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Collateral, Debt Capacity, and Corporate Investment: Evidence from a Natural Experiment

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Abstract

This paper examines how a shock to collateral value, caused by asset market fluctuations, influences the debt capacities and investments of firms. Using a source of exogenous variation in collateral value provided by the land market collapse in Japan, I find a large impact of collateral on the corporate investments of a large sample of manufacturing firms. For every 10 percent drop in collateral value, the investment rate of an average firm is reduced by 0.8 percentage point. Further, exploiting a unique data set of matched bank-firm lending, I provide direct evidence on the mechanism by which collateral affects investment. In particular, I show that collateral losses results in lower debt capacities: firms with greater collateral losses are less likely to sustain their banking relationships and, conditional on lending being renewed, they obtain a smaller amount of bank credit. Moreover, the collateral channel is independent of the contemporaneous influence of worsened bank financial conditions.

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I. Introduction

This paper investigates how a shock to collateral value, caused by asset market fluctuations, influences the debt capacities and investments of firms. It makes two contributions to the literature. First, using detailed data at both firm and loan levels, it identifies and quantifies, for the first time, the economy-wide impact of a large decline in the asset markets on firms' debt capacities and investment decisions. Second, it provides new evidence on whether and how financing frictions, inversely measured by the firms' abilities to collateralize, affect corporate investment. Overall, the evidence highlights the importance of external credit constraints in transmitting booms and busts in the asset markets, particularly the property market, to the real economy.

In recent years, asset markets around the world have experienced large swings in prices. As a result, there have been increasing concerns among academics and policy makers about the real consequences of asset market bubbles. A sizable theoretical literature, dating back as far as Fisher (1933), suggests a "collateral channel" through which the burst of a bubble in asset markets might affect the real economy: a large decline in asset markets adversely affects the value of collaterizable assets which hurts a firm's credit-worthiness and reduces its debt capacity; a lower debt capacity, in turn, leads to reduced investment and output (e.g., Bernanke and Gertler 1989, 1990, Kiyotaki and Moore 1997). This "collateral channel" is potentially important, because bank loans, the dominant source of external financing in all countries (Mayer, 1990), are typically backed by collateral. However, despite a strong belief among the theoretical literature about the importance of the collateral channel, there has been little empirical work that identifies and quantifies its full economic impact. This paper is an effort to fill this gap.

An analysis of the role of collateral also contributes to our understanding of how capital market imperfections, and the resulting financing frictions, might affect firm investment. Financing frictions are not directly observable to empirical researchers. Following an influential paper by Fazzari et al. (1988), researchers have focused on firms' reliance on internal funds and interpreted the observed investment responses to cash flow as evidence of financial constraints (see Hubbard, 1998, for a survey). Recent research, however, has raised serious questions both about the interpretation of observed investment-cash flow sensitivity and about the validity of using investment-cash flow sensitivity to measure financial constraints in the first place (e.g., Kaplan and Zingales, 1997 and 2000; Alti, 2003; and Gomes, 2001). Examining investment responses to collateral value provides a new test of the effect of financial constraints on investments. To the extent that collateral can mitigate the informational asymmetries and agency problems in external financing relationships, a firm's ability to collateralize reflects the frictions it faces in raising external funds and serves as a better measure of the degree of financial constraints. Further, due to the natural link between collateral and bank lending, it is possible to pin down the mechanism by which financing frictions affect investment, which helps rule out alternative intepretations of the results.

Japan's experience in the early 1990s provides an ideal experiment, for at least three reasons. First, it resolves the endogeneity problem typically encountered in this type of studies. In Japan, corporate borrowing is traditionally collateralized by land. Between 1991 and 1993, land prices in Japan dropped by 50%, a shock that was unambiguously exogenous to any individual firm. Since firms suffered losses in collateral proportionate to their land holdings prior to the shock, their pre-shock land holdings can serve as an exogenous instrument to measure the change in the value of collateral. This focus on cross sectional variations in collateral is important because, while this economic shock can also affect firms' investment opportunities, its influence is systematic and should be uncorrelated with firms' idiosyncratic land holdings. Moreover, it is difficult to argue that land holdings prior to the shock (in 1989) were strongly associated with information about investment opportunity in the post-shock period (1994-98), which was more than five years later.

Second, the Japanese setting allows me to further pin down causality by investigating how losses in collateral value are related to lower debt capacities. The main challenge here lies in the fact that banking relationships are not randomly assigned. Therefore, there might be unobserved bank characteristics that simultaneously affect credit availability and bank-firm relationships. For example, firms with more land holdings might have borrowed from banks that prefer to extend loans secured by land. If these same banks later run into trouble, one may observe a spurious relationship between land holdings and reduced bank credit. Using a unique sample of matched loans between publicly traded firms and their banks, I can fully control for unobserved bank characteristics and examine whether the *same* bank lends less to firms with larger land holdings.

A third advantage of the Japanese setting is that Japanese firms are well known for their close banking relationships. Since durable banking relationship may weaken the effect of a (negative) shock to collateral, a significant relationship between collateral value and debt capacity detected in this sample is strong evidence of the collateral channel.

Based on a large sample containing all the publicly traded manufacturing firms in Japan, I find a significant collateral-damage effect during the five-year period after the land price collapse. Losses in collateral value reduce a firm's borrowing capacity and the firm responds by cutting back on its investments. Such an effect is economically significant: for every 10 percent drop in land value, the investment rate is reduced by 0.8 percentage point. As further evidence of causality, I find that collateral losses lead to lower debt capacities of firms. All else equal, firms that suffer greater collateral losses are less likely to sustain their banking relationships and, conditional on lending being renewed, they obtain a smaller amount of bank credit. Moreover, the collateral channel is independent of the contemporaneous influence of worsened bank financial conditions. To my knowledge, this is the first study that provides direct evidence on the mechanism through which collateral influences investment, using a matched sample of bank-firm lending.

The Japanese experience has implications for the U.S. and other countries. Around the world, collateral plays an important role in bank lending. For example, it has been estimated that about 70% of all commercial and industrial loans are made on a secured basis in the U.S., U.K, and Gemany (see Berger and Udell, 1990; Harhoff and Korting, 1998; Binks et al.,1988). An important form of collateral is real estate.[1] Given the recent booms in the property markets around the world, Japan's experience in the 1990s is particularly valuable. It suggests that, while durable banking relationships may mitigate the effect of a decline in collateral value, the collateral channel remains powerful in transmitting a decline in the property market into the real economy.

The collateral channel also has important implications for the transmission of monetary policy.[2] According to the "balance-sheet channel," a tightening of monetary policy through higher interest rate impairs collateral value and thus the net worth of certain borrowers, diminishing their ability to borrow (e.g., see Bernanke and Gertler, 1995; and Bernanke et al., 1996). This issue is of considerable concern in the current U.S. policy debates. To the extent that findings about the investment behavior of industrial firms is indicative of the spending behavior of consumers, this paper suggests that, if the raising of rates by the Federal Reserve burst the bubble in the housing

[1] For example, according to the World Bank Investment Climate Survey of 28,000 firms in 58 emerging markets, real estate constitutes 50% of firms' collateral (see http://iresearch.worldbank.org/ics/jsp/index.jsp). Tests in Hurst and Lusardi (2004) suggest that real estate is an important source of collateral for entrepreneurial firms in the U.S. Davydenko and Franks (2005) report that real estate is the most widely used collateral in Germany and the U.K.

[2] I thank the referee for pointing out this important implication of the paper.

market, it would be difficult for U.S. consumers to continue to borrow against their home values to fuel consumption, which can result in a larger-than-expected economic contraction.

The remainder of this paper is organized as follows. Section 2 describes why the land-market collapse in Japan in the early 1990s provides a good natural experiment. Section 3 describes the data. Section 4 presents evidence of the effects of a shock to collateral value on investments. Section 5 presents evidence of the effects of collateral losses on firms' debt capacities. Section 6 discusses the generality of the Japanese experience and the some other explanations of the recession in Japan in the 1990s. Finally, Section 6 concludes the paper.

