Collateral Channel and Credit Cycle: Evidence from the Land-Price Collapse in Japan

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Abstract

This paper investigates empirically the effect of real assets as collateral on the economy. As pointed out by Kiyotaki and Moore (1997), when loans are collateralized and firms are credit constrained, the amount borrowed is determined by the value of the collateral; a decrease in the price of productive assets will therefore have a negative impact on firm investments. These effects are cumulative, which leads to credit cycles.

There are potentially two major difficulties in empirically testing the relationship between collateral and firm investments. First, the value of collateral often is not observable due to the lack of active secondary markets for collateralizable assets, such as plants and machineries. Second, collateral is endogenous. For example, when firms invest they need to purchase machines and build plants, which expands their collateralizable assets. This paper deals with these two difficulties by using the land-price collapse in Japan in the early 1990s as a natural experiment. In Japan, the main form of collateral for corporate borrowing is land, the value of which is observable. In addition, between 1990 and 1993, there was a near 50% drop in land prices, which was unambiguously exogenous to any one individual firm. As firms suffer losses proportionate to their land holding, the amount of land held prior to the shock can serve as an exogenous instrument to measure collateral. I find that collateral affected Japanese firm investments in two important ways. The first is a collateral-damage effect: losses in collateral value reduced investments. The second is an indirect internal-liquidity effect: with reduced borrowing capacity, the firms had to rely more upon internally generated cash to finance their investments.

In addition to the investment analysis, we use a unique dataset of matched firm-bank lending, which permits us to further examine the mechanism through which collateral affects firm investments. In particular, I investigate whether colllateral losses also leads to reduced borrowing capacities. The matched sample allows me to control for unobservable heterogeneity in the loan supply. The results show, again, a significant collateral-damage effect: banks tended to lend less to those who suffered greater collateral losses.

*I thank Sudipto Dasgupta, Vidhan Goyal, David Scharfstein and William Wheaton for their comments and suggestions. I also thank Yoshiaki Ogura for excellent research assistance and a faculty research grant from the Center on Japanese Economy and Business at the Columimbia Business School.

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Contents

I. Introduction

Most bank loans to corporations are backed by collateral. For example, in the U.S., about 70% of all commercial and industrial loans are made on secured bases (Berger and Udell, 1990). Most of the collateral, such as machinery and land, are also inputs into the production process. What would happen if there were a shock to the collateral value? In particular, would such a shock affect firms' investments and thus growth? In a perfect capital market, collateral value should not matter because firms' investments depend solely on their investment opportunities. However, when the capital market is imperfect and when loans are collateralized (and firms are credit constrained), the amount borrowed is determined by the value of the collateral; a decrease in the price of productive assets will also have a negative impact on firm investments. This effect is cumulative: a drop in investments decreases future revenues, the firm's collateral value falls, and investments are reduced further. The model presented by Kiyotaki and Moore (1997) elegantly captures the above idea. The first theoretical work that addresses this issue is by Kashyap, Scharfstein, and Weil (1993) who present a model with multiple equilibria in which expectations about future output growth (decline) embodied in high (low) land prices are self-fulfilling.

Empirical testing of the relationship between collateral and firm investments, however, encounters two difficulties. First, the value of collateral may be difficult to observe. For example, in the U.S., because there are no active secondary markets for collateralized assets such as plants, machineries, and inventories, the value of collateral is not observable. The second difficulty is that collateral is endogenous. Firms making investments build plants and purchase machines, all of which can serve as collateral. Therefore, a shock that increases a firm's investments also increases its collateral value, which potentially results in an upward bias on the coefficient estimate in a regression of investments on collateral value.[1]

This paper seeks to address both empirical difficulties by studying how the collapse in land prices in Japan in the 1990s affected subsequent corporate investments. With regard to the observability of collateral value, land is widely used as collateral for corporate borrowing in Japan.[2] There is an active land market and consequently the value of collateral is observable. With regard to the endogeneity issue, I focus on a source of variation in collateral that is plausibly exogenous to the firms under study. Between 1991 and 1993, there was almost a 50% drop in land prices, which is unambiguously exogenous to cash flow or profitability for any individual firm. As firms suffered losses proportionate to their land holding prior to the shock, their land holdings prior to the shock can serve as an exogenous instrument to measure collateral. In particular, land-holdings prior to the shock measure the loss in collateral value and therefore can be thought of as an inverse measure of collateral.[3]

In addition to the investment analysis, I use a unique data set of matched firm-bank lend-

[1]Using the lagged value of the collateral may not help, because firms may have planned their investments earlier and have accumulated collateralizable assets, for example plants and machineries, prior to the actual investment expenditure.

[2]Theoretically, it is a little puzzling why collateral is so important in Japan where the bank-firm relationship is strong. Presumably, relationships and more informed monitoring by creditors substitute for physical collateral. For example, Berger and Udell (1994) show that, among small businesses in the U.S., firms with close relationships with creditors need to provide less collateral. Some researchers propose that unsecured loans collide with the Japansese 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 (Global Finance, 1995).

[3]What is left out from this measure is the land purchase between 1991 and 1993. However, this is a very small portion of the total land holding.

ing, which permits us to further examine the mechanism through which collateral affects firm investments. In particular, I investigate whether collateral losses also lead to reduced borrowing capacities. The main challenge in the testing lies in that it is difficult to separate the collateral effect from a loan supply effect due to the unobservable heterogeneity in lenders. For example, consider two Japanese firms, A and B, that are otherwise identical except that they borrow from two different banks and that firm A has invested more in land. Suppose one bank runs into trouble and has to cut back on its lending. If this unhealthy bank happens to be firm B's bank, a regression of borrowings on collateral would spuriously (and falsely) indicate a positive relationship. If this bank were firm A's bank, the regression would generate a negative coefficient on the collateral. This relation is again spurious and not causal. The matched sample allows me to control for the unobservable heterogeneity in the loan supply and therefore to isolate the effect of collateral on credit allocation.

I find that collateral affects Japanese firm investments in two important ways. The first is what I term as the collateral-damage effect: losses in collateral value reduce a firm's borrowing capacity and the firm responds by cutting back on its investments. The second is an indirect internal-liquidity effect: with reduced borrowing capacity, the firm has to rely more upon internally generated cash to finance its investments. With regard to corporate borrowing, I find, again, a significant collateral-damage effect: banks tend to lend less to firms that have suffered greater collateral losses.

In the original Kiyotaki and Moore's original model, the mechanism to generate a credit cycle is through the feedback between asset prices and investments. Admittedly, a main limitation of using the micro data is that it does not allow for an explicit test of the feedback effect. Several studies use macro time-series data to explain the investment behavior of Japanese firms in the 1990s (e.g., Kiyotaki and West, 1996, Ogawa and Kitasaka, 1999) and find that land value is related to investment behavior. However, the nature of macroeconomic data restrict the ability of these studies to deal with the endogeneity issue, and in the end, there is a limit to what the macro data can tell us. Therefore, by using micro, firm-level data, this paper complements the time-series analysis and provides rich micro-level evidence regarding the real effects of collateral.

