Understanding the rise and decline of the Japanese main bank system: The changing effects of bank rent extraction

Xueping Wu [a,*], Jun Yao [b]

[a] Department of Economics and Finance, City University of Hong Kong, Kowloon, Hong Kong
[b] School of Accounting and Finance, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

ABSTRACT

This paper shows how main bank rent extraction affects corporate decisions about investment and financing during financial regulatory reform. Our model predicts that limited loanable funds can initially contain main bank controlled overinvestment, even when new equity is available to the firm. Abundant funds facilitate overinvestment to the detriment of firm profitability. A shift of control rights back to the firm due to financial deregulation produces an "equity for upside potential and bank debt for downside risk" bias against the banks. A stock market and real estate boom in Japan made it harder than ever for the banks to diversify risk. The insights from this analysis help explain why Japan's main bank system was beneficial in the (capital constrained) postwar period but became harmful during the (capital abundant and even bubbly) 1980s, and why the adverse shocks of the post-deregulation 1990s had such severe effects on the banking system.

© 2011 Elsevier B.V. All rights reserved.

1. Introduction

Banks usually have a close banking relationship with their client firms and are considered as corporate insiders (Fama, 1985). The main banks in Japan used to have particularly close relationship, and were well known for their hands-on involvement in corporate finance and governance (Aoki et al., 1994). Unlike banks in the US, the main banks in Japan typically hold considerable equity holdings in client firms. Prowse (1990) suggests that such equity holdings can greatly mitigate the agency problem between shareholders and debt-holders. Using data from the late-1970s to the mid-1980s, Hoshi et al. (1990a,b, 1991) find that, thanks to their main bank ties, Japanese firms are usually less constrained by internal cash flow. This allows them to continue investing and growing even when facing a cash flow shortage.

It has also been well documented that the main banks often help Japanese firms in financial difficulty (Aoki, 1990; Kaplan and Minton, 1994; Kang and Shivdasani, 1997). The main bank system is commonly believed to be one of the reasons for Japan's rapid economic growth and success during most of the postwar period because of the way a main bank can mitigate the investment inefficiencies resulting from market imperfections.[1]

Japan's economic troubles in the 1990s have caused the main bank system to again catch the attention of researchers, but this time in a negative light. See Allen (1996) for a review on the reversal of opinion about the pros and cons of the main bank system. Recent research has emphasized the economic costs of a close banking relationship and of the main bank system in particular. Theoretically, a bank as an insider can, *ex post*, extract rent from a client firm because the bank often has monopoly power over certain information (Sharpe, 1990). Rajan (1992) further argues that *ex ante*, the bank's *ex post* rent extraction affects the firm's investment and financing decisions. This suggests that without effective competition from other funding sources such 'holdup' behaviour

---

* Corresponding author. Tel.: +852 3442 7577; fax: +852 3442 0195.
  E-mail addresses: efxpwu@cityu.edu.hk (X. Wu), afyaojun@inet.polyu.edu.hk (J. Yao).

[1] During the 1980s, American corporations felt the need to keep up with the increasingly competitive Japanese firms, and they underwent a painful corporate restructuring. Porter (1992) and Jacobs (1993) raised economic-policy concerns about the alleged lack of long-run perspective among American firms which have the tradition of financing at arm's-length. The discussion in Mankiw (1988) on Mayer (1988) suggests, however, it is not obvious that short-termism and hence arm's-length capital markets really caused lower investments in the US and the UK in the 1970s, compared to Japan.

can choke investment, especially in a firm with high growth potential, thus eroding firm value.

Given its influence, a main bank's holdup behaviour can also cause overinvestment, another way to erode firm value. A main bank can prod its client firm to take on unattractive or even negative NPV projects to generate more interest income for itself to the detriment of the firm's own profitability (Weinstein and Yafeh, 1998; Wu and Xu, 2005). Rajan and Zingales (1995) show that Japanese firms usually maintain larger cash holdings than US firms, but Pinkowitz and Williamson (2001) demonstrate that the cash holdings are associated with main bank power such that Japanese firms' required compensating deposits at their main banks reflect bank rent extraction. Nakatani (1984) previously suggested that the main bank system (in particular, a financial or *keiretsu* industrial group with a main bank at its core) can actually weigh down the performance of bank-affiliated firms.