II. The Land-Price Collapse In Japan in the Early 1990s

The Japanese economy in the second half of the 1980s is frequently characterized as a "bubble" economy by analysts (e.g., Cargill, Hutchison, and Ito, 1997; French and Poterba, 1991). Land prices in Japan almost tripled in the second half of the 1980s. At its peak in 1990, the market value of all the land in Japan, according to several estimates, was four times the land value of the United States, which is 25 times Japan's size. The boom was followed by an equally sharp fall in the early 1990s. Between March 1990 and the end of 1993, the land price dropped by almost one half. Meanwhile, stock prices experienced a similar pattern of boom and bust.

While detecting the "bubble" is beyond the scope of this study, there is evidence suggesting that the boom in the equity and land markets cannot be justified by fundamentals. For example, French and Poterba (1991) report that none of the usual suspects, including accounting differences, changes in required stock returns or growth expectations, can explain the movements of stock prices and price-earning ratios in Japan in the late 1980s and earlier 1990s. They also find that the value-to-rent ratios in the Japanese land market in the 1980s behaved like price-earning ratios in the Japanese stock market, suggesting a deviation of land prices from fundamentals.

Japanese banks traditionally extend loans only on a secured basis.[3] The monetary authority also encourages the collateralization principle through periodic bank examinations (Shimzu, 1992). This institutional feature mitigates the concern as to who collaterizes and whether collateral proxies

[3]Some researchers propose that unsecured loans collide with the Japanese social custom of never (openly) judging others (Shibata, 1995). In preparing for a departure from the doctrine of land collateral after the land prices collapsed, one major city bank classified its clients into three categories: those who qualified for unsecured loans, those whose borrowing had to be personally guaranteed, and those whose requests for loans would be declined. Client corporations were so upset to learn that they could be put in the second and third categories that the system was not implemented (Shibata, 1995).

for firm quality. This is an important advantage because the theoretical banking literature has not reached a consensus on what types of borrowers are likely to put up collateral. On one hand, Besanko and Thakor (1987) and Boot, Thakor, Udell (1991) suggest that good borrowers will use collateral to signal its quality. On the other hand, Rajan and Winton (1998) propose that collateral, along with covenants, improves the creditor's incentive to monitor and banks demand more collateral from bad firms. These differences, however, becomes unimportant for the Japan setting as everyone has to put up collateral.

This setting provides an excellent setting to test for the effect of collateral because it resolves the two empirical difficulties commonly encountered in this type of study. First, due to a lack of a secondary market for collateralizable assets such as machinery and inventory, collateral value may not be observable. In Japan, land is the most important form of collateral and 70% of secured loans are backed by land (Bank of Japan). Since there is a secondary market for land, land value is observable. The second difficulty is that collateral is endogenous to investment. When firms make investments, they build plants and purchase machines, all of which can serve as collateral. In addition, increased investment opportunity may simultaneously drive investment and the market value of existing collateral. Therefore, even if one observes a correlation between investment and collateral, it is hard to establish causality. The almost 50% drop in land prices between 1990 and 1993 is unambiguously exogenous to the cash flow or profitability of any one individual firm. Firms lost collateral proportionate to their land holding prior to the shock; therefore the pre-shock land holding provides an exogenous measure of the change in collateral value. Moreover, using a unique sample of matched loans between lenders and borrowers including all publicly traded firms and banks, I can identify the effect of collateral losses on firms' borrowing capacities, which provides direct evidence on the mechanism through which collateral affects investment.[4]

It is worth noting that obtaining an accurate estimate of declines in land value is never easy. Most available land price series are based on appraisals, which may not accurately reflect market value. However, market transaction data also suffer from some well-known flaws. For example, they usually do not control for property types or quality (e.g., location, size, etc.) and may suffer from a sample-selection bias. A distinct feature of my experiment is that it does not depend on an

[4]Some Japan experts have recognized that land price appreciation in the 1980s was related to the high rate of investment (see Kashyap, Scharfstein, and Weil, 1993 and Ogawa and Suzuki, 1999). This paper differs from these studies in two important aspects. First, I explicitly deal with the endogeneity issues using a natural experiment. Second, I document the mechanism through which collateral affects investment using detailed loan-level data.

accurate estimate of land prices: with a 50% drop in land prices, any variations due to estimation error or location are of second order. Therefore, land holding prior to the shock is a reasonably clean measure of cross-sectional losses in collateral value. Later I check the robustness of the results to regional variations in land prices using price data in the 47 prefectures.

III. The Data

The data mainly come from the Development Bank of Japan (DBJ), which contains detailed accounting data on all publically traded non-financial firms. Its main advantage over NIKKEI NEEDS, a popular database for Japanese studies, is that it contains a detailed breakdown of five depreciable capital goods, as well as asset specific gross and current period depreciation, which enables a more accurate calculation of the replacement cost of capital and the investment rate net of asset sale. Other data sources include NIKKEI NEEDS for share prices and the wholesale price index (WPI) for prices of output and investment goods.

Following Hayashi and Inoue (1991), I apply different physical depreciation rates to construct the capital stock by the perpetual inventory method.[5] To construct the market value of land, I again apply the perpetual inventory method, which involves a long time series of land prices and firms' book value of land back to the 1960s (see the Appendix for details).

The sample contains all manufacturing firms in the DBJ database. My sample period include five years after the shock during 1994-1998. I drop firms that do not have enough data to construct the capital stock measure or have missing stock price data, firms that were involved in mergers and acquisitions between 1989 and 1998, and, if a firm changes its accounting period, the year in which such a change occurs.[6] The final sample contains 847 firms. Table I presents the sample summary statistics. Column (1) of Table I displays the firm characteristics. Note that the average investment rate for Japanese firms during this period is heavily right-skewed with the median (0.09) being only about half of mean (0.24). In columns (2) and (3) of Table I, I divide the sample into land-holding companies and non-land-holding companies, based on whether the firm has market value of land to the replacement cost of capital above the top quartile of the industry in 1989. All the variables are

[5] There has been numerous procedures in the literature for estimating capital stock and Tobin's q. The most well known methods for Japanese data are from Hoshi and Kashyap (1990) and Hayashi and Inoue (1991). Their methods differ mostly because of their available data. As the data in this paper matches that in Hayashi and Inoue (1991), I follow their methodology.

[6] The Japanese fiscal year ends in March. However, many firms file late in the year. I define the fiscal year for a particular observation as the previous year if the firm filed before or in June, and as the current year if the firm files after June.

adjusted by the industry median. Land-holding companies are significantly smaller, have more cash stock and fewer future investment opportunities. They also have less debt, but rely significantly more on bank debt. Their average investment rates are not significantly different from the control group. Interestingly, according to the median which is a more efficient measure of the location for skewed distribution, land holding companies invest significantly less than the control group, consistent with the collateral hypothesis.

IV. Collateral Effects on Corporate Investment

This section investigates whether losses in collateral value, caused by the real estate collapse, affect firms' investment behavior. I hypothesize a collateral-damage effect: the shock reduces firms' collateral value and thus their borrowing capacities, which is translated into lower investment rates.

One might, however, propose an alternative story. Suppose that there were two companies, A and B, in the same industry and that company A had more land than company B before the shock. After the shock, although the collateral value of company A is much less, it still has more collateral, which should enable it to borrower thus invest more. It is helpful here to examine what happened to the additional land at company A prior to the shock. The first possibility is that company A used its additional land to borrow more and to invest more before the shock. If this is the case, comparison of investment rates should be made after controlling for the investment levels prior to the shock. This is because, after the shock, banks would be hesitant to extend the same amount of credit and, as a result, the firm would invest less *relative to* its investment prior to the shock. The second possibility is that company A did not borrow more than company B because it decided to kept the additional debt capacity unused.[7] This suggests that one needs to control for leverage, especially the extent to which the firm pledged land as collateral. As is discussed later, my results are robust to inclusion of leverage-related variables and the pre-shock investment level as controls.