The remainder of this paper is organized as follows. The next section lays out the research design. Section III describes the economic background of the land-market collapse in Japan in the early 1990s. Section IV describes the data. Section V presents evidence of the effects of collateral on investments. Section VI presents evidence of the effects of collateral on firm borrowing. Finally, Section VII presents a conclusion.

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

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 (Cargill, Hutchison, and Ito, 1997). 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.[4] Meanwhile, stock prices experienced a similar pattern of boom and bust.

Evidence on whether or not the asset-market crash was anticipated is mixed. On one hand, the monetary authorities were fully aware of, and concerned about, asset inflation. From May 31, 1989 to the end of 1989, the Bank of Japan raised the discount rates several times, from 2.5 percent to 4.25 percent. The Ministry of Finance also introduced several measures to slow down land-price inflation, such as raising land-related taxes and controlling lending to the real estate sector. On the other hand, contemporary press accounts indicate that the depth and rapidity of the drop surprised the public both in Japan and around the world.

The damage to collateral was significant. In Japan, a large fraction of business investments is financed by long-term intermediated loans that require collateral. As a rough estimate, about 75% of bank loans for investment purposes are backed by land.[5] This important form of collateral lost about half of its value between 1990 and 1993. This provides an excellent setting to test the effects of collateral a lá Kiyotaki and Moore (1997). It resolves the two major difficulties in the empirical testing, namely the observability and the endogeneity problem of collateral. With regard to the observability of collateral value, unlike other forms of collateral, such as machinery or inventory, there is an active secondary market for land and therefore land value is observable. Moreover, compared with other collateralizable assets such as plants, machinery, and inventories, the value of land depends less on a firm's idiosyncratic project value or cash flow. With regard to the endogeneity issue, the almost 50% drop in land prices between 1990 and 1993 is unambiguously exogenous to the cash flow or profitability for any one individual firm. As firms suffered losses proportionate to their land holding prior to the shock, land holding prior to the shock can serve as an exogenous measure of collateral. In

[4] Land prices dropped by between 3%-5% each year from 1994 to 1999 (Bernanke 2000, Table 2).

[5] Estimated based on numbers provided in Hoshi and Kashyap (2001).

particular, land holding prior to the shock measures the loss in collateral value and therefore can be thought of as an inverse measure of collateral.[6]

III. The Data

The data mainly come from the tapes compiled by the Development Bank of Japan (DBJ). The DBJ database contains detailed accounting data on all non-financial firms listed on various stock exchanges from 1956 to 1998. Other data sources used in this paper are the NIKKEI NEEDS database for share prices and the wholesale price index (WPI) for prices of output and investment goods.

The DBJ database has several advantages over the NIKKEI NEEDS database, a popular database for Japanese studies. First, it provides 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. This is why Japanese data have been used frequently in tests of investment models (e.g., Hayahi and Inoue 1991). Second, and more importantly, the DBJ database specifies for each firm the amount of long-term loans from each lender. In Japan, long-term loans are strongly associated with Japanese fixed investments and are typically backed by land. These data therefore can be used to examine whether firms with larger land holdings, while exhibiting drops in investments, also experienced reduced borrowing capacity. A matched sample allows me to control for the unobservable heterogeneity in the loan supply.

Following Hayashi and Inoue (1991), I apply different physical depreciation rates to construct the capital stock by the perpetual inventory method.[7] Worth mentioning is that Japanese law permits firms to carry land at historical rather than market value and, as a non-depreciable asset, the book value of land is a very poor measure of both the physical land owned by the firm and its market value.

The sample contains all manufacturing firms in the DBJ database. I drop firms that do not have enough data to construct a 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

[6] What is left out from this measure is the land purchased between 1991 and 1993. However, this should be a small portion of the total land holding.

[7] 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.

its accounting period, the year in which such a change occurs.[8] The final sample contains 847 firms. Table I presents the sample summary statistics. Column (1) of Table I displays the main firm characteristics after the shock for the period between 1994 and 1998. 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). Depending on the conditional distribution, the conventional ordinary-least-square (OLS) regression may not be the suitable model for the analysis of investment behavior.

To further investigate the characteristics and investment behaviors of firms that held lots of land prior to the shock, I sub-divide the sample into land-holding companies and non-land-holding companies. Land-holding companies are those with market values of land to the replacement cost of capital above the top quartile of the industry. The remaining firms in the sample are classified as non-land-holding companies and serve as the control group. Columns (2) and (3) of Table I summarizes the characteristics of the land-holding companies and the control group. All the variables are adjusted by the industry median. Land-holding companies are significantly smaller, have more cash stock and have fewer future investment opportunities. They also have less debt, but rely significantly more on bank debt. On average, they seem to invest more than the control group but the difference is not statistically significant. As indicated earlier, investment rates are skewed. The median should be a more efficient measure of the location of investments. Interestingly, according to the median, land-holding companies invest significantly less than the control group, consistent with the collateral hypothesis.

IV. Collateral Effects on Investments

This section investigates the effect of collateral on fixed investments. In particular, I examine how losses in collateral value during the real estate collapse affect a firm's investment behavior. The shock potentially affects investments in two ways. The first is a collateral-damage effect. The shock reduces collateral value and affects the borrowing capacity, which is translated into reduced investments. The second is an indirect internal-liquidity effect. Firms with larger land holdings become financially more constrained and have to rely more on internally generated cash. Thus, land-holding companies should have higher investment sensitivities to internal

[8] 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.

liquidity. Consistent with this, Goyal and Yamada (2003) find that cash-flow sensitivity for Japanese firms with high collateral decreased significantly during the asset inflation period in the 1980s and increased in 1991. Both effects can be captured in the following equation:

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

I/K is the fixed investments normalized by the beginning-period replacement cost of capital. q is Tobin's q measured as the total market value of the firm excluding market value of land divided by the replacement cost of capital (excluding land);[9] $CASH/K$ measures the internal liquidity which is defined either as the cash flow or as the cash stock (in 1993) normalized by the capital stock; and $Land/K^{pre}$ 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; it equals 1 if the firm had $Land/K^{pre}$ greater than the top industry quartile and 0 otherwise. Industry dummies control for differences in land-holding patterns due to industry-specific production technologies.[10] As it is difficult to know how long it takes for the collateral effect to show up in investment behavior, I examine the average investment rate after the shock, between 1994 and 1998, the end of year of the DBJ database. All the independent variables except cash stock are also averaged across years. The coefficient d captures the collateral-damage effect; e captures the internal-liquidity effect.