Keiretsu firms are likely to have legacy main bank relationships even after the financial deregulation. Wu et al. (2000) show that during 1974–1995 large *keiretsu* firms enjoyed no advantage in their cost of capital but had significantly lower returns on investment than peers without a *keiretsu* affiliation. Kang and Stulz (2000) directly question the value of the main bank system—once the envy of many other economies around the world—by showing that during the Japanese stock market meltdown in the early 1990s, firms with more bank borrowings in the late 1980s saw deeper losses in their equity value and that this cannot be explained by leverage effects. In short, the most recent empirical studies conclude that the main bank system hurts firm value.[2]

Scholars have made useful attempts to explain the costs and benefits of the main bank system (for a review, see Hoshi and Kashyap, 2001), but it remains unclear why the main bank system should have facilitated Japan's economic growth when the main banks were at their most powerful (in the 1950s, 1960s and 1970s), but become a burden following financial deregulation in the 1980s.

Financial deregulation aimed at opening up Japanese capital markets actually began in the early 1980s, and since then Japanese firms previously controlled by the main banks have gradually been able to take investment and financing decisions into their own hands. Following the deregulation, Japanese corporate financing changed significantly from bank borrowing to capital market financing (Campbell and Hamao, 1994). If the main banks' sharing in a rent surplus is important to maintaining long-term firm-bank relationships as described by Petersen and Rajan (1995), this surely means that bank rent extraction had reached a point that many business firms could no longer tolerate. But it remains unclear why rent extraction by the main banks was not an obstacle during the early years of high growth.

There are many interesting questions also about the effects of the financial deregulation on Japan's financial system. Did the main banks change their modus operandi in response to deregulation that restricted their influence? Is the deregulation the main cause of the post-deregulation malaise in Japan's banking system? The equity and real estate market crashes of the late-1980s constitute an adverse shock to most firms but especially banks (Hoshi, 2001). Since firms with larger bank borrowings suffered deeper losses in equity value, did they drag down their main banks, or was it the other way around? Previous studies have provided some useful insights into individual issues, but they have handled those issues largely in isolation; there has been no theoretical analysis that attempts to explain both the rise and the fall of the main bank

system in the presence of rent extraction—an important feature of ongoing fundamental behaviour as identified in the literature about the relationship-based financial system.

This study set out to develop a model of a firm's investment and financing decisions under main bank rent extraction. Our analysis focuses on how corporate decisions interact with main bank control and Japanese financial deregulation. In his concluding remarks, Rajan (1992) suggests that the deterioration in credit ratings in Japan may partly reflect the deterioration in control that accompanies movement from a relationship-based system to a transactions-based competitive system. He points out that statements about the efficiency implications of this transition require an examination of the accompanying effect on corporate investment. Following this advice, this study emphasizes the effects of change in control rights on investment and financing.

The model presented in this paper considers agency conflicts between a firm's silent shareholders and its main bank. The payoffs of the main bank depend on: the value of its equity holdings in the firm, the perfect-market-determined risky debt income and the information rent extracted from the firm. Rent extraction arises from the bank's monopoly power over the firm's information as well as regulations favouring banks. The information monopoly power exists even in capital-market-oriented economies such as in the US (Houston and James, 1996). Depending on financing alternatives and who controls the firm, agency conflicts can evolve to reverse the firm's under- and overinvestment problems. Our model is able to show how changes in corporate control and governance affect investment efficiency and the risk profiles associated with bank debt and equity financing.