In addition to the collateral-damage effect, it is possible that firms with larger land holdings have to rely more on internally generated cash, since they face more binding financing constraints. Thus, land-holding companies may have higher investment sensitivities to internal liquidity. Therefore, I

[7] It is also possible that company B had other forms of collateral (such as plant and machinery) that allowed it to borrow as much as company A. However, in this case, company A would still have a larger collateral losses since other form of collateral did not suffer the same loss as did land.

estimate the base-line model as follows:

$$I/K = a + bq + cCASH/K + dLand/K^{pre} + eCASH/K * LANDCO + \ f \ Industry \ Dummies \quad (1)$$

I/K is the fixed investments normalized by the beginning-period replacement cost of capital. As it is difficult to know how long it takes for the collateral effect to show up in investment, I examine the average investment rate during the five years after the shock, 1994-1998. All the independent variables except cash stock are also averaged across years. q is Tobin's q measured as the total market value of the firm divided by the replacement cost of capital (excluding land).[8] $CASH/K$ is internal liquidity with two measures: the cash flow which reflects funds entering the firm during the sample period and the cash stock in 1993 which reflects funds entering the firm in earlier periods. Both measures are normalized by the capital stock. $Land/K^{pre}$ is the market value of land in 1989 normalized by the replacement cost of capital. $LANDCO$ is a dummy variable indicating whether or not a company is a land-holding company. Industry dummies control for differences in land-holdings due to industry-specific production technologies. The coefficient d captures the collateral-damage effect.

The last coefficient, e, deserves a special note. To the extent that firms suffering greater collateral damage have to rely more on internal cash to finance their investment projects, e is expected to be positive. Recent literature, however, has raised serious doubt about this interpretation (e.g., Kaplan and Zingales, 1997; Alti, 2003; and Gomes, 2001). Therefore, while it may be worthwhile to control for the structural differences in investment responses to internal liquidity between the two groups of firms, the results should be interpreted with caution. In fact, the difficulty in interpreting the internal liquidity effects actually highlights the importance of looking beyond investment-cash flow sensitivity in testing for the effects of financing constraints on corporate investment.

A well-documented problem in estimating an investment equation is the measurement error resulting from using average q in place of marginal q (Erickson and Whited, 2000). This paper explicitly deals with this problem in two ways. First, by research design, I exploit a source of variation in collateral value that is plausibly uncorrelated with investment opportunities. Specifically, I measure loss in collateral value with pre-shock land holdings in 1989, which are not likely to be strongly associated with information about investment opportunities more than five years

[8] I exclude land from q calculation to minimize the effect of the land-price collapse on q. The results are qualitatively similar if I include land in q.

later during 1994-98. Later, I will check the robustness of the results by only using information in the collateral measure that is orthogonal to variables related to firm quality and /or investment opportunities. Second, I do not simply infer causality from the investment equation. Rather, I explicitly examine the mechanism through which collateral influences investment, using a unique data set of matched bank-firm lending.

A related issue is how the collapse in the stock market might have affected the tests. A decline in stock prices is reflected in firms' q. If one believes that q is a reasonable control for marginal product of capital, it is already included in the estimation. However, a number of studies have pointed out, both theoretically and empirically, that investments respond to both the fundamental and the non-fundamental components in stock prices (e.g., Morck, Shleifer and Vishny, 1990; Chirinko and Schaller, 2001; Baker, Stein, Wurgler, 2003). In the Japanese setting, the bust in the equity market is largely a correction to the boom in the second half of the 1980s, after which the non-fundamental component in stock prices is mostly gone (Goyal and Yamada, 2003). As my sample period is after the correction, q should mostly reflects the fundamental component.[9]

Regarding the estimation technique, recall that in Panel A of Table I, the investment rate is right-skewed. It turns out that the conditional distribution is also skewed, suggesting that the OLS estimators are not efficient. Therefore, I estimate median or least absolute distance (LAD) regressions.[10] Unless otherwise specified, the standard errors are calculated based on the method suggested by Koenker and Bassett (1982).

A. Basic Results

Table II shows a significant collateral-damage effect: the coefficient on pre-shock land holding, $Land/K^{pre}$, is significantly negative at the 1% level (columns (1) and (2) of Table II). The coefficients on the interaction between the land-holding company dummy and the two measures of internal liquidity (cash flow and cash stock) are significantly positive at the 1% level, which is consistent with the conjecture that land holding companies, facing tighter financial constraints,

[9]Of course this implicitly assumes that the non-fundamental component in q is greater or equal to zero. What if equity prices reflect a pessimism sentiment after the bust? If this sentiment affects the land-holding companies more than the control group, the negative relationship between land holding prior to the shock and investments may be driven by the fact that land-holding is a proxy for the pessimistic sentiment in q. This, however, does not seem to be the case because, compared with the control group, land-holding companies on average experienced a lower percentage drop in q (15% v. 47%).

[10]For an overview of LAD and quantile regressions in economics research, see Koenker and Hallock (2001). Koener and Bassett (1978) show that the regression median is more efficient than the least squares estimator in the linear model for any distribution for which the median is more efficient than the mean in the location model.

rely more on internally generated funds. However, given the controversy over investment-cash flow sensitivities, this interpretation should be taken with caution. In the remaining of this paper, I focuses on the investment responses to collateral.

Column (3) of Table II controls for the timing of land purchases. Firms that purchased land at the peak of the bubble would suffer larger collateral losses. I include in the estimation the proportion of land (in market value) purchased from 1988 to 1990 (%*Recent Purchase*), and its interaction with the land-holding company dummy. The coefficient on %*Recent Purchase* is positive but not statistically significant, probably because land purchased more recently is for planned investments. The interaction term is significantly negative (1% level), suggesting that firms are not able to undertake planned investments if their overall collateral positions are severely damaged.

In column (4) of Table II, I examine how leverage affects the estimation, motivated by two considerations. First, leverage has been reported to be negatively related to future growth (Lang, Ofek, and Stulz, 1996). Thus, if land-holding companies are more leveraged, they may invest less not because of collateral but because of high leverage. Second, firms that have pledged more of their land as collateral would be more affected by the shock. I thus create a dummy variable indicating firms with debt- -to-land ratio in 1989 above the top industry quartile (High Debt-to-Land dummy) and let it interact with pre-shock landholding. As reported in column (4) of Table II, this interaction term is, as expected, significantly negative (10% level). Leverage itself has a positive but insignificant coefficient, probably because in an economy where debt is the dominating source of financing, leverage may also reflect lending relationships and/or firm quality.

In column (5) of Table II, I examine whether firms, facing collateral losses, cut back investment *relative to* its investment level prior to the shock. Controlling for the pre-shock investment level does not change any of the earlier findings. Notice that, although pre-shock investment has a significant coefficient, it contributes little to the overall fit of the regression model, with the Pseudo R^2 virtually unchanged.

Finally, I check whether my estimates imply economically meaningful magnitudes. I compare the investment rates of two hypothetical firms. One is a median firm with every control variable at the median; the other is identical in all dimensions except that it had land holding in 1989 at the 75th percentile (which is 12.2 percentage point above the median). According to the baseline estimation in column (1) of Table II, the higher land holding has a direct effect of reducing the investment rate by 1.6 percentage point ($-0.128 * 0.122$). Given that the median firm has an investment rate of 9%, this is a non-trivial effect since it implies a 18% reduction in investment rates. My estimates also suggest a significant sensitivity of investment to asset-market movements: for every 10 percent drop in land prices, the investment rate of an average firm (with $Land/K^{pre}$of 67%) is reduced by 0.8 percentage point ($= -0.128 * 67\% * 10\%$).

B. Further Analysis

B.1. Is Land Holding Merely A Proxy For Firm Quality?

An alternative interpretation of my results is that land holding is simply picking up (negative) information about growth opportunities. However I measure changes in collateral value using land holdings prior to the shock (in 1989), which are not likely to be strongly correlated with investment opportunities more than five years later in the post-shock period (1994-98). Nevertheless, this alternative interpretation deserves some consideration because, as shown in Table I, land-holding companies tend to be smaller and with fewer growth opportunities.

Two tests are useful in ruling out the above interpretation. The first is the test in which the investment rate prior to the shock is controlled for (column (7) of Table II). If land holding is a proxy for firm quality, land-holding companies may have always invested less. Therefore, controlling the pre-shock investment level would render the collateral effect insignificant. However, the results in Table II suggest the opposite. In the second test, I include additional control variables that are commonly used to reflect firm quality, that is, three-year sales growth (robust to one-year growth), the gross margin (defined as operating income over sales) and size (log of assets), all measured in 1989. This way I only use information in the pre-shock land holding that is not related to firm quality in assessing the collateral effects. As reported in columns (1) and (2) of Table III, there are not any qualitative changes from the earlier results. These robustness checks, combined with the lending tests in Section V., which identifies the mechanism through which collateral affects investment, further suggest that mis-measurement in q is not a serious concern in my tests.

B.2. Does Group Affiliation Make a Difference?