A well-documented problem is the measurement error resulting from using average q in place of marginal q.[11] Cummings et al. (1999) use analysts' earnings forecasts to construct more accurate measures of the fundamentals that affect the expected returns to investments. As analyst coverage is limited among Japanese firms, this methodology is not feasible in this study. Some researchers estimate the Euler equation, which measures a firm's intertemporal first-order condition for investments, to avoid measuring Tobin's q directly (e.g., Hubbard and Kashyap, 1994 and Whited, 1992). Gilchrist and Himmelberg (1998) assume that the marginal productivity of capital follows a VAR process and use variables that reflect information available to the firm to forecast the future profitability. Both the Euler equation and VAR methods require extensive time-series data. As my sample period is four years after the shock, a major

[9] 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.

[10] For example, a computer maker may own much less land than a ship builder simply because making computers does not require a lot of land. If I do not control for the industry fixed effects, I may attribute the differences in investments between these two firms to collateral even if it is purely due to industry wide shocks.

[11] See Erickson and Whited (2000) for an excellent discussion of measurement-error problems of Tobin's q.

structural changes, it is not feasible to implement these methods in this study. However, we measure collateral with pre-shock land holdings and focus on how these holdings affect post-shock investments. Unless the land holdings prior to the shock are strongly associated with information about investment opportunities in the after shock period, which is more than four years later, mis-measurement of q is less of a problem. Nevertheless, we will check the robustness of the results by only using the residual of collateral measure after taking out information about firm characteristics related to investment opportunities.

A related issue is on how the stock price collapse might have affected the tests. Similar to land prices, the stock prices in Japan also experienced a boom and bust from the second half of the 1980s to the early 1990s. A collapse in stock prices is directly 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; Blanchard, Rhee, and Summers, 1993; Stein, 1996; Chirinko and Schaller, 2001; Baker, Stein, Wurgler, 2003; Goyal and Takeshi, 2003). In the Japanese setting, the bust in 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 Takeshi, 2003). As my sample period is after the correction, q should mostly reflects the fundamental component. Of course this implicitly assumes that the non-fundamental component in q is greater or equal to zero. What if after the bust equity prices reflect a pessimism sentiment? 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, is not the case because compared with the control group, land-holding companies on average experienced a lower percentage drop in q (15% v. 47%).

Regarding the estimation technique, recall that in Panel A of Table I, the investment rate is right-skewed, with the median being only about one-third of the mean. When I estimate Equation (1) by using an ordinary-least-squares (OLS) regression, I find that the distribution of the residual is still skewed, violating the assumptions of OLS regressions. Therefore, I estimate the median or least absolute distance (LAD) regressions. LAD minimizes that sum of the absolute deviations rather the sum of the squared deviations. Therefore, it is less sensitive to the tail of the distribution or to outliers. Additionally, since for skewed data the median is generally a more efficient measure of the center of the data than the mean, the precision of the estimates will also increase.[12] The standard errors are calculated based on the method suggested by Koenker and Bassett (1982).[13] Later, I will examine the robustness of the results using alternative econometric techniques.

A. Basic Results

Table II shows both a collateral-damage effect and an internal-liquidity effect. The baseline regression uses cash flow as the measure of internal liquidity. Cash flow is defined as income after taxes plus (accounting) depreciation.[14] As a comparison, I report in column (1) the regression of investments on cash flow and Tobin's q (with industry dummies) only. Then I add collateral-related variables and report the results in column (2). The coefficient on pre-shock land holding, $Land/K^{pre}$, is, as expected, negative and significant at the 1% level. The coefficient on the interaction term between the land-holding company dummy and cash flow, meant to capture the internal-liquidity effect, is positive and significant at the 1% level. Moreover, compared with column (1), allowing for collateral effects improves the overall fit of the model considerably, increasing the pseudo R^2 from 2% to 14%.

Although most of the literature focuses on the sensitivity of investment to cash flow, some authors (e.g., Kashyap, Lamont, and Stein, 1994; Hoshi, Kashyap and Scharfstein, 1991) examine the sensitivity of investments to the cash stock available at the beginning of the year. Theoretically, the effect of an extra dollar of funds should be the same, independent of whether it enters the firm in this period or in an earlier period. In column (3) of Table II, I reestimate the baseline regression using the cash stock (cash and short-term securities) in 1993, the year before the sample period, as the measure of internal liquidity. I use lagged cash stock to reduce potential endogeneity issues.[15] Column (3) shows that the results are qualitatively the same

[12] 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.

[13] Except in the subsection on major investments, where the standard errors are estimated by bootstrapping.

[14] My cash flow measure includes dividends as dividends are discretionary. When I estmate the models using a cash flow measure excluding dividends, the results do not change. This is not surprising given the low and stable payout ratio in Japan.

[15] Cash reserves are endogenous for two reasons. On one hand, they are a residual financial variable: the firms invested heavily in land may be depleted in cash. This source of endogeneity is less problematic because although the correlations among variables complicate things, intuitively this endogeneity problem would bias the coefficient downwards. On the other hand, as pointed out by Opler, Pinkowitz, Stulz, and Williamson (1999), cash stock reflects firms' financial decisions. For example, land-holding companies, being more financially

as those in the baseline regression. The coefficient on collateral is negatively significant; the coefficient on the interaction term between cash stock and the land-holding company dummy is significantly positive, both at the 1% level. Then, I include both flow and stock measures of liquidity in the estimation and report the results in column (4). The basic pattern of collateral-damage and internal-liquidity effect holds: the coefficient on $Land/K^{pre}$ is significantly negative (1% level); the sensitivities of investments to cash flow and cash stock are significantly positive (1% level).

In column (5) of Table II, I also control for the timing of the land purchase. All else equal, firms that purchased more land immediately before the collapse in land prices, a period of rapid asset price runup, would suffer larger collateral losses. I include as an independent variable the % Recent Purchase, which is the proportion of land that were purchased from 1988 to 1990, and its interaction with the land-holding company dummy. The coefficient on % Recent Purchase is positive but not statistically significant whereas the interaction term is significantly negative (1% level). This suggest that a firm's investments are affected by recent purchase only if its total land holding is high, which is not surprising as the borrowing capacity depends on the total amount of collateral. Moreover, firms that purchased lots of land may have done so because they plan to undertake investments, which might explain the positive sign and the high standard error in the coefficient estimate of % Recent Purchase. The negative interaction term indicates that even if the land purchase is for future investments, firms are not able to actually undertake these investments if their overall collateral positions are severely damaged.

Lang, Ofek, and Stulz (1996) find that future growth and investment are negatively related to leverage, particularly for firms with low Tobin's q and high debt ratios. If land-holding companies are more leveraged, they may invest less not because of collateral but because of high leverage. Recall that in Table I, however, land-holding companies are actually less leveraged than the control group. Nevertheless, I add leverage as an explanatory variable and reestimate the model in column (6) of Table II. I measure leverage using the book debt-to-asset ratio in 1989, the year prior to the shock, to reduce the endogeneity problem. In column (6) of Table II, leverage itself has a positive although insignificant coefficient. This is probably because in an economy where debt is the dominating source of financing, leverage may also proxy for lending

constrained after the shock, may tend to pile up more cash in anticipation of future investments. I measure cash stock as the sum of the cash stock prior to the shock (year-end 1990) and cash flows between 1991 and 1993. This new measure of cash stock excludes the effects of past investments and financial decisions. I find the results remain qualitatively the same.

relationships and/or firm quality. The interaction term between leverage and the land-holding company dummy is significantly negative. Moreover, the leverage coefficient for land-holding companies (the sum of the coefficients on $Leverage$ and $Leverage * Landco$) is significantly negative at the 1% level. Meanwhile, the coefficients on collateral measures remain unchanged. Therefore, although leverage hinders investments in land-holding companies, it does not account for the collateral effects.

