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Corporate Investment, Liquidity Constraints, and the Asset Price Bubble from the 1980s through the 1990s: Evidence from Japan

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Abstract

We examine the effect of the asset price bubble in the 1980s on firms' fixed investment and liquidity constraints using manufacturing panel data. In particular, we try to identify the effect of asset price inflation and the monetary easing policy on firms' liquidity constraints. The findings are twofold. First, an asset price bubble decreases firms' liquidity constraints and promotes fixed investment regardless of firm size. Specifically, the effect is greater for large firms than for small firms. Second, the monetary easing policy decreases the liquidity constraint of small firms during asset price inflation.

Keywords

Asset price bubble, Liquidity constraint, Corporate investment

1. Introduction

How non-fundamental valuations or bubbles affect corporate investment and liquidity constraints has been a long-standing issue. According to Stein (1996), firms increase investment when their stock price is overvalued and decrease investment when it is undervalued. In addition, firms with more collateral assets do not tend to face liquidity constraints and have easy access to external finance. In contrast, firms with less collateral assets tend to suffer from liquidity constraints, and do not have many sources of external funding. However, during periods of asset price inflation, even firms holding relatively fewer collateral assets raise external funds with relative ease. We investigate the differential reaction to the asset price bubble by firm size.

During the Japanese bubble years from the late 1980s to the early 1990s, stock and land prices witnessed drastic boom-and-bust cycles. Likewise, real investment swiftly increased when asset prices soared and decreased when they collapsed. During asset price inflation, collateral values increase and firms raise external funding through the capital market or borrow funds from banks. Firms then use external funds for real investment. Many empirical works have studied asset price inflation or bubbles, but the effect of bubbles on real investment or liquidity constraints has not been adequately examined.[1]

Chirinko and Schaller (2001) examined the existence of bubbles and the shock of bubbles on Japanese business investment. They found that the bubble increased business investment by approximately 6-9%. Only Chirinko and Schaller (2001) directly investigated the effect of bubbles on firm fixed investment. However, they have not clarified whether bubbles influence liquidity constraints.

Goyal and Yamada (2004) explored how asset price inflation affects corporate investment and external finance costs during the asset price bubble in Japan from the late 1980s to the early 1990s. Goyal and Yamada (2004) found that liquidity constraints decrease and corporate investments increase during a bubble. However, their estimation results, based on cross-

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1 Nemoto (2017) and Hu and Oxley (2018) are recent works on the Japanese bubble in the 1980s.

sectional data, may face omitted-variable problems. In addition, since the sample size markedly differs by estimation period, the relationship between firm fixed investment and liquidity constraints during the bubble might not have been correctly captured. To clarify these problems, we use a panel data set of Japanese manufacturing companies and estimate a Tobin's q-type function according to firm size.

Here, we briefly summarize the main results of our study. First, regardless of firm size, the asset price bubble decreases liquidity constraints. The result suggests that firms with collateral assets, whose value increased during asset price inflation, were able to raise external funding. In particular, the larger the firm, the greater is the effect of the bubble on the liquidity constraint. Large firms with more collateral assets originally have greater access to external funding. Evidence indicates that they additionally increased external finance during asset price inflation. Second, a monetary easing policy decreases the liquidity constraints of small firms during asset price inflation.

This paper is organized as follows. In section 2, we construct a panel dataset and define the firm size classes. In section 3, we present the dummy variable for the bubble, as well as independent and dependent variables. Section 4 reports the estimation results of the effect of bubbles on liquidity constraints. In section 5, we investigate whether monetary easing affects firms' liquidity constraints during asset price inflation. Section 6 presents our conclusions.

2. Data

2. 1. Construction of panel data

The panel data set consists of firm data from the Nikkei NEEDS

Financial Quest database, with the sample period ranging from 1978 to 1994. The estimation period starts from 1979 because lagged variables were included. The firms, numbering 798, belong to the manufacturing industry. They are listed in the first and second sections of the Tokyo Stock Exchange. However, the panel data set is unbalanced for two reasons. First, some firms were delisted during the sample period. Second, two firms were consolidated into a single firm through a merger and acquisition.