2. The model

Let us first set up the analytical framework (Section 2.1), then we use the firm's first best investment policy to set the optimal benchmark (Section 2.2). We will then analyse three scenarios. In the first scenario, we focus on the firm's investment policy with bank debt only (Section 2.3). In the second, we study the main bank controlled corporate investment and financing policies when new equity is available (Section 2.4). In the third, we highlight firm-controlled financing decisions when there is a choice between bank loan and new equity financing, and this scenario will allow us to examine the effect on the main bank system of this shift in control rights back to the firm (Section 2.5).

2.1. The basic framework

The analytical framework is constructed to capture the conflicts of interest between a main bank and its client firm's existing shareholders as a whole. We make the following assumptions for clarity and simplicity. The firm has only one main bank, which provides the firm's (risky) debt. The main bank relationship and bank power are maintained in part because the firm would face higher asymmetric information costs in switching to new lenders and in part because of regulations or historical reasons pertaining to, for example, the financial *keiretsu* in Japan. The firm's manager will either maximize existing shareholders' wealth, or rule on behalf of the main bank if the bank controls the firm. There are no taxes, bankruptcy costs and other transaction costs. All the decision makers are risk neutral.

Consider a three-date, two-period model. The firm has assets-in-place valued A at time $t = 0$. The bank holds a share, α, of the firm's total equity. We are interested in decisions and valuations at time $t = 1$. The firm has an investment opportunity at $t = 1$ requiring an input of capital, I. At time $t = 2$ the project produces either a non-negative return, r_H, in the good state, or, a

---

non-positive return, r_L, in the bad state ($-1 \leqslant r_L \leqslant 0 \leqslant r_H$). Assume further that both the insiders and the market know r_L and r_H at $t = 1$. The probability of reaching the good state is q. The value of q can be interpreted as the result of a combination of the firm's managerial skills and its business prospects. These conditions are known only to the insiders at $t = 1$. In other words, q can be observed precisely by the manager and the main bank at $t = 1$. But outside investors and the stock market know only that q is uniformly distributed over $[q_l, q_u]$ ($0 < q_l < q_u < 1$). The range $[q_l, q_u]$ reflects the range of guesses by the market about the quality of the project given r_L, and r_H.

To finance the investment, the firm can either borrow from its main bank, or issue new equity, or do both. The perfect market interest rate, r, for risky debt, will be rationally determined. The upper bound on r (imposed, for example, by the government) is r_u. At time $t = 2$, if the firm borrows from the bank it will subsequently pay off the debt and interest if it can generate enough cash inflow. Otherwise, the bank liquidates the firm. Note that this assumption assures that any overinvestment does not flow from the "soft-budget-constraint" problem of Dewatripont and Maskin (1995). To capture the main bank's holdup behaviour backed by its information monopoly, assume that only in the good state will the bank be able to extract rent from the firm in the form of a proportion, m, of its profits.[3] Let the extracted rent depend on the size of the debt, $D \leqslant I$, to reflect the extent of the firm's transactions with the bank, an important basis of bank power. As a result, the bank requires, including (normal) debt payment, a total payoff of $mD(r_H - r) + D(1 + r)$ in the good state.[4] The value of m is exogenously determined as in the analysis of Petersen and Rajan (1995), and is presumed to be public knowledge in view of the legacy of long-term relationships. Equity holders will keep the residual value if the firm remains solvent at $t = 2$. If bankruptcy occurs, the bank will liquidate the firm and collect the liquidation value. For simplicity, assume that $A + I(1 + r_H)$ is always greater than $I(1 + r)$, so the firm is always solvent in the good state.

2.2. The first best investment policy

At $t = 1$, to maximize the firm's value, the manager should choose all the positive NPV projects:

$$NPV_{firm} = qr_H + (1 - q)r_L \geqslant 0. \tag{1}$$

This means, as depicted in Fig. 1, a project (r_L, r_H) will be chosen if and only if it is located above the bold line. To facilitate the discussion, let us introduce the following definition (cf. John and John, 1993, and John et al., 1994):

---

[3] Rent extraction only in the good state was also assumed by Rajan (1992). It looks less extortionate than *ex ante* or indiscriminate rent extraction, being more compatible with a firm-bank relationship. Nevertheless, if we