So far, a consistent pattern has emerged. First, companies that suffer greater losses in collateral cut back their fixed investments. Second, land-holding companies have to rely more upon internally generated funds (both cash flow and cash stock), to finance their fixed investments.

B. Discussion

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

If investment opportunities are not fully controlled for by Tobin's q or cash flow, it is possible that investments are negatively related to land holding not because of the collateral effect but because land holding contains additional (negative) information about profitable investment opportunities. This argument deserves serious consideration because, as shown in Table I, land-holding companies tend to be smaller and with fewer growth opportunities.

I try to mitigate this concern by performing two tests. First, I extract, from the pre-shock land holding, information that is not related to firm quality and see if it still affects the fixed investments. This involves two steps. In the first step, I run an OLS regression of pre-shock land holding on commonly used variables related to firm quality. In particular, the right-hand side variables sales growth,[16] the gross margin (defined as operating income over sales), q, liquidity measures (cash flow and cash stock normalized by capital stock), size (log of assets), all measured in 1989, and industry dummies in the first-stage regression. In the second step, I use the residuals (robust to the residual plus size) from the first-stage regression in place of $Land/K^{pre}$ in Equation (1). I report the results of the second-stage regressions in columns (1) and (2) of Table III.[17] There are not any qualitative changes from the earlier results.

In the second test, I control for the investment level prior to the shock. If land holding

[16] Similar to Shin and Stulz (1998), I try both one-year and three-year sales growth, which produces similar results. I report only the results from the three-year sales growth.

[17] Note that the second-stage regression includes a generated regressor. Normally, the standard errors should be adjusted to account for the uncertainty in the estimate of this generated regressor, $Land/K^{pre}\_residual$. However, as the first-stage regression is estimated on data for a sample period four years ago, $Land/K^{pre}\_residual$ can be considered as being generated in a sample independent of that in the second-stage regression. Therefore, the sampling variation of the generated regressor can be reasonably ignored asympotically.

is a proxy for firm quality, land-holding companies may have always invested less. Therefore, controlling the pre-shock investment level should drive away the effects of collateral. The results are reported in columns (3) and (4) of Table III. Adding the pre-shock investment level makes the absolute value of the coefficient on land holding slightly smaller. However, none of the earlier results change qualitatively.

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*.

At an aggregate level, a slightly higher proportion of non land-holding companies than land-holding companies have group affiliations (42% v. 33%). I estimate Equation (1) separately for group and non-group affiliated firms and report the results in columns (5) and (6) of Table III. Interestingly, the collateral effects identified earlier only exist for non-group firms. 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. However, such a benefit seems to come at a cost of efficiency: the investments of group affiliated firms are less responsive to Tobin's q (significant at 1% level).

These findings shed light on the recent debate on the benefit of the main bank system in Japan (Hoshi and Kashyap, 2001). Allegedly, close affiliation with a bank helps to avoid adverse selection and mitigate moral hazard problems. However, in light of the non-performing loan problem that emerged in the 1990s, scholars have recognized that the *keiretsu* system also has its costs and they questioned if the supposed benefits of main banking actually accrue to the firm. For example, Weinstein and Yafeh (1999) argue that banks, using their market power, push loans to client firms and cause firms to invest inefficiently. More radically, Miwa and Ramseyer (2002) in an article titled "The Fable of *keiretsu*," argue that *keiretsu* simply never existed, but rather ... began as a figment of the academic imagination, and they remain that today."

To check the robustness of the results to alternative classifications of *keiretsu* firms, I perform the tests based on another popular publication *Keiretsu no Kenkyu* published by the Keizai

Chosa Kyokai (Economic Survey Association).[18] The earlier results disappear: there is not any difference in collateral effects between group and non-group firms.[19] Given the controversy on the existence of the main bank system and the sensitivity of the results to the classification schemes, the earlier test results regarding the effect of group-affilation should be interpreted with caution.

B.3. Overinvestment or Underinvestment?

According to the model of Kiyotaki and Moore's (1997) model, reduced collateral value leads firms to underinvestment. In contrast, Jensen (1986) and others have argued that if managers prefer growth over profitability, they may 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 pet projects. The reduced 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 macro economy in general.

I distinguish between these two hypotheses by examining the different behavior of those firms with good investment prospects and those without. The overinvestment theory predicts that firms with poor investment opportunities would be hurt more because their investment expenditure depends more on collateral value rather than on the availability of good projects. Therefore, I create a dummy variable indicating whether a firm's average Tobin's q during the sample period 1994 - 1998 is below the industry median and let it interact with the pre-shock land-holding in Equation (1). Its coefficient is expected to be negative according to the overinvestment theory. Column (7) of Table III reports the regression results. The interaction term between the low-q dummy and $Land/K^{pre}$ is significantly positive (1% level), which is inconsistent with the overinvestment hypothesis. The positive sign probably is because low-q firms have fewer investment opportunities to begin with and thus are affected less by their

[18] 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.

[19] If I use the 1995 edition, collateral effects exist for both group affliated and non group affiliated firms. If I use the 1984 edition, collateral effects exist for none of the two groups.

collateral losses.

The next section examines how collateral affects different types of investments with a focus on major investments, which are less likely to be influenced by agency problems. The evidence is also supportive of the underinvestment hypothesis.

B.4. How Does Collateral Affect Different Types of Investments?

In this section, I further examine the collateral effect in a setting where it is likely to be important: decisions to make major investments. I ask two related questions. First, does collateral affect major investments? Due to the importance of major investments to firm growth, this question speaks to the significance of the collateral effect on the macro economy. Second, how does the collateral effect on major investments compare to that on ordinary investments? This question speaks to the composition of the collateral effect.

I define major investments as around the 90th percentile of the distribution of investment rates for all firm-years between 1994 and 1998. Ordinary investments are around the 25th percentile of the distribution of investment rates. Quantile regression provides a good econometric framework for evaluating the effect of collateral on these two types of investments because it allows for different coefficient estimates for the different portions (quantiles) of the investment distribution. I estimate simultaneously the .90 and .25 quantile regression and obtain an estimate of the entire variance-covariance matrix of the estimator by bootstrapping. Then I perform hypothesis testing concerning the coefficients across equations. Table IV presents the results from the two quantile regressions and the p-values for statistical tests of equality between the coefficient estimates from the two regressions.