Japanese corporate finance is characterized by a main bank system. I examine whether group affiliation has any impact on the collateral effects. I use Dodwell Marketing Consultant's *Industrial Groupings in Japan* to classify whether a firm belongs to a corporate group or a *Keiretsu*. A slightly lower proportion of land-holding companies have group affiliations (42% v. 33%). When I estimate Equation (1) separately for group and non-group affiliated firms, the collateral effects only exist for non-group firms (columns (3) and (4) of Table III). This result is consistent with the findings by Hoshi, Kashyap, and Scharfstein (1990) that main banks are effective in supporting client firms when they are in financial difficulty. This result, however, does not seem to be robust to alternative classifications of *keiretsu* firms. When I rerun the tests based on another popular publication *Keiretsu no Kenkyu* published by the Keizai Chosa Kyokai (Economic Survey Association).[11] There is not any difference in collateral effects between group and non-group firms.

These findings shed light on the recent debate on the main bank system. Allegedly, close affiliation with a bank helps to avoid adverse selection and mitigate moral hazard problems. However, in light of the non-performing loan problems in the 1990s, scholars began to recognize that the *keiretsu* system also has its costs and they questioned if the supposed benefits of main banking actually accrued to the firm (Weinstein and Yafeh, 1998). More radically, in an article titled "The Fable of *keiretsu*," Miwa and Ramseyer (2002) argue that *keiretsu* simply never existed, but rather ... began as a figment of the academic imagination, and they remain that today." The results in this paper provide some support of the benefit of the main bank system. The sensitivity of the results, however, suggests that the main bank system does not seem to be very well defined.

B.3. Overinvestment or Underinvestment?

Theoretical work on the collateral channel predicts underinvestment due to collateral losses (e.g., Bernanke and Gertler, 1989 and 1990; Kiyotaki and Moore, 1997). Jensen (1986) and others, however, have argued that managers tend to invest free cash flow in negative net-present-value projects. Under this view, land holding companies may have taken advantage of the price run-up in the 1980s and borrowed excessively to finance thier pet projects. The drop in investments after the collapse is simply a correction to the overinvestment problem. Note that although this hypothesis changes the interpretation, it does not negate the effect of collateral on firm investments. Nevertheless, this issue is important because it relates to our understanding of both the recession in Japan in the 1990s in particular and the real effect of collateral on the economy in general.

[11] Both *Keiretsu no Kenkyu* and Dodwell publications classify Keiretsu firms based loan structure, bank shareholding, and historical factors. Dodwell's definition of group firms is narrower than *Keiretsu no Kenkyu* and are stabler over time. Using the Dodwell classification, less than 4% of the firms in the sample switch into or out of their groups over a 13-year period.

I perform two tests to distinguish between these two hypotheses. First, the overinvestment theory predicts that firms with poor investment opportunities would be hurt more because their investment depends more on collateral value than on the availability of good projects. Therefore, I include in the estimation an interaction term between collateral and a low-q dummy indicating whether a firm's average q during 1994 - 1998 is below the industry median. The overinvestment story would predict the coefficient to be negative. However, results in column (5) of Table III does not support the overinvestment hypothesis: this coefficient is insignificantly positive. In the second test, I explore whether collateral affect major investments, a type of investment that is less likely to be driven by the agency problem. Using quantile regressions at the 90th percentile, I find that collateral position affect major investments, which is supportive of an underinvestment story.[12]

C. Robustness Checks

C.1. Investments prior to the shock

Presumably, a collateral channel should also exist during the bubble period, as firms with more land might have taken advantage of the increased collateral value and invested more. However, quantifying this effect is difficulty due to endogeneity issue discussed earlier. Nevertheless, as a robustness check, I examine the response of investment during the bubble period (1986-1989) to land holding in 1985, controlling for Tobin's q and internal liquidity. I find that, consistent with Kashyap, et. al. (1993), the coefficient on land holding is significantly positive (not reported).

C.2. Regional variations of land prices

My tests implicitly assume that firms' land holdings are subject to the same price shock. There are, however, variations in price drops across regions. While regional variation in price drops is of second order given the size of the shock, it is worth checking the robustness of my findings. Therefore, I collect data on land prices in all the 47 prefectures in Japan and incorporate a location-specific loss factor (based on firm location) in the estimation.[13] None of the earlier results change (not reported). Although the problem can be completely resolved only if data on the exact locations of different parcels of land owned by firms is available, if both tests yield qualitatively the same results, it probably means that land location does not play an important role in the estimation.

[12] The detailed results are available from the author upon request.

[13] Arguably, land prices may differ even within a prefecture, e.g., depending on the purpose of land (residential, commercial, and industrial). However, this should not be a concern, since my sample only contains manufacturing firms and I have controlled for the industry effect by including industrial dummies in all the regressions.

C.3. Other robustness checks

Other robustness checks include alternative measures of land holding and definitions of the sample period. The earlier results are robust to measures of land holding as market value of land over total market value of the firm and over the total book value of assets; to the alternative cutoff for land-holding companies at the industry median (rather than the top quartile); to the alternative definition of the sample period as between 1994 and 1997; and to an additional control of firms' access to the bond market (the definition of this variable will be discussed in more detail in the lending tests in the next section).

V. Collateral Effects on Corporate Borrowing

So far, I have presented evidence of the collateral channel. While the tests are designed to deal with the endogeneity problem, the interpretation of results would be more convincing if evidence on the mechanism through which the shock to collateral influences investment can be provided. In particular, does the loss of collateral reduce firms' ability to obtain external funds and particularly bank lending? Would the presence of durable banking relationships weaken the effect of collateral losses? Is the collateral channel independent of the effect of banks' (worsened) financial conditions? The Japan setting is particularly suited to this test, given that Japanese firms are well known for their close relationships with their banks. If I find a significant collateral effect in Japan, it is strong evidence of the importance of collateral in credit allocation.

A. Model Specifications

If banking relationships are randomly assigned, one can simply compare the amount of credit available to firms with different levels of land holdings. Banking relationships, however, are not random and there might be unobserved bank characteristics that simultaneously affect credit availability and selection of bank-firm relationships. For example, firms that prefer to store more land may have formed banking relationships with banks that prefer to grant loans secured by land. If these "land-loving" banks later had to cut back lending due to the collapse in land prices, one may observe a (spurious) relation between land holding and credit availability. This problem can not be resolved by simply adding control variables related to bank healthiness, such as credit ratings or bank capital for at least two reasons. First, bank healthiness is endogenous and depends critically on client firms' performance. Second, some of the bank characteristics that affect both credit availability and banking relationships may not be observable.

I deal with this difficulty using a sample of matched firm-bank lending data containing all the publicly traded manufacturing firms and their banks. This data tracks, for any given bank, its lending to multiple firms with different levels of land holdings. Therefore, I can examine whether the same bank would grant fewer loans to firms with larger land holdings. In a regression framework, I estimate the following model of loan growth with bank fixed effects:

$$Lending_{ij} = a + b \text{ Firm characteristics} + c \text{ Relationship characteristics} + dLand/K_i^{pre} + u_j, \quad (2)$$

subscript i indexes firms; j indexes banks. $Lending_{ij}$ is a measure of credit availability, which I will discuss shortly. Firm control variables include variables related to investment need and demand for credit, namely, Tobin's q and measures of internal liquidity (cash flow and cash stock). The effect of cash flow, however, is not an exte clear. To the extent that it reflects future profitability, it measures the demand for credit. However, if firms follow a pecking-order financial policy, higher cash flow reduces loan demand. Relationship variables are measured in the ten years (1984-1993) prior to my sample period. They are duration, which reflects the private information the lender has about the firm (see e.g., Petersen and Rajan, 1992); the natural log of the number of banks, which reflects the firm's effort in economizing monitoring cost, as well as the lender's information monopoly; whether the bank was the firm's biggest lender at least once from 1984 to 1993, which is motivated by the fact that while Japanese firms borrowed from multiple banks (16 banks on average), they concentrate about one-third from a single institution; the bank's equity stake, which allows the lender to share future surpluses and thus mitigates the "hold-up" problem; and, lastly, whether the bank is the firm's main bank. $Land/K^{pre}$ is the market value of land in 1989 normalized by capital stock, and u_j is the bank fixed effect. The coefficient d captures the collateral-damage effect and is expected to be negative.

