corrected for clustering at the bank level are in parentheses. ***Significant at the 1 percent level. **Significant at the 5 percent level. We use 108 industry codes in the first period corresponding to the DBJ industry classification scheme and 81 codes in the latter period corresponding to the Nikkei system. In column 3 and all subsequent columns, the industry dummies are multiplied by each year dummy.

Table 4: Endogeneity

| Dependent variable | $\Delta \ln(\text{exports})_{f,t}$ | | | | $\Delta \ln(\text{exports}/\text{domestic sales})_{f,t}$ |
|------------------------------------------------------------|------------------------------------|----------------------------|---------------------------------------|------------------------------------------------|----------------------------------------------------------|
| | With lagged dependent variable | With lagged firms' profits | Pre-Asian crisis years (1987 to 1996) | IV Instrument adjusted for firms' share prices | IV Instrument adjusted for firms' share prices |
| | (1) | (2) | (3) | (4) | (5) |
| $\Delta \ln(\text{market-to-book value})_{f,t-1}$ | 0.079*** (0.018) | 0.080*** (0.019) | 0.076*** (0.029) | 0.073*** (0.016) | 0.068*** (0.019) |
| $\Delta \ln(\text{exports})_{f,t-1}$ | -0.052*** (0.016) | | | | |
| $\Delta \ln(\text{assets})_{f,t-1}$ | | 0.264*** (0.037) | | | |
| $\Delta(\text{profits})_{f,t-1}$ | | -0.072 (0.187) | | | |
| Fixed effects: | | | | | |
| Year-industry | yes | yes | yes | yes | yes |
| Bank | yes | yes | yes | yes | yes |
| First-stage: | | | | | |
| $\Delta \ln(\text{adjusted market-to-book value})_{f,t-1}$ | | | | 1.000*** (0.001) | 1.000*** (0.001) |
| F-stat | | | | 1.5e+06 | 1.40e+06 |
| Observations | 8,308 | 8,292 | 5,313 | 8,289 | 8,171 |
| Adjusted R ² | 0.19 | 0.20 | 0.15 | | |

Notes: Robust standard errors corrected for clustering at the bank level are in parentheses. ***Significant at the 1 percent level. **Significant at the 5 percent level. Profits are defined as the ratio of after-tax net income to total assets. The instrument in columns 4 and 5 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.

Table 5: Alternative Measures of Main Bank and Market Timing

| Dependent Variable: $\Delta \ln(\text{exports})_{f,t}$ | | | | |
|--------------------------------------------------------------------------|------------------------------------|---------------------|--------------------------------|----------------------------|
| | (1) | (2) | (3) | (4) |
| | Alternative bank matching Loans | All banks | MTB value: 3 months average | March accounting period |
| $\Delta \ln(\text{market-to-book value})_{f,t-1}$ | 0.072*** (0.016) | 0.067*** (0.014) | 0.056*** (0.019) | 0.049** (0.022) |
| Fixed effects: | | | | |
| Year-Industry | yes | yes | yes | yes |
| Bank | yes | yes | yes | yes |
| Observations | 6,702 | 8,702 | 8,592 | 7,441 |
| Adjusted R ² | 0.13 | 0.19 | 0.19 | 0.20 |

Notes: Robust standard errors corrected for clustering at the bank level are in parentheses. ***Significant at the 1 percent level. **Significant at the 5 percent 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. Note that this data was unavailable for the consolidated firms in the later period. 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.