In columns (1) and (2) of Table IV, the regressions produce vastly different coefficients for the .90 and 0.25 quantile regressions. Major investments are much more responsive to Tobin's q then ordinary investments; the relationship is significant at the 1% level. This is probably because ordinary investments are mostly necessary expenditures to maintain normal business operations and do not depend on future investment opportunities. Collateral-damage effect works for major and ordinary investments differently. The coefficient on $Land/K^{pre}$ is significant only for ordinary investments. For major investments, land purchased immediately before the shock, *% Recent Purchase*, is significantly positively (1% level) related to major investments, probably because firms anticipating major investments plan ahead and purchase more land. However, they seem not to be able to implement all these investments if they have large total land holdings, as suggested by the significantly negative sign of the interaction between % *Recent Purchase* and the land-holding company dummy (1% level). Therefore, the collateral damage affects major investments through recent purchases. The internal-liquidity effect is similar for the two types of investments: the interaction terms between the land-holding dummy and internal liquidity are both significantly positive (1% level).

C. Robustness Checks

The evidence presented so far suggests a strong influence of collateral on firm investment decisions, both through a direct collateral-damage effect and an indirect internal-liquidity effect. This section adds additional controls to the model to test the robustness of this finding and the accuracy of my assumptions.

C.1. The impact of negative cash flow observations

If firms that held a lot of land prior to the shock are more likely to be in financial distress, they may have to invest less because they might be forced by their creditors to use cash to repay debt rather than to invest in profitable projects. Also, according to Allayannis and Mozumdar (2001), financially distressed firms are responsible for the observed non-monotonic sensitivity of investments to cash flows. Therefore, following Allayannis and Mozumdar (2001), I classify firms with negative cash flow observations as potentially financially distressed. Land-holding companies do not seem to be more likely to be in financial distress: negative cash flow observations (13% of the sample) are distributed equally across land-holding and the control group (0.12% v. 0.16%). I delete all the negative cash flow observations and re-estimate Equation (1). All the qualitative results remain the same (not reported).

C.2. Investments prior to the shock

I examine the impact of land holdings on firm investments prior to the shock. As noted earlier, there is an endogeneity issue in estimating an investment equation with contemporaneous land holdings. However, as a robustness check, this test helps to mitigate the concern that the results so far also exist prior to the shock, which means that greater land holding proxies for lower firm quality and that land-holding companies are always more financially constrained. I estimate the investment equation (1) using data between 1986 and 1989, the period of rapid land price increase (not reported). I find that land holding itself is not significant in explaining the investments prior to the shock. The coefficient on the interaction between land-holding company dummy and cash flow is significantly negative, suggesting that land-holding companies enjoyed a larger expansion of their borrowing capacities relative to non-land-holding companies.

C.3. Alternative definitions of land holding and the sample period

So far, the tests assume that land owned by firms is located in the same area and therefore is subject to the same price shock. However, the locations of corporate land holdings can be complicated. For a given firm, land used for production is mostly likely located in the region where the firm is located, whereas land used for speculation purposes may be located in areas with rapid price inflation such as Tokyo. This is not a problem if different regions experienced the degree of decline in prices. However, there are considerable variations in price decreases across regions. This problem can be resolved if I have data on the exact locations of different parcels of land owned by firms. However, these data are not availably. To check the robustness of the earlier results, I collect data on land prices in all the 47 prefectures.[20] I perform the tests based on the assumption that all land owned by a firm is in the same area as the location of the firm. Note that the earlier assumption of same land location overestimates collateral losses for firms with land holdings located in regions with smaller price drops. Location-specific prices allows me to correct the overestimation problem for those firms located in areas with small price drops. If both tests yield qualitatively the same results, it probably means that land location does not play an important role in the estimation. Incorporating location-specific loss factor does not change any of the earlier results (not reported).

I also perform robustness checks regarding other measures of land holding and the definition 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); and to the alternative definition of the sample period as between 1994 and 1997.

V. Collateral Effects on Firm Borrowings

So far, I have found evidence of collateral effects on firm investments. In this section, I examine whether losses of collateral value also lead to reduced borrowing capacity.

[20] I grateful to Ritsuko Yamazaki at the Ministry of Finance in Japan and Bill Wheaton at MIT for their help on this data.

A. Model Specifications

The main difficulty in testing is that it is hard to separate the collateral effect from the loan supply effect due to unobservable heterogeneity in the lenders. For example, consider two firms, A and B, that are otherwise identical except that firm A invested more in land and the two firms borrow from two (unobservable) different banks. Suppose one bank runs into trouble and the other does not. The troubled bank has to cut back on its lending. If it happened to be firm B's bank, a regression of borrowing on collateral would spuriously (and falsely) indicate a positive relation. If this bank were firm A's bank, the regression would generate a negative coefficient on collateral. This relation is again spurious, not causal. This problem can not be resolved by adding controlling variables relating to bank healthiness such as credit ratings or bank capital because bank healthiness is endogenous and depends critically on client firms' performance.

I deal with the above difficulty by improving on the data and using a sample of matched firm-bank lending data. This data allows me to fully control for the (observable and unobservable) characteristics of the lenders through bank fixed effects. In particular, I estimate the following equation:

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

Similar to the tests on firm investments, I look at average lending for the period of 1994-98. Subscript i indexes firms; j indexes banks. $Lending_{ij}$ is a measure of lending from bank j to firm i between 1994 and 1998, which I will discuss shortly. $Land/K^{pre}$ is the market value of land in 1989 normalized by capital stock, and u_j is the bank fixed effect. Similar to the investment equation (Equation (1)), the coefficient d captures the collateral-damage effect. The null hypothesis is that collateral value does not affect borrowing capacity and therefore collateral loss does not lead to tightened credit availability.

I measure the availability of credit using the log of a firm's long-term borrowing from a particular bank between 1994 and 1998 normalized by the average borrowing from the same bank during the five years prior to the shock between 1984 and 1989. 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, due to collateral losses, firms generally face tighter credit constraints. 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. 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. Again, I average across years.[21]

With regard to firm control variables, I include Tobin's q to control for investment need. I also control for cash flow and cash stock. The effect of cash flow, however, is not obvious. To the extent that it reflects future profitability, it also controls for demand for credit. If firms follow a pecking-order financial policy, however, higher cash flow reduces loan demand. Other firm controls in the regressions are firm size (measured as the log of assets) and industry dummies.

I include in the regressions a set of variables reflecting the strength of the lending relationship in the ten years (1984-1993) prior to my sample period. Table V presents the summary statistics of relationship-related variables. The first dimension of the relationship is its duration. This should be a proxy for the private information the lender has about the firm. Petersen and Rajan (1994) and Berger and Udell (1995) demonstrate explicitly that firms with long-term relationships receive more credit from banks and pay lower interest rates on loan commitments.