I measure credit availability using the log of a firm's long-term borrowing from a particular bank during 1994-1998 normalized by the average borrowing from the same bank during the five years prior to the shock (1984-89). I focus on long-term borrowing because it is strongly associated with Japanese fixed investments and is typically backed by land (Kwon, 1998; Hibara, 2001). The contractual features of long-term loans necessarily mean that the loan balances adjust slower than desired by the lender. Therefore, after loan demand is controlled for, a large loan balance can arise both from the lender's willingness to lend and from lending decisions in the past. Normalizing loan balances by those in earlier years helps separate out the effect of prior lending decisions.

It is worth noting that using the amount of bank lending to measure credit availability implicitly assumes that the amount of debt used is the amount of debt available to the firm. This assumption is defensible for two reasons. First, on the firm's side, firms generally face tighter credit constraints due to their collateral losses. On the lender's side, after the collapse of stock and land prices, banks, facing mounting non-performing loans and severe losses in their security holdings, had to tighten credit.

In my sample, of all the firm-bank pairs in 1989, about 18% did not have a lending relationship during the sample period.[14] To correct for the potential survivorship bias, I estimate a selection model using Heckman's (1979) two-stage regressions. The first stage is a probit regression of whether the relationship survived; the second stage is an ordinary-least-squares regression of loan growth. To the extent that the credit allocation is a two-step process in which the bank first decides whether to lend and then decides how much to lend, the selection model provides insight to both decisions. In addition, the firm characteristics prior to the shock is more likely to affect the lending/ no-lending decision whereas the contemporaneous firm characteristics tend to affect the second decision more. Therefore, in the first-stage regression, firm controls are measured in 1989, which naturally serve as instruments to help identify the lending equation.

B. Findings

Column (1a) of Table VI reports the first-stage probit regression results. Relationship variables are important in determining the chance of loan renewal. Duration, being a big lender to the firm, and equity stake all significantly increase the probability for the bank to renew loans (the 1% level). Probably because I have already controlled for different aspects of the lending relationship, the coefficient on the main-bank dummy is not statistically significant. Somewhat surprisingly, the coefficient on Tobin's q is significantly negative. This is probably because, due to the well-documented long-run reversal of stock prices, when the stock market collapsed in the late 1980s, firms that enjoyed the boom the most and therefore had higher q's may have experienced bigger

[14] I exclude firm-bank pairs that ended between 1990-93 because these relationship may have been terminated due to reasons other than the collapse in land prices. The results are qualitatively similar if I keep these observations in the sample.

drops in stock prices. Therefore, a higher q in the late 1980s may indicate a lower q in the post-shock period, all else equal. Cash stock has a significantly negative sign (at the 10% level), suggesting that cash stock reduces financing need. Lastly, firms suffered larger collateral losses have a significal lower chance of loan renewal (the 10% level). Interestingly, firms with more recent land purchases have a greater chance of continued relationships, probably reflecting that the loans made for the land purchase have not been paid off.

In the second-stage OLS regression (column (1b) of Table VI), the coefficient on the inverse Mills ratio is significant, indicating that the sample-selection bias does have an impact on the estimation. Consistent with a collateral-damage effect on credit allocation, the coefficient on $Land/K^{pre}$ is significantly negative at the 1% level. Among the relationship variables, equity stake is significantly positive as expected. Duration, however, is significantly negative, probably reflecting that some of the loans granted earlier have been paid back. Notably, the coefficient on Tobin's q is insignificant, which seems to be consistent with media reports that Japanese banks are protective of their weak clients with whom they have good relationships and that investment opportunities becomes a relatively unimportant in credit allocation.

An alternative intepretation of the above results is that land-holding companies borrowed less not because of their collateral losses but because of access to other sources of financing, e.g., the public bond market. Starting from November 1990, the bond market was liberalized and all the official restrictions were abadoned. However, firms still need at least an investment grade (i.e., a rating equivalent to S&P's BBB rating or higher) to issue public debt, which means larger and more profitable companies had better access to the bond market (Hoshi and Kashyap, 2001).[15] Recall from Table I that land-holding companies tend to be smaller than the control group, suggesting that it is less likely that their lower loan growth is due to borrowing from alternative sources. Nevertheless, to further check this hypothesis, I measure a firm's access to the bond market based on the rating agencies' accounting criteria for an investment grade (reported in Hoshi and Kashyap (2001). I include a dummy variable indicating whether a firm met these criteria at least once during 1994-1998.[16] As reported in column (2a) of Table VI, firms with bond eligibility have higher chance

[15] According to Hoshi and Kashyap (2001), the accounting criteria based on which the government restricted public bond issuance before 1990 were similar to the criteria that rating agencies use to grant an investment grade. In that sense, despite the deregulation, the "actual" criteria for bond issuance stay largely the same.

[16] Note that this is a relatively less restrictive cutoff. As the official restrictions are lifted, firms can issue bond whenever they get an investment grade, whereas prior to 1990 government may have required the issuer to meet the criteria during the several years prior to the actual issuance. However, the results on collateral effects are robust to the alternative cutoffs of meeting the criteria 3 or 4 times out of 5 years.

of loan renewal (1% level), suggesting that they are more desirable bank customers and that firms do not terminate lending relationships during bad times even if they have access to alternative sources of financing. However, the overall impact of bond market access on lending is insignificant, as shown in column (2b) of Table VI. Meanwhile, the earlier results remain qualitatively the same.

To examine the economic significance of the results, again consider a median firm and another firm which is identical in every aspect except for a land holding at the 75th percentile. The marginal impact of land holding on the probability of loan continuation evaluated at the median is -0.066. Thus the probability of continued relationship is 0.8% ($= -0.066 * 0.122$) lower for the 75th percentile firm, which is moderate compared to the unconditional probability of relationship survival (82%). However, the overall impact of collateral is significant: the 75th percentile firm is expected to have a growth rate that is 6 percentage points ($= 0.494 * 0.122$) lower than that is for the median firm. This magnitude is clearly economically important.

C. Re-Examining the Collateral Channel with Bank Controls

While the above results confirm the workings of a collateral channel through reduced borrowing capacity, I cannot completely rule out the possibility that, as the burst of the bubble also damages the banks' financial conditions (e.g., through their lending to the real estate sector, see Gan, 2006), the influence of collateral on investment is due to banks' losses on their real estate loans that are correlated with the firms' collateral losses.[17] This possibility deserves serious consideration, as the bank and the firm may own real estate that is geographically proximate or they have a similar taste for land. In fact, both a lending channel (through banks' financial conditions) and a collateral channel (through firms' collateral losses) are likely to be at work. Therefore, it is important to control for investment cutback due to the bank's financial conditions, so that one could be sure that the collateral channel identified in this paper does not simply pick up the effect of a lending channel.

Recall that Japanese firms source one-third of their borrowing from the top lender. Therefore, I control for the financial condition of the top lender, using two measures. The first is the bank's lending to the real estate sector, which on average accounted for 5.5% of assets in 1989. When land prices dropped by half, many of these loans went bad which hurt bank health significantly. Arguably, the impact of such losses on the bank's ability to lend should depend on how well it is

[17] I thank the referee for pointing out this possibility and suggesting tests to deal with this problem.

capitalized. Therefore, I also control for the bank's capital ratio in 1989.

For each firm in the matched lending data, I identify its top lender and then match with the DBJ financial data.[18] I re-estimate the investment equation with bank controls. As shown in columns (1)-(4) of Table VI, both measures of the top lender's financial conditions are significantly negative, as expected. Meanwhile, the collateral effects remain unchanged, suggesting that the collateral and the lending channels have their independent influences on firm investments.

One remaining concern is that the bank's financial health is not fully captured in their real estate loans and / or capital positions. To mitigate the concern, I add bank dummies to the investment equation and thus control for both observed and unobserved bank characteristics. The collateral effects remain qualitatively the same (columns (5)-(8) of Table VI).

These results, combined with the earlier results on bank lending, help pin down the causality of a collateral effect. That is, the collateral channel works through firms' reduced borrowing capacity and is independent of the effect of banks' financial conditions.

VI. Discussions

A. The Applicability of the Japanese Experience

While Japan provides an excellent setting to test the collateral channel, it is useful to discuss, at this point, how the findings may apply to other countries. It should be noted that the Japanese settting utilizes a very unusual economic environment with a shock of an extraordinary size. Although its exact relation is hard to estimate due to the rare occurrences of bubbles, the marginal impact of collateral losses may depend on the size of the bubble. Therefore, while the results in this paper are very useful to predict a directional collateral channel after the burst of bubbles, the exact magnitude should not be simply extrapolated.