2. 2. Firm size classification

According to Bernanke and Gertler (1995), firms with more net worth (e.g., collateral assets) do not suffer from liquidity constraints. In short, a better financial position facilitates raising external funds. On the other hand, firms with less net worth struggle to raise external finance. Generally, large firms hold more collateral assets than small firms. Therefore, responses to financial shocks, such as asset price inflation, would probably differ according to firm size.

We then divide the sample into two groups based on total assets to examine the differential response to asset price inflation by firm size. We use the median, not the mean, to classify the firms into two categories. Firms with total assets more than the median are defined as large firms, whereas those with total assets less than the median are regarded as small firms.

3. Specifications of variables

3. 1. Dummy variable of bubble

Goyal and Yamada (2004) discuss asset inflation in detail to identify the effect of bubbles from other financial factors. They divide the asset variation phase in Japan, 1981-1994, into four periods. The first is the pre-asset inflation period (1981-1986), when the Tokyo Stock Price Index (TOPIX) and the land price index increased gradually. The second is the soaring asset inflation period (1987-1990), when prices in the Japanese asset markets soared. The third is the asset price collapse period (1991), when stock and land prices dropped suddenly and drastically. The fourth is the contraction period (1992-1994), when the Japanese economy contracted with deflation of asset prices. We focus on the asset inflation period (1987-1990) based on the above details, and our estimation model includes a dummy variable for 1987-1990 (the bubble period).

Now, we need to point out an important fact. Bank of Japan (BOJ) conducts an expansionary monetary policy during asset price inflation. In a historical narrative of the monetary policy of BOJ, Kuroki (1999) identifies January 1986 to April 1989 as an easy monetary policy period. Therefore, in section 5, we try to distinguish the effect of the bubble from that of the expansionary monetary policy.

3. 2. Variables

Following Masuda (2015), we employ Tobin's q type investment function as our baseline model, using the firms liquid assets as a proxy for net worth.[2] Based on Suzuki (2001), Hosono and Watanabe (2002), and Masuda (2015), we construct the following variables: investment spending

[2] Fazzari et al. (1988), Goyal and Yamada (2004), and Angelopoulou and Gibson (2009), among others, used cash flow. However, we used liquid assets because the measurement error is relatively low, as Hosono and Watanabe (2002) point out. Additionally, banks and investors utilize liquid assets as an indicator to decide the propriety of financing.

(I/K), Tobin's q (q), and the liquid asset ratio (LIQ).

I_t : *real investment*. The nominal investment is divided by the price of capital goods (PK_t) to construct the real investment variable for each of the following asset categories: building and structures, machinery and equipment, and transportation equipment. The total real investment is the sum of the real investments calculated by category.

K_t : *real capital stock*. We use the perpetual inventory method for each asset and treat the capital value of the 1978 fiscal year as the standard.[3] Therefore, we apply this method to funded firms after 1979. K_t is excluded if it is negative in the calculation.

q : Tobin's q. Tobin's q is calculated as follows: market value of equity plus total debt minus liquid assets minus intangible fixed assets minus the book values of other assets, all scaled by the replacement value of capital stock.[4]

LIQ: *liquid assets ratio*. The liquid assets ratio is defined as the ratio of liquid assets to total assets. Liquid assets consist of cash deposits, accounts receivable, and securities.

Table 1 shows the summary statistics of investment, Tobin's q, and the liquid assets ratio. The variation in the annual cross-sectional average of Tobin's q reflects stock prices during the period 1978-1994. As asset inflation soared from 1987 to 1990, Tobin's q increased from 4.1162 in the mid-1980s to 5.4548 in the late 1980s. The decline in Tobin's q in the early 1990s mirrors the asset price collapse. On the other hand, in contrast to

[3] The depreciation rate for each asset is follows: 0.047 for buildings and structures, 0.09489 for machinery and equipment, and 0.147 for transportation equipment.

[4] Tobin's q is constructed according to Hosono and Watanabe (2002, appendix). Please refer to them for details.