My second measure of the strength of the relationship is how concentrated the firm's borrowing is (measured as the natural log of the number of banks). Firms may concentrate their borrowing with a lender to reduce overall monitoring costs, improve the lender's control, and cement their relationships (Petersen and Rajan, 1994). On the other hand, concentration also increases the lender's information monopoly and creates "hold-up" costs. Sharpe (1990), Rajan (1992), and von Thadden (1995) argue that firms can avoid these hold-up costs by establishing relationships with another bank. From Table V, it is clear that the firms in my sample borrow from multiple banks. During the ten-year period between 1984 and 1993 prior to the sample period, the firms borrowed from 16 banks on average with a median of 14 banks. The firms do not spread their borrowing evenly across all banks. They on average borrowed about one-third from a single institution. Even firms with over 20 lenders concentrated about one-fourth of

[21] In addition to the consideration as discussed earlier in the investment analysis, averaging across years is reasonable given the long-term nature of the loans in my sample. Loan balances adjust slower than the willingness of the lender to lend. As the loan matures, we observe a zero balance after years of stable balances. It is possible that the firm does not need further financing in the current year but the relationship resumes in the next year as the firm's needs arise. On the other hand, it is also possible that the bank decides to terminate the relationship permanently. Therefore, compared with snapshots of loan balances, averaging across years is less noisy.

their borrowing with its largest lender. Therefore, I also include a dummy variable indicating whether the bank was the firm's biggest lender at least once from 1984 to 1993.

Another way to mitigate the "hold-up" problem and to ensure bilateral commitment between the lender and the borrower is for the lender to take an equity stake that allows her to share future surpluses with the borrower. While prohibited in some countries, it is common for Japanese banks to hold equity in client firms. Therefore, the third dimension of the relationship that I include in the regression is the percentage of equity stake that the bank has in the firm. Lastly, the institutional setting in Japan suggests that main banks obtain additional information of the group-affiliated firms. Therefore, I include a dummy variable indicating whether the bank is the firm's main bank.

Of all the firm-bank pairs in 1989, about 18% did not have a lending relationship during the after-shock period between 1994 and 1998. To correct for the potential survivorship bias, I estimate a Heckman's (1979) two-stage regression. The first stage is a probit regression on whether the relationship survived using all the firm-bank pairs; the second stage is an ordinary-least-squares regression on the log of loan growth with bank fixed effects. The results are presented in Table VI.

B. Findings

Column (1a) of Table VI reports the first-stage probit regression results. The dependent variable equals one if the relationship remains after the shock and zero otherwise. The independent variables are measured at the end of 1989. Relationship variables are important in determining the change in loan renewals. Duration, being a big lender to the firm, and equity stake all increase the chance of loan renewal significantly (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 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 proportionally bigger 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 negative sign (significant at the 10% level), suggesting that cash stock reduces financing need. Lastly, there is a significant effect of collateral damage on the lender's decision regarding whether to continue a relationship (10% level). All else equal, firms suffered larger collateral losses were less likely to have their loans renewed. 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.

The second-stage OLS regression is estimated based on the subgroup of firm-bank observations that have positive loan balances. The results are in 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. Collateral-damage effect is significant in credit allocation, that is, firms with larger collateral losses receive less funds, as indicated by the significantly negative coefficient on $Land/K^{pre}$ (1% level). Among the relationship variables, equity stake is still significantly positive. Duration, however, is significantly negative. This could be reflecting that some of the loans granted earlier have been paid back. Notably, the coefficient on Tobin's q is insignificant. This seems to be consistent with media reports that Japanese banks are protective of their weak clients with whom they have good relationships and q becomes relative unimportant in the credit allocation decisions.

C. Alternative Explanation

It is possible that land-holding companies borrowed less from banks not because of the collateral but because they had more access to other sources of financing, say the public bond market. In Japan before 1990, access to the public debt market was highly regulated and issuing firms had to meet certain accounting criteria. In November 1990, all the official restrictions were dropped. 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.[22] In general, larger and more profitable companies had more access to the public bond market (Hoshi and Kashyap, 2001). Recall from Table I that land-holding companies tend to be smaller than the control group. Therefore, it is less likely that their lower loan growth results from their lower demand for loans due to their borrowing from alternative sources. Nevertheless, to further check this hypothesis, I measure a firm's accessibility to the public debt market using the accounting criteria rating agencies use to give firms an investment grade as reported by Hoshi and Kashyap (2001). I code a dummy variable indicating whether or not a firm meets these criteria at least once during the sample

[22] According to Hoshi and Kashyap (2001), the accounting criteria based on which the government restricted public bond issurance 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.

period 1994-1998 and include it in the estimation.[23] It turns out that access to bond markets does not alter any of the earlier results qualitatively. The coefficient estimate on bond eligibility itself is positive and significant (1% level) in the first stage, suggesting that firms that meet the bond issuance criteria are more desirable customers to banks and that during bad times, firms do not terminate lending relationships even if they have access to alternative sources of financing. Bond eligibility is not significant in the second stage.

VI. Conclusions

This paper begins its empirical investigation by noting that a small shock to the return of productive assets can, at least theoretically, generate a large swing in outputs if these productive assets serve both as a production factor and as the collateral for borrowing. Is this effect real and significant? The answer based on this analysis is affirmative.

Using the shock to collateral due to the land market collapse in Japan as a natural experiment, this paper finds that collateral affects fixed investments of manufacturing firms in two important ways. The first is a collateral-damage effect: the firm responds to losses in collateral value by cutting back investments. The second is an indirect internal-liquidity effect: with a reduced borrowing capacity, the firm has to rely more on internally generated cash to finance investments. As evidence of the importance of the collateral effects, I find that they affect both major and ordinary investments. Lastly, bank lending provides further evidence of the mechanism through which collateral value affects investments. Using matched firm-bank data and hence controlling for the unobservable heterogeneity in the loan supply, I find a significant collateral-damage effect on bank credit allocation. That is, banks tend to lend less to those who suffer greater collateral losses.

The significant collateral effects on firm borrowing and investment shed light on the debate as to whether the U.S. will fall into a similar trap as Japan did in the 1990s. In U.S., due to its abundant supply in many regions, land is not widely used as collateral. To the extent that it is, real estate prices have been stable and therefore, the collateral channel is not likely to be as strong as it is in Japan in amplifying a downturn. However, the very existence of the collateral channel as established in this paper, suggest that the recession can be exacerbated by

[23] 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.

the fact that a significant portion of firm borrowing depends on collateral value. The Japanese experience also has implications for economies other than the U.S.: there is a risk that some Asian economies, where land has also been used extensively as collateral for corporate borrowing and land prices have experienced persistent declines since 1997, could mimic Japan's recession in the 1990s.

REFERENCES

Allayannis, G. and A. Mozumda, 2001, The investment-cash flow sensitivity puzzle: can negative cash flow observations explain it? University of Virginia working paper.

Almeida, H. and M. Campello, 2001, Financial constraints and investment-cash flow sensitivities: new research directions. New York University working paper.

Baker, M., J. Stein, J. Wurgler, 2003, When does the market matter? stock price and the investment of equity-dependent firms, forthcoming, Quaterly Journal of Economics.