Table 6: Heterogeneous Effects

| Dependent variable: $\Delta \ln(\text{exports})_{f,t}$ | | | | | |
|--------------------------------------------------------------------------|-----------------------|---------------------------|-------------------------|-------------------------------------|-------------------------------------------|
| | (1) | (2) | (3) | (4) | (5) |
| | Crisis interaction | Subsample 2008 to 2010 | With air interaction | Firms with foreign affiliates | Firms without foreign affiliates |
| $\Delta \ln(\text{market-to-book value})_{f,t-1}$ | 0.049** (0.025) | 0.091*** (0.034) | 0.105*** (0.021) | 0.010 (0.022) | 0.105*** (0.033) |
| $RZ_i * \Delta \ln(\text{market-to-book value})_{f,t-1}$ | | | | | |
| Crisis* $\Delta \ln(\text{market-to-book value})_{f,t-1}$ | 0.077*** (0.033) | | | | |
| Air* $\Delta \ln(\text{market-to-book value})_{f,t-1}$ | | | -0.126*** (0.040) | | |
| Fixed effects: | | | | | |
| Year-industry | Yes | Yes | Yes | Yes | Yes |
| Bank | Yes | Yes | Yes | Yes | Yes |
| Observations | 8,679 | 1,619 | 5,202 | 3,389 | 3,671 |
| Adjusted R ² | 0.19 | 0.28 | 0.14 | 0.18 | 0.12 |

Notes: Robust standard errors corrected for clustering at the bank level are in parentheses. ***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level. Crisis dummy equals 1 for years 1990, 1992, 1997, 2008, 2009. In column 3, the air dummy is defined as equal one if the share of trade exported by air is greater than 50 percent within that industry. Miscellaneous industries were dropped because of concordance difficulties. The concordance required to match the industrial data to the air/shipping data was only available for the earlier period. Similarly, information on foreign affiliates was unavailable for the consolidated data in the later period.

Table 7: Selection

| Dependent variable: | $\Delta \ln(\text{exports})_{f,t}$ | | | Percentage change in exports |
|---------------------------------------------------|------------------------------------|--------------------------------|----------------------|------------------------------|
| | (1) | (2) | (3) | (4) |
| | No bank switchers | Percentage change in MTB value | Heckman selection | Tobit (random effects) |
| $\Delta \ln(\text{market-to-book value})_{f,t-1}$ | 0.076*** (0.016) | 0.067*** (0.018) | 0.088*** (0.019) | 0.077*** (0.020) |
| Fixed effects: | | | | |
| Year-Industry | yes | yes | yes | no |
| Bank | yes | yes | yes | yes |
| year | no | no | no | yes |
| First stage | | | | |
| Relative value added per worker $_{f,t-1}$ | | | 0.353*** (0.068) | |
| $\Delta \ln(\text{market-to-book value})_{f,t-1}$ | | | -0.040 (0.108) | |
| Fixed effects: | | | | |
| Year | | | yes | |
| Bank | | | yes | |
| Inverse mills ratio | | | -2.018*** (0.587) | |
| Observations | 8,055 | 8,686 | 8,357 | 8,851 |
| R-squared | 0.19 | 0.19 | | 0.17 |

Notes: Robust standard errors corrected for clustering at the bank level are in parentheses. ***Significant at the 1 percent level. **Significant at the 5 percent level. In column 2, 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 1,297 censored observations and 7,060 uncensored observations in column 3. The random effects in the Tobit specification are at the industry level, and there are 172 left-censored observations.

Appendix

Validity of Instrumental Variables Approach

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

$$(A1) \quad \Delta E = \alpha \Delta S + \theta Z + \xi,$$

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 that we can write:

$$(A2) \quad \Delta M = \beta \Delta S + \lambda Z + \eta.$$

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 A1) 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 (A2) as

$$(A3) \quad \Delta S = \frac{\Delta M - \lambda Z - \eta}{\beta}$$

and equation (A1) as

$$(A3) \quad \Delta E = \frac{\alpha(\Delta M - \lambda Z - \eta)}{\beta} + \theta Z + \xi$$

or

$$(A4) \quad \Delta E = \frac{\alpha \Delta M}{\beta} + \left(\theta - \frac{\lambda}{\beta} \right) Z + \left(\xi - \frac{\eta}{\beta} \right)$$

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

$$(A5) \quad p \lim \begin{pmatrix} \hat{\alpha} \\ \hat{\beta} \end{pmatrix} = \frac{\text{cov}(\eta, \Delta E)}{\text{cov}(\eta, \Delta M)}$$

By (A2), the denominator of this expression can be written as $\text{var}(\eta)$. By (A1) and (A2) the numerator can be written as $\text{cov}(\eta, \xi) = 0$, which establishes the validity of the instrument.