Table1. Summary Statistics

Year	*I/K*		*q*		*LIQ*	
	mean	s. d.	mean	s. d.	mean	s. d.
1978	0.1715	0.1181	3.6318	2.7788	0.4643	0.1143
1979	0.1740	0.1219	3.2003	2.5974	0.4730	0.1118
1980	0.1661	0.1072	2.9284	2.5455	0.4699	0.1090
1981	0.1769	0.1132	2.4185	2.2173	0.4621	0.1123
1982	0.1673	0.1102	2.6376	2.3210	0.4655	0.1129
1983	0.1583	0.1085	3.1770	2.6895	0.4645	0.1137
1984	0.1497	0.1034	3.3601	2.6026	0.4767	0.1146
1985	0.1647	0.1129	3.7621	2.6206	0.4759	0.1125
1986	0.1574	0.1040	4.1162	2.6295	0.4653	0.1140
1987	0.1337	0.0921	4.6880	2.6854	0.4760	0.1167
1988	0.1190	0.0814	5.5731	2.9364	0.4906	0.1162
1989	0.1352	0.0902	5.4548	2.9435	0.4932	0.1150
1990	0.1557	0.0994	4.4805	2.7039	0.4918	0.1186
1991	0.1677	0.1003	3.2338	2.1950	0.4713	0.1176
1992	0.1552	0.1010	3.0540	2.0554	0.4391	0.1191
1993	0.1175	0.0800	2.9243	1.8800	0.4288	0.1204
1994	0.0884	0.0695	2.4997	1.6831	0.4290	0.1232

Note: This table reports means and standard deviation of the real investment-to-real capital stock ratio (*I/K*), Tobin's q (q), and liquid assets ratio (*LIQ*).

Tobin's q, investments and the liquid assets ratio (cross-sectional averages) barely changed from the middle of the 1980s to the early 1990s.

4. Estimation

4. 1. Baseline model

This section examines whether an asset price bubble has a statistically significant effect on liquidity constraints and whether it changes according to firm size. For that purpose, the cross-term of the liquidity assets ratio and the bubble dummy are added to Tobin's q investment function. The explanatory variables take one-year-lagged values to avoid simultaneous equation bias. According to the Hausman specification test results, we adopt the fixed effects model. We estimate regression model (1) using the least-squares dummy variable method:

$$\frac{I_{it}}{K_{it-1}} = \alpha_0 + \alpha_1 q_{it-1} + \alpha_2 LIQ_{it-1} + \alpha_3 (LIQ_{it-1} \times Bubble_{it-1}) + f_i + v_t + \varepsilon_{it}, \quad (1)$$

where subscripts i and t stand for firm i in year t, I/K for the ratio of real investment to the real capital stock, q for Tobin's q, LIQ for the liquid assets ratio, *bubble* for the bubble dummy, f for the individual firm fixed effects, v for year fixed effects, and ε for the disturbance term.

As mentioned in section 3, we introduce the liquid assets ratio instead of cash flow into our model. According to Masuda (2015), a contractionary monetary policy tends to affect firms with less liquid assets more than those with more liquid assets. In short, firms with less liquid assets face severe liquidity constraints from an adverse monetary policy and struggle to raise external financing. Firms with more liquid assets faced lower liquidity constraints during 2001-2006, a quantitative monetary easing policy period.

Therefore, the relationship between the liquidity constraint of firms and the asset price bubble is considered to follow the same pattern; investments should be less sensitive to liquid assets during bubble period. If so, the coefficient of LIQ should be significantly positive (i.e., $\alpha_2 > 0$), and that of $LIQ \times Bubble$ significantly negative (i.e., $\alpha_3 < 0$), statistically.

4. 2. Estimation results

Table 2 shows the estimation results of equation (1). All the coefficients of the independent variable are highly significant statistically, and the signs of the coefficients of *LIQ* and *LIQ*×*Bubble* are as predicted in section 4.1. Columns (3) and (5) show the coefficients of *LIQ* for small and large firms, respectively—both significantly positive. The coefficient of *LIQ* for small firms in column (3) is 0.1740, and that of *LIQ* for large firms in column (5) is 0.1555. These results suggest that small firms normally face more liquidity constraints than large firms.

Columns (4) and (6) respectively present the coefficients of cross-terms for small and large firms, at -0.0163 and -0.0572. The estimation results imply that investment is less sensitive to the liquid assets ratio for large firms compared to small firms during asset price inflation (small firms ($\alpha_2+\alpha_3$=0.1644) > large firms ($\alpha_2+\alpha_3$=0.1297)). That is, compared to small firms, large firms raise external funds easily and invest actively in the bubble period.