Berger, A. and G. Udell, 1990, Collateral, loan quality, and bank risk, Journal of Monetary Economics 25, 21-42.

Blanchard, O., C. Rhee, and L. Summers, 1993, The stock market, profit, and investment, Quaterly Journal of Economics: pp. 115-136.

Cargill, Thomas, Hutchison, Michael M; Ito, Takatoshi, 1997, The political economy of Japanese monetary policy. Cambridge and London: MIT Press.

Chirinko, R. and H. Schaller, 2001, Business fixed investment and "bubbles": the Japanese case, American Economic Review XCI: 663-680.

Cleary, S., 1999, The relationship between firm investment and financial status, Journal of Finance 54: 673-692.

Cummins, J., K. Hassett, and S. Oliner, 1999, Investment behavior, observable expectations, and internal funds, mimeo, New York University.

Erickson, T., and T. Whited, 2000, Measurement error and the relationship between investment and q, Journal of Political Economy 108, 1027-1057.

Gilchrist and Himmelberg, 1995, Evidence on the role of cash flow for investment, Journal of Monetary Economics 36, 541-572.

Goyal V. and T. Yamada, 2003, Asset price shocks, financial constraints, and investment: evidence from Japan, forthcoming, *Journal of Business.*

Hayashi, F. and T. Inoue, 1991, The relation between firm growth and Q with multiple capital goods: theory and evidence from panel data on Japanese firms, Econometrica 59: 731-53.

Heckman, J., 1978, Dummy endogenous variables in a simultaneous equation system, Econometrica 46: 931-59.

Hoshi, T. and A. Kashyap, 2001, Corporate financing and governance in Japan (MIT Press, Cambridge, MA).

Hoshi, T., A. Kashyap, and D. Scharfstein, 1990, The role of banks in reducing the costs of financial distress, Journal of Financial Economics: 67-88.

Hoshi, T., A. Kashyap, and D. Scharfstein, 1991, Corporate structure, liquidity, and investment: evidence from Japanese industrial groups, Quarterly Journal of Economics 106: 33-60.

Hubbard, G., 1998, Capital market imperfections and investment, Journal of Economic Literature 36: 193-225.

Hubbard, G. and A. Kashyap, 1994, Internal net worth and the investment process: an application to U.S. agriculture, Journal of Political Economy 100, 506-534.

Kaplan, S. and L. Zingales, 1997, Do investment-cash flow sensitivities provide useful measures of financing constraints? Quarterly Journal of Economics 112: 169-215.

Kaplan, S. and L. Zingales, 2000, Investment-cash flow sensitivities are not valid measures of financing constraints, Quarterly Journal of Economics 115: 707-12.

Kashyap, S, L. Owen, and J. Stein, 1994, Credit conditions and the cyclical behavior of inventories, Quarterly Journal of Economics 109: 565-92.

Kashyap, A., D. Scharfstein, and D. Weil, 1993, The high price of land and the low cost of capital: theory and evidence from Japan, MIT working paper.

Kiyotaki, N. and J. Moore, 1997, Credit cycles, Journal of Political Economy 105: 211-248.

Kiyotaki, N. and K. West, 1996, Business fixed investment and the recent business cycle in Japan, National Bureau of Economic Research Working Paper 5546.

Koenker, R. and G. Bassett Jr., 1982, Robust tests for heteroscedasticity based on regression quantiles, Econometrica 50, 43-61.

Koenker, R. and K. Hallock, 2001, Quantile Regression, Journal of economic persepctives 15, 143-156.

Lamont, O., 1997, Cash flow and investment: evidence from internal capital markets, Journal of Finance 52: 83-109.

Morck, R., R. Vishny, and A. Shleifer, 1990, The stock market and investment: is the market a sideshow? Brokkings Papers on Economic Activity.

Ogawa, K. and S. Kitasaka, 1999, Market valuation and the q theory of investment, The Japanese Economic Review 50: 191-211.

Opler, Pinkowitz, Stulz, and Williamson, 1999, The determinants and implications of corporate cash holdings, Journal of Financial Economics 52: 3-46.

Petersen, M. and R. Rajan, 1994, The benefits of lending relationships: evidence from small business data, Journal of Finance 49, 3-37.

Rajan, R., 1992, Insiders and outsiders: the choice between informed and arm's length debt, Journal of Finance 47, 1367-1400.

Stafford, E., 2001, Managing financial policy: evidence from the financing of major investments, Harvard University Working Paper.

Shibata, Y., 1995, Coming soon, a whole new bank credit system for Japan. Global Finance, August, 58-59.

Stein, J., 1996, Rational capital budgeting in an irrational world, Journal of Business LXIX: 429-455.

Toshi, Kashyap, and Scharfstein, 1991, Corporate structure, liquidity, and investment: evidence from Japanese industrial groups, Quarterly Journal of Economics: 33-60.

Whited, 1992, Debt, liquidity constraints, and corporate investment, Journal of Finance 47, 1425-1459.

Table I. Summary Statistics

This table presents descriptive statistics on various firm characteristics in Japan averaged over the sample period between 1994 and 1998. Column (1) presents the whole-sample summary statistics. 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 normalized by the beginning-of-period capital stock) between 1994 and 1998. Cash flow/K is cash flow normalized by normalized by the beginning-of-period capital stock. q is Tobin's average q, Land/K^{pre} is the market value of land in 1989 normalized by the replacement cost of capital. Landco is a dummy variable equal to 1 if Land/K^{pre} is above the top industry quartile and 0 otherwise. Cash flow*Landco is an interaction term between Cash flow/K and Landco. Cash stock/K is the cash stock in 1993 normalized by the beginning-of-period capital stock. Cash stock*Landco is an interaction term between Cash stock/K and Landco. % Recent purchase is the proportion of land (in market value) purchased during 1988-1990. Standard errors are calculated based on the asymptotic variance and are presented in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
Cash flow / K	0.02***	0.415***		0.216***	0.142***	0.140***
	(0.001)	(0.021)		(0.024)	(0.033)	(0.026)
q	0.016***	0.019***	0.002***	0.005***	0.019***	0.023***
	(0.002)	0.000	0.000	0.000	0.000	0.000
Land / K^{pre}		-0.128***	-0.215***	-0.165***	-0.142***	-0.089***
		(0.017)	(0.019)	(0.016)	(0.024)	(0.022)
Cash flow * Landco		0.569***		0.717***	0.759***	0.764***
		(0.021)		(0.025)	(0.034)	(0.027)
Cash stock / K			0.032***	0.027***	0.023***	0.014***
			(0.004)	(0.004)	(0.005)	(0.004)
Cash stock * Landco			0.145***	0.102***	0.169***	0.195***
			(0.004)	(0.004)	(0.005)	(0.005)
% Recent purchase					0.002	0.016
					(0.042)	(0.035)
% Recent purchase * Landco					-0.708***	-0.368***
					(0.109)	(0.085)
Leverage						0.046
						(0.028)
Landco * Leverage						-0.419***
						(0.046)
Industry dummies	yes	yes	yes	yes	yes	yes
# of observations	847	824	751	751	708	708
Psuso R^2	0.018	0.137	0.175	0.243	0.321	0.323