It is also worth noting that, according to the measures in La Porta et al. (1998), Japan has a relative strong creditor rights protection. Moreover, despite the occasional press reports that some borrowers hired *yakuza* (gangsters) to sit on properties which made it hard for banks to collect on some commercial real estate collateral, the overall quality of law enforcement in Japan ranks among the top across all countries. For example, it takes only 60 days to enforce a standard debt contract

[18] The sample size drops to 472 firms during this matching. However, there does not seem to be any systematic pattern in the firms dropped. Indeed, the earlier results in Tables 3 and 4 can be reproduced (i.e., both the magnitudes of the main coefficients and their significant levels) in this smaller sample. In the interest of brevity, I do not report these results; but they are available upon request.

in Japan, whereas the world average is 234 days and the average for countries with the English law original (which has better enforcement in general) is 176 days (La Porta et al., 2003). Secured creditor rights and their enforcement may explain, at least partially, the dominance of bank finance and the economic growth in Japan.

While this strengthens the argument for using the Japan setting to test for a collateral channel, an understanding of the relationship between creditor rights and use of collateral is helpful in assessing the generality of the Japanese experience. Such a relationship, however, is not clear cut and unfortunately there is little research on this regard. On the one hand, one may hypothesize that a lack of creditor rights would discourage the use of collateral and the banks may not lend at all. On the other hand, it is possible that weak creditor rights prompt lenders to demand collateral since this is at least something that they could hope to get hold of in case of a default. In both cases, it seems reasonable to argue that, conditional on loans being granted, they are likely to be collateralized, which is consistent with the popularity of secured loans around the world. Base on these considerations, one might expect that the lessons learned from the Japanese experience are quite general.

B. Other Explanations of the Post-Bubble Recession in Japan

This paper emphasizes tighter credit constraints due to the burst of real estate bubble as a contributing factor to Japan's economic recession in the 1990s. I now discuss how this explanation is related to other explanations that have been proposed by analysts.

Gan (2006) emphasizes the role of a lending channel in propagating the downturn. The burst of asset market bubbles impaired the financial condition of banks, since they had significant exposure to asset markets either through their real estate lending or through their direct holdings of equity and land. To the extent that banks are liquidity constrained and that firms cannot substitute other sources of financing for bank lending, a bank liquidity shock can significantly reduce firm investment and valuation. This lending channel, together with the collateral channel identified in this paper, points to two powerful ways by which asset market bubbles may be transmitted into the real economy.

Hoshi and Kashyap (2004) and Peek and Rosengren (2005) propose that Japanese banks' evergreening of loans and the resulting misallocation of funds contribute to the economic decline in the 1990s. Indeed total domestic bank lending did not decline till mid-1990s. However, this pattern is likely to be driven by lending to firms in the real estate sector which steadily increased from the early 1990s till 1998. Lending to the manufacturing firms, which is the focus of my lending tests, started to decline as soon as the bubble burst. To the extent that banks over-lent to other more problematic firms, such as firms in the real estate sector, the "ever-greening" incentive at banks may have exacerbated the impact of the collateral channel among manufacturing firms.

Hayashi and Prescott (2002) point out a slowdown in total factor productivity growth, rather than financial constraints, as the main reason for Japan's "lost decade of growth." They argue that Japanese firms do not seem to be financially constrained as they hold much more cash than the U.S. firms and small firms have steadily increased their cash holding since 1996. Cash holding, however, is endogenous. Theoretical work has shown that in a multi-period setting, an improved liquidity position may make a firm more conservative in its investment choices, if it anticipates being constrained in the future (Dasgupta and Sengupta, 2003). Recent findings that financially constrained firms save a bigger fraction of their cash balances during recessions support this view (Almeida, Campello, and Weisbach, 2004). Therefore, larger cash holdings are not inconsistent with the main point in this paper. Moreover, to the extent that firms, facing collateral losses, have to curtail investment in productivity-improving technologies, the total factor productivity in the economy would be lowered.

VII. Conclusions

When the bubble in the Japanese land market burst in the 1990s, the value of collateralizable assets plummeted. This effect was especially pronounced among firms with larger land holdings prior to the shock. This paper demonstrates that the bursting of this asset bubble had an enormous impact on investment behavior and credit allocation.

The empirical setting is ideal because it does not suffer from the problems that normally plague these types of studies. Exploiting an exogenous variation in the change of collateral value, I find that collateral significantly affects investment decisions of firms in the manufacturing sector. The effect is large: for an average firm, every 10 percentage drop in land value implies a 0.8 percentage point reduction in investment rate. Bank lending provides further evidence on the mechanism through which shocks to collateral affect investments. Using matched firm-bank data and hence controlling for possible endogenous selection of banking relationships, I find a significant collateral effect on bank credit allocation. That is, firms with greater collateral losses are less likely to sustain their banking relationships and, conditional on loan renewal, they obtain a small amount of bank credit. Additionally, the collateral channel remain unchanged after the influence of worsened bank financial conditions is controlled for.

This study also has macroeconomic implications. The effect of collateral can be cumulative: as many collateralizable assets are also inputs into a firm's production process, a drop in investment decreases future revenues, which further reduces the firm's collateral value and thus its investments (Kiyotaki and Moore, 1997 and Kashyap, Scharfstein, and Weil, 1993). This feedback effect generates credit cycles and amplifies the decline in the asset markets.[19]

Overall, the results highlight an economically significant collateral channel through which extreme movements in asset markets are transmitted to the real economy. As real estate is an important form of collateral world-wide and the property markets around the world have experienced unprecedented booms in recent years, Japan's experience in the 1990s is particularly relevant. It suggests that the collateral channel can be powerful in transmitting a decline in the property market into the real economy.

[19] This credit-multiplier effect has been employed by Almeida and Campello (2004) and Braun and Larrain (2004) in their studies of investment-cash flow sensitivities and the effect of financial development on short-run fluctuations in production, respectively.

A. Appendix

This Appendix describes the calculation of replacement cost of capital and market value of land for the firms in my sample.

A. Replacement Cost of Capital

The perpetual inventory calculation is carried out separately for each of the five types of capital goods (land is calculated separately as described in A.2). Let $K_{i,t}$ be the real stock of asset i at the beginning of period t, $P_{i,t}$ the corresponding tax-unadjusted price at the beginning of year t, and $\delta_{i,t}$ the asset-specific depreciation rate. Then, the perpetual inventory recursion is based on the relationship

$$P_{i,t}K_{i,t+1} = (1 - \sigma_{i,t})P_{i,t}K_{i,t} + NOMI_{i,t}, \tag{A.1}$$

or, alternatively,

$$K_{i,t+1} = (1 - \sigma_{i,t})K_{i,t} + \frac{NOMI_{i,t}}{P_{i,t}}, \tag{A.2}$$

where $NOMI_{i,t}$ is nominal investment in asset i during period t valued at beginning of period t price. The recursion is started for all asset types in 1961, or the first year the firm enters the data set. To start the recursion, $P_{i,0}K_{i,0}$ is assumed equal to the beginning of period book value in 1961 of the corresponding asset type as listed on the firms balance sheet at the end of 1960 (or the year after the firm is listed if later than 1960). The key is to determine nominal investment, $NOMI$, for each asset type:

$$NOMI_{i,t} = KNB_{i,t+1} - KNB_{i,t} + DEP_{i,t}, \tag{A.3}$$

where $KNB_{i,t}$ is the book value of the net stock of asset i during time t, $DEP_{i,t}$ is accounting depreciation on asset i during period t. Due to data availability, $NOMI_{i,t}$ is calculated in different ways depending on the time period. For more details, see Hayashi and Inoue (1991).

B. Market Value of Land

Define $LAND_t$ as the real value, and $LANDB_t$ as the book value of land, both at the beginning of period t. Assuming a LIFO valuation process, the recursion equation for land is, as suggested by Hoshi and Kashyap (1990),

$$P_t LAND_{t+1} = P_t LAND_t + (LANDB_{t+1} - LANDB_t)\,\frac{P_t}{P_t}, \tag{A.4}$$

where $P_t = P_t$ if ($LANDB_{t+1}$ - $LANDB_t$) > 0, and $P_t = P_{t-x}$ where x is the number of periods that have passed since the last time ($LANDB_{t+1-x}$ - $LANDB_{t-x}$) >0.