Table2. Estimation results of baseline model (1)

Independent Variables	All Firms		Small Firms		Large Firms	
	(1)	(2)	(3)	(4)	(5)	(6)
q	0.0070***	0.0071***	0.0048***	0.0053***	0.0066***	0.0082***
	(11.440)	(11.645)	(6.3027)	(6.5228)	(7.8902)	(9.4836)
LIQ	0.1805***	0.1934***	0.1740***	0.1807***	0.1555***	0.1869***
	(11.354)	(11.562)	(8.2608)	(8.5147)	(6.3489)	(7.7342)
LIQ × Bubble		−0.0456***		−0.0163**		−0.0572***
		(−3.0488)		(−2.1229)		(−7.2060)
Adjusted R-squared	0.2107	0.2112	0.1947	0.1949	0.1972	0.2007
No. of Observations	11736	11736	11736	11736	11736	11736
No. of Firms	798	798	399	399	399	399

Notes: 1. *** and ** denote 1% and 5% significance level, respectively. 2. t-statistics in parenthesis are computed on the basis of White's heteroskedasticity-consistent standard errors.

5 . The effect of monetary easing in the bubble period

5. 1. Dummy variable of monetary easing

This subsection examines whether an expansionary monetary policy influences firms' liquidity constraints during an asset price bubble. As mentioned in section 3.1, BOJ implemented a monetary easing policy from January 1986 to April 1989. Since the policy was implemented during the asset price inflation period (1987-1990), we need to identify the effects of both. Thus, we construct a dummy variable for the monetary easing policy, following Masuda (2015), and introduce the dummy into our estimation model. In line with Kuroki (1999), the dummy variable takes the value 1 for each month of monetary easing, and 0 for other months.

$$DM_{jt} = \begin{cases} 1 & monetary\ easing\ policy\ (MEP)\ period \\ 0 & otherwise \end{cases} \tag{2}$$

Subscripts j and t denote month j and year t. To combine the monthly dummy to annual firm-level data, we average this variable over the firm's fiscal year t and obtain the dummy for *MEP* as follows.

$$MEP_{it} = \frac{\sum_{(j,t)\in T_{it}} DM_{jt}}{12} \tag{3}$$

MEP_{it} stands for the average monthly dummy of monetary easing policy for firm i in year t. This average dummy variable takes values between 0 and 1, according to the number of months in which the monetary easing policy was implemented in the firm's fiscal year t. T_{it} denotes a set of month-year observations for firm i's fiscal year t. The interaction term of *LIQ* and *MEP* is introduced into our estimation model, as presented below:

$$\frac{I_{it}}{K_{it-1}} = \alpha_0 + \alpha_1 q_{it-1} + \alpha_2 LIQ_{it-1} + \alpha_3 (LIQ_{it-1} \times Bubble_{it-1})$$
$$+\alpha_4 (LIQ_{it-1} \times MEP_{it-1}) + f_i + \upsilon_t + \varepsilon_{it}, \quad (4)$$

If investments become less sensitive to the liquid assets ratio with the monetary easing policy, the coefficient of *LIQ*×*MEP* is expected to be significantly negative (i.e., $\alpha_4 < 0$).

5. 2. Results

Table 3 reports the estimation results of model (4), excluding the cross-term *LIQ*×*Bubble*. As presented in column (4), the coefficient of *LIQ*×*MEP* for small firms is significantly negative and their liquidity constraint decreases ($\alpha_2 + \alpha_4 = 0.0052$). However, the coefficient of the cross-term for large firms shown in column (6) is not as expected.