Table III. Collateral Effects on Fixed Investments: Additional Tests

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 normalized by the beginning-of-period capital stock) between 1994 and 1998. Cash flow/K is cash flow normalized by normalized by the beginning-of-period capital stock. q is Tobin's average q, Land/K^{pre} is the market value of land in 1989 normalized by the replacement cost of capital, Land/K^{pre}_residual is the residual of a regression of Land/K^{pre} on variables related to firm quality. Landco is a dummy variable equal to 1 if Land/K^{pre} is above the top industry quartile and 0 otherwise. Cash flow*Landco is an interaction term between Cash flow/K and Landco. Cash stock/K is the cash stock in 1993 normalized by the beginning-of-period capital stock. Cash stock*Landco is an interaction term between Cash stock/K and Landco. % Recent purchase is the proportion of land (in market value) purchased during 1988-1990. Low-q is a dummy variable equal to 1 if q is above the median. Standard errors are calculated based on the asymptotic variance and are presented in parentheses.

					Group	Non-group	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cash flow/K	0.144***	0.250***	0.213***	0.137***	0.191***	0.111***	0.131***
	(0.012)	(0.015)	(0.028)	(0.026)	(0.043)	(0.037)	(0.024)
Q	0.021***	0.017***	0.007***	0.024***	0.006**	0.029***	0.027***
	(0.001)	(0.001)			(0.002)		
Land / K^{pre}_residual	-0.112***	-0.101***					
	(0.022)	(0.026)					
Land / K^{pre}			-0.128***	-0.087***	0.04	-0.110***	-0.112***
			(0.019)	(0.022)	(0.031)	(0.032)	(0.021)
Cash flow * Landco	1.220***	1.336***	0.636***	0.767***	-0.159***	0.776***	0.775***
	(0.035)	(0.038)	(0.029)	(0.027)	(0.048)	(0.038)	(0.025)
Cash stock / K	0.016***	0.014***	0.013***	0.013***	0.000	0.021***	0.016***
	(0.004)	(0.005)	(0.005)	(0.004)	(0.007)	(0.006)	(0.004)
Cash stock * Landco	0.152***	0.124***	0.083***	0.195***	-0.004	0.215***	0.208***
	(0.006)	(0.007)	(0.005)	(0.005)	(0.008)	(0.006)	(0.004)
% Recent purchase		0.018		-0.021	0.038	-0.009	-0.02
		(0.071)		(0.035)	(0.044)	(0.052)	(0.032)
% Recent purchase		-1.784***		-0.377***	-0.028	-0.795***	-0.429***
* Landco		(0.606)		(0.085)	(0.139)	(0.134)	(0.079)
Leverage		0.159***		0.042	0.035	0.028	0.061**
		(0.047)		(0.028)	(0.039)	(0.043)	(0.026)
Landco * Leverage		-0.110*		-0.419***	-0.022	-0.319***	-0.487***
		(0.066)		(0.046)	(0.074)	(0.068)	(0.044)
I_K^{pre}			0.100***	0.009**			
			(0.004)	(0.004)			
LH^{pre} * Low-q							0.031***
							(0.008)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of observations	660	602	751	708	290	418	751
Psuso R^2	0.452	0.483	0.249	0.323	0.054	0.537	0.325

Table IV. Quantile Regressions of Major Investments v. Ordinary Investments

This table presents the effect of loss of collateral on investments based on quantile regressions. The dependent variable is the average investment rate (defined as fixed investments normalized by the beginning-of-period capital stock) between 1994 and 1998. Cash flow/K is cash flow normalized by normalized by the beginning-of-period capital stock. q is Tobin's average q, Land/K^{pre} is the market value of land in 1989 normalized by the replacement cost of capital. Landco is a dummy variable equal to 1 if Land/K^{pre} is above the top industry quartile and 0 otherwise. Cash flow*Landco is an interaction term between Cash flow/K and Landco. Cash stock/K is the cash stock in 1993 normalized by the beginning-of-period capital stock. Cash stock*Landco is an interaction term between Cash stock/K and Landco. % Recent purchase is the proportion of land (in market value) purchased during 1988-1990. Standard errors in column (1) and (2) are calculated based on asymptotic variance and are presented in parentheses. The p-values in column (3) are for tests of equality in coefficient estimates in column (1) and (2) and are calculated based on a simultaneous estimation of 0.25 and 0.90 quantile regression by bootstrapping.

	Regression Quantiles		
	.25 quantile	.90 quantile	p-values
	(1)	(2)	(3)
Cash flow / K	0.217***	0.213**	0.912
	(0.044)	(0.083)	
Q	0.000	0.040***	0.002
	(0.001)	(0.002)	
Land / K^{pre}	-0.085**	0.049	0.535
	(0.040)	(0.083)	
Cash flow * Landco	0.154***	0.613***	0.498
	(0.046)	(0.108)	
Cash stock / K	0.016**	0.000	0.525
	(0.007)	(0.014)	
Cash stock * Landco	0.123***	0.224***	0.011
	(0.008)	(0.019)	
% Recent purchase	0.057	0.288***	0.517
	(0.064)	(0.107)	
% Recent purchase * Landco	-0.066	-1.266***	0.061
	(0.204)	(0.211)	
Leverage	0.019	0.044	0.858
	(0.049)	(0.114)	
Leverage * Landco	-0.206***	-0.065	0.572
	(0.077)	(0.166)	
I_K^{pre}	0.012	0.117***	0.420
	(0.010)	(0.009)	
Industry dummies / cluster	yes	yes	
# of observations	708	708	
Psuso R^2	0.140	0.664	

Table V. Summary Statistics on Lending Relationships

This table presents descriptive statistics on banking relationships in the matched lending sample. Column (1) presents the whole-sample summary statistics. 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)
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		

Table VI. Collateral Effects on Firm Borrowing from Banks

This table presents the effect of loss of collateral 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. Log of assets is the log of the total assets. q is Tobin's average q. Cash flow/K is cash flow normalized by normalized by beginning-of-period capital stock. Cash stock/K is the cash stock in 1993 normalized by beginning-of-period capital stock. Duration is the number of years that the firm-bank pair had positive loan balances during 1984-93. Big banker is whether the bank served as the firms largest lender at least once during 1984-93. 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 number of shares owned by the bank as a percent of the firm's total shares outstanding. Number bank is the number of all the banks that the firm had lending relationship during 1984-93. $Land/K^{pre}$ is the market value of land in 1989 normalized by capital stock. 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) Probit	(1b) OLS	(2a) Probit	(2b) 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 stock / K	-0.025*	-0.017	-0.023*	-0.017
	(0.013)	(0.022)	(0.013)	(0.021)
Collateral				
$Land/K^{pre}$	-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