Unlike the capital stock calculation, assuming that $P_0 LAND_0 = LANDB_0$ (i.e. that the market value and the book value are equal in the first period) is difficult because the book value and market value of land had already diverged significantly by 1960. To get around this, Hayashi and Inoue (1991) suggest a conversion factor of 7.582446 be applied to the book value to generate $P_0 LAND_0$ for firms that existed prior to 1969. $P_0 LAND_0 = LANDB_0$ for all firms that enter later.

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Table I. Summary Statistics

This table presents descriptive statistics on various firm characteristics in Japan. Column (1) presents the whole-sample summary statistics averaged over the sample period between 1994 and 1998. Columns (2) and (3) present the industry-adjusted statistics (adjusted by the median) for the sub-samples of land-holding companies and the control group. The table presents the mean of each characteristic, with the median in the parentheses. Land-holding companies are defined as the companies with market value of land to total replacement cost of capital above the industry top quartile. The remaining firms serve as the control group. Significance levels for the difference between the landholding companies and the control groups are based on two-tailed tests; significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	Raw statistics	Statistics adjusted by the industry median	
	The Whole Sample	Land-holding companies	The Control Group
	(1)	(2)	(3)
Sales ($mil)	165.47	37.58***	149.95
	(48.62)	(-5.79)***	(15.04)
Cash flow / K	0.08	0.17	0.00
	(0.03)	(-0.01)	(-0.01)
Cash / K	1.23	1.94**	0.24
	(0.55)	(0.26)***	(-0.03)
EBDIT / Total assets	0.03	-0.01*	0.00
	(0.03)	(0.00)	(0.00)
I / K	0.24	0.46	0.07
	(0.09)	(0.01)**	(0.02)
Debt / Total assets	0.12	0.00**	0.02
	(0.11)	(-0.01)***	-0.01
Bank debt / Debt	0.56	-0.02***	-0.10
	(0.59)	(0.03)***	(-0.11)
Tobin's q	0.99	0.06***	0.35
	(0.74)	(-0.15)***	(0.12)
Number of firms	847	212	635

Table II.
Collateral Effects on Fixed Investments: Basic Results

This table presents the effect of loss of collateral on firm investments based on Least Absolute Distance (LAD) Regressions. The dependent variable I/K is the average investment rate (defined as fixed investments over the beginning-of-period capital stock) between 1994 and 1998. Cash flow / K is cash flow over the beginning-of-period capital stock. q is Tobin's average q, Land/K^{pre} is the market value of land over the replacement cost of capital in 1989. Landco is a dummy variable equal to 1 if Land/K^{pre} is above the top industry quartile and 0 otherwise. Cash/K is the cash stock over the beginning-of-period capital stock at the end of 1993. % Recent purchase is the proportion of land (in market value) purchased during 1988-1990. High Debt-to-Land is a dummy variable indicating firms with debt over market value of land in 1989 above the top quartile. I / K^{pre} is the investment rate prior to the shock in 1989. Standard errors are based on the asymptotic variance in Koenker and Bassett (1982) and are presented in parentheses.

	(1)	(2)	(3)	(4)	(5)
Cash flow / K	0.415***	0.216***	0.142***	0.126***	0.146***
	(0.021)	(0.024)	(0.033)	(0.032)	(0.039)
q	0.019***	0.005***	0.019***	0.019***	0.019***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Land / K^{pre}	-0.128***	-0.165***	-0.142***	-0.153***	-0.138***
	(0.017)	(0.016)	(0.024)	(0.023)	(0.028)
Cash flow * Landco	0.569***	0.717***	0.759***	0.783***	0.761***
	(0.021)	(0.025)	(0.034)	(0.033)	(0.040)
Cash/K		0.027***	0.023***	0.027***	0.022***
		(0.004)	(0.005)	(0.005)	(0.006)
Cash * Landco		0.102***	0.169***	0.162***	0.160***
		(0.004)	(0.005)	(0.005)	(0.007)
% Recent purchase			0.002	0.039	0.014
			(0.042)	(0.041)	(0.051)
% Recent purchase * Landco			-0.708***	-0.759***	-0.752***
			(0.109)	(0.105)	(0.126)
Leverage				0.008	0.01
				(0.033)	(0.040)
Land / K^{pre} * High Debt-to-Land				-0.025*	-0.019
				(0.015)	(0.018)
I_K^{pre}					0.019***
					(0.006)
Industry dummies	Yes	Yes	Yes	Yes	Yes
Number of observations	824	751	708	708	708
Psuso R^2	0.137	0.243	0.311	0.312	0.312

Table III.
Collateral Effects on Fixed Investments: Additional Tests

This table presents additional tests of the effect of loss of collateral on firm investments. The dependent variable I/K is the average investment rate (defined as fixed investments over the beginning-of-period capital stock) between 1994 and 1998. Cash flow / K is cash flow over the beginning-of-period capital stock. q is Tobin's average q, Land/K^{pre} is the market value of land over the replacement cost of capital in 1989. Additonal proxies for firm quality are measured in 1989. Profit margin is operating profits over sales, sales growth is the sales growth in the past three years. Landco is a dummy variable equal to 1 if Land/K^{pre} is above the top industry quartile and 0 otherwise. Cash/K is the cash stock over the beginning-of-period capital stock at the end of 1993. % Recent purchase is the proportion of land (in market value) purchased during 1988-1990. High Debt-to-Land is a dummy variable indicating firms with debt over market value of land in 1989 above the top quartile. I / K^{pre} is the investment rate prior to the shock in 1989. Standard errors are based on the asymptotic variance in Koenker and Bassett (1982) and are presented in parentheses.

			Group	Non-group	
	(1)	(2)	(3)	(4)	(5)
Cash flow / K	0.120***	0.156***	0.217***	0.101*	0.135***
	(0.010)	(0.012)	(0.041)	(0.060)	(0.029)
q	0.017***	0.017***	0.005***	0.029***	0.020***
	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)
Land / K^{pre}	-0.038***	-0.031***	0.030	-0.151***	-0.154***
	(0.005)	(0.005)	(0.026)	(0.045)	(0.022)
Cash flow * Landco	1.442***	1.466***	-0.188***	0.780***	0.774***
	(0.030)	(0.025)	(0.045)	(0.062)	(0.029)
Cash stock / K	0.001	0.009**	-0.004	0.030***	0.026***
	(0.003)	(0.004)	(0.006)	(0.010)	(0.005)
Cash * Landco	0.140***	0.123***	0.000	0.206***	0.167***
	(0.005)	(0.005)	(0.007)	(0.011)	(0.005)
% Recent purchase		0.053	0.03	0.019	0.037
		(0.054)	(0.043)	(0.084)	(0.036)
% Recent purchase * Landco		-2.283***	-0.021	-1.716***	-0.619***
		(0.441)	(0.125)	(0.168)	(0.088)
Leverage		0.117***	0.045	-0.017	0.02
		(0.037)	(0.037)	(0.065)	(0.029)
Land / K^{pre} * High Debt-to-Land		-0.026*	0.014	-0.015	-0.027**
		(0.016)	(0.016)	(0.029)	(0.013)
Additional Proxies for Firm Quality					
Sales growth	-0.032	-0.025			
	(0.025)	(0.033)			
Profit margin	0.035	0.072			
	(0.069)	(0.067)			
Log (size)	0.004*	0.003			
	(0.002)	(0.002)			
I_K^{pre}		0.003			
		(0.006)			
LH^{pre} * Low-q					0.012
					(0.010)
Industry dummies	Yes	Yes	Yes	Yes	Yes
Number of observations	716	651	290	418	708
Psuso R^2	0.328	0.359	0.055	0.531	0.312

Table IV. Summary Statistics on the Lending Relationships and the Firms' Top Banks