Table 4 shows the estimation results of regression model (4). The coefficients of *LIQ*×*Bubble* and *LIQ*×*MEP* are presented in column (4) for small firms and in column (6) large firms. As column (4) shows, the

Table3. Estimation results of model (4) exluding the cross term of LIQ × bubble

Independent Variables	All Firms		Small Firms		Large Firms	
	(1)	(2)	(3)	(4)	(5)	(6)
q	0.0070*** (11.440)	0.0070*** (11.037)	0.0048*** (6.3027)	0.0048*** (6.1325)	0.0066*** (7.8902)	0.0065*** (7.8098)
LIQ	0.1805*** (11.354)	0.1807*** (10.960)	0.1740*** (8.2608)	0.1757*** (8.0524)	0.1555*** (6.3489)	0.1554*** (6.3444)
LIQ × MEP		−0.0237 (−0.4674)		−0.1205** (−2.5079)		0.0704 (1.4539)
Adjusted R-squared	0.2107	0.2106	0.1947	0.1951	0.1972	0.1972
No. of Observations	11736	11736	11736	11736	11736	11736
No. of Firms	798	798	399	399	399	399

Notes: 1. *** and ** denote 1% and 5% significance level, respectively. 2. t-statistics in parenthesis are computed on the basis of White's heteroskedasticity-consistent standard errors.

Table4. Estimation results of model (4)

Independent Variables	All Firms		Small Firms		Large Firms	
	(1)	(2)	(3)	(4)	(5)	(6)
q	0.0071***	0.0071***	0.0053***	0.0053***	0.0082***	0.0082***
	(11.645)	(11.646)	(6.5228)	(6.4974)	(9.4836)	(9.0993)
LIQ	0.1934***	0.1935***	0.1807***	0.1815***	0.1869***	0.188***
	(11.562)	(11.565)	(8.5147)	(8.5562)	(7.7342)	(7.5038)
LIQ × Bubble	−0.0456***	−0.0454***	−0.0163**	−0.0143*	−0.0572***	−0.0594***
	(−3.0488)	(−3.0309)	(−2.1229)	(−1.8415)	(−7.206)	(−7.1608)
LIQ ×MEP		−0.015108		−0.1106**		0.1154
		(−0.3089)		(−2.3661)		(2.3481)
Adjusted R-squared	0.2112	0.2112	0.1949	0.1952	0.2007	0.2010
No. of Observations	11736	11736	11736	11736	11736	11736
No. of Firms	798	798	399	399	399	399

Notes: 1. ***, **, and * denote 1%, 5%, and 10% significance level, respectively. 2. t-statistics in parenthesis are computed on the basis of White's heteroskedasticity-consistent standard errors. 3. We used Wald test to test whether the coefficients of *LIQ × Bubble* and *LIQ ×MEP* in Column (4) are equal: $H_0: \alpha_3 = \alpha_4$, $H_1: \alpha_3 \neq \alpha_4$, and the null hypothesis was rejected at 5% significance level: $\chi^2(1) = 3.9648$, probability > χ2 = 0.0465.

coefficients of *LIQ×Bubble* and *LIQ×MEP* for small firms are significantly negative.[5] Therefore, the monetary easing policy and asset price inflation influence the liquidity constraint of small firms ($\alpha_2+\alpha_3+\alpha_4=0.0566$). However, the expansionary monetary policy does not affect the sensitivity of the investment to the liquid assets ratio for large firms, as shown in column (6). From these results, we conclude that asset price inflation has a much greater effect on large firms than monetary easing.

6. Conclusions

We examine whether firms' liquidity constraints decrease investment and spending during the asset price inflation period in Japan from the mid-1980s through the early 1990s. This study presents two

[5] We used a Wald test to test the null hypothesis that these two coefficients are equal and the null hypothesis was rejected at the 5 percent significance level.

findings. First, as expected, the asset price bubble decreases the liquidity constraints of firms and stimulates their fixed investment. In particular, this effect is stronger for large firms than for small firms. Second, the liquidity constraints of small firms decrease not only because of asset price inflation but also because of the monetary easing policy during the bubble period (1987-1990). Large firms with more liquid assets hold a larger amount of collateral assets than small firms with less liquid assets. Therefore, the collateral value of large firms soars during asset price inflation, and they easily raise external finance without being affected by monetary easing.

Finally, we mention an issue that is yet to be examined. According to Kuroki (1999), while the asset inflation bubble collapsed in 1991, the contractionary monetary policy was implemented from May 1989 to June 1991. Thus, in future research, we need to investigate what influenced firms' behavior in the early 1990s—the collapse of asset inflation or the contractionary monetary policy.

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