This table presents descriptive statistics on banking relationships in the matched lending sample. Column (1) presents the whole-sample summary statistics averaged over the sample period between 1994 and 1998. Columns (2) and (3) present the statistics for the sub-samples of land-holding companies and the control group. The table presents the mean of each statistic, with the median in the parentheses. Land-holding companies are defined as the companies with market value of land to total replacement cost of capital above the industry top quartile. The remaining firms serve as the control group. Significance levels for the difference between the landholding companies and the control groups are based on two-tailed tests; significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	The Whole Sample	Land-holding companies	The control group
	(1)	(2)	(3)
Relationship Charateristics			
Duration (1984-93)	8.32	8.21	8.37
	(9.00)	(9.00)	(9.00)
Number of banks (1984-93)	16.37	15.65	1.65
	(14.00)	(13.00)	(0.00)
% Equity stake (1993)	1.61	1.49	16.63
	(0.00)	(0.00)	(14.00)
Log loan growth (1994-98 v. 1984-89)	0.34	0.17***	0.40
	(0.30)	(0.09)***	(0.42)
% of Relationships with the bigbanker	0.179	0.159	0.187
% of Relationships with the main bank	0.113	0.092*	0.122
% of firms with BBB or above rating (1989)	0.513	0.602***	0.481
% of firms with BBB or above rating (1994-98)	0.723	0.684**	0.738
Total number of firm-bank pairs	3,194		
Bank Charateristics			
% Real estate loans	0.055	0.053	0.055
	(0.037)	(0.037)	(0.037)
Capital ratio	0.03	0.03	0.03
	(0.028)	(0.028)	(0.028)

Table V
Collateral Effects on Corporate Borrowing

This table presents the effect of collateral losses on bank lending based on Heckman two-stage regressions. The first stage is a probit regression. The dependent variable is a dummy variable indicating the survival of the lending relationship. q is Tobin's average q. Cash flow/K is cash flow over the beginning-of-period capital stock. Cash/K is the cash stock over the capital stock at the end of 1993. Duration is the number of years that the firm-bank pair had positive loan balances. Big banker is whether the bank served as the firm's largest lender at least once. Main bank is a dummy variable equals to 1 if the bank is also the firm's main bank and zero otherwise. Equity ownership is the percent of shares owned by the bank. Number of banks is the number of banks with which the firm had lending relationships. Land/K^{pre} is the market value of land over the capital stock in 1990. Landco is a dummy variable equals to 1 if Land/K^{pre} is above the top quartile in the industry and 0 otherwise. Robust standard errors are presented in parentheses.

	(1a)	(1b)	(2a)	(2b)
	Probit	OLS	Probit	OLS
Relationship Characteristics				
Duration (1984-89)	0.193***	-0.421***	0.193***	-0.403***
	(0.013)	(0.040)	(0.013)	(0.038)
Number of banks (1984-89)	0.007	-0.015	0.017	-0.024
	(0.078)	(0.079)	(0.078)	(0.078)
Bigbanker (1984-89)	0.457***	-0.082	0.454***	-0.060
	(0.097)	(0.083)	(0.096)	(0.082)
Equity ownership	0.094***	0.033*	0.094***	0.039**
	(0.021)	(0.019)	(0.021)	(0.019)
Main Bank	0.113	-0.120	0.123	-0.112
	(0.102)	(0.089)	(0.103)	(0.089)
Access to Bond Market			0.131***	-0.039
			(0.050)	(0.063)
Firm Characteristics				
Log of assets	-0.044	-0.041	-0.039	-0.041
	(0.032)	(0.032)	(0.032)	(0.032)
q	-0.106***	0.001	-0.112***	0.001
	(0.023)	(0.002)	(0.023)	(0.002)
Cash flow/K	0.144**	0.103	0.131*	0.103
	(0.067)	(0.131)	(0.067)	(0.130)
Cash/K	-0.025*	-0.017	-0.023*	-0.017
	(0.013)	(0.022)	(0.013)	(0.021)
Collateral Related Variables				
Land/K^{pre}	-0.240*	-0.487***	-0.294**	-0.494***
	(0.135)	(0.187)	(0.132)	(0.188)
% Recent purchase	4.100***	1.051	4.154***	1.265*
	(1.050)	(0.729)	(1.072)	(0.732)
% Recent purchase * Landco	1.026	-3.570	1.133	-3.507
	(3.043)	(3.387)	(3.140)	(3.407)
Inverse Mills Ratio		-1.247***		-1.022**
		(0.472)		(0.454)
Number of observations	3191	2626	3191	2626
Psuso R^2 / R^2	0.162	0.300	0.164	0.300

Table VI
Collateral Effects on Fixed Investments: Controlling for Bank Characteristic

This table presents the effect of loss of collateral on firm investments after controlling for the firm's top lender characteristic. The dependent variable I/K is the average investment rate (defined as fixed investments over the beginning-of-period capital stock) between 1994 and 1998. Cash flow / K is cash flow over the beginning-of-period capital stock. q is Tobin's average q. $Land/K^{pre}$ is the market value of land over the replacement cost of capital in 1989. Landco is a dummy variable equal to 1 if $Land/K^{pre}$ is above the top industry quartile and 0 otherwise. Cash/K is the cash stock over the beginning-of-period capital stock at the end of 1993. % Recent purchase is the proportion of land (in market value) purchased during 1988-1990. High Debt-to-Land is a dummy variable indicating firms with debt over market value of land in 1989 above the top quartile. I / K^{pre} is the investment rate prior to the shock in 1989. %Real estate loan is the bank's real estate loan over assets in 1989. Capital ratio is bank equity over assets in 1989. Standard errors are based on the asymptotic variance in Koenker and Basset (1982) and are presented in parentheses.

	Including Bank Characteristics				Including Bank Dummies			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash flow / K	0.191***	0.184***	0.186***	0.149*	0.192**	0.199**	0.187*	0.177*
	(0.047)	(0.052)	(0.047)	(0.084)	(0.092)	(0.095)	(0.109)	(0.097)
q	0.029***	0.028***	0.036***	0.037**	0.029	0.028	0.037**	0.038*
	(0.000)	(0.000)	(0.001)	(0.017)	(0.024)	(0.021)	(0.018)	(0.020)
$Land / K^{pre}$	-0.093***	-0.113***	-0.082***	-0.092*	-0.114*	-0.118*	-0.134*	-0.112**
	(0.025)	(0.030)	(0.027)	(0.057)	(0.065)	(0.064)	(0.080)	(0.053)
Cash flow * Landco	0.687***	0.760***	0.750***	0.759**	0.696	0.764	0.756	0.745
	(0.048)	(0.053)	(0.049)	(0.386)	(0.547)	(0.500)	(0.516)	(0.587)
Cash/K	0.024***	0.031***	0.018***	0.028*	0.023**	0.024**	0.016	0.023
	(0.006)	(0.007)	(0.006)	(0.015)	(0.011)	(0.012)	(0.011)	(0.015)
Cash * Landco	0.213***	0.197***	0.196***	0.188**	0.212*	0.200**	0.194**	0.190**
	(0.006)	(0.007)	(0.007)	(0.088)	(0.111)	(0.098)	(0.097)	(0.082)
% Recent purchase		-0.078	-0.100	-0.045		-0.046	-0.115	-0.1
		(0.094)	(0.088)	(0.098)		(0.119)	(0.126)	(0.110)
% Recent purchase * Landco		-2.496***	-2.509***	-2.417**		-2.466	-2.246	-2.169
		(0.338)	(0.305)	(1.161)		(2.224)	(1.738)	(2.767)
Leverage		0.052	0.018	(0.007)		0.042	0.007	0.028
		(0.043)	(0.039)	(0.044)		(0.065)	(0.067)	(0.063)
$Land / K^{pre}$ * High Debt-to-Land		-0.013	-0.006	-0.014		-0.008	-0.012	-0.009
		(0.015)	(0.014)	(0.025)		(0.020)	(0.023)	(0.019)
I_K^{pre}			0.091***	0.103*			0.117*	0.117*
			(0.008)	(0.058)			(0.063)	(0.070)
Additional Proxies for Firm Quality								
Sales growth				-0.099				-0.063
				(0.175)				(0.134)
Profit margin				0.199				0.277
				(0.189)				(0.203)
Log (size)				0.007				0.004
				(0.005)				(0.006)
Bank characteristics								
% Real estate loans	-0.286*	-0.429**	-0.366**	-0.339*				
	(0.177)	(0.190)	(0.177)	(0.196)				
Capital ratio	2.139**	2.833***	2.263**	2.538*				
	(0.984)	(1.071)	(1.001)	(1.319)				
Bank dummies					Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	472	420	420	420	472	420	420	420
Psuso R^2	0.460	0.551	0.556	0.558	0.482	0.570	0.576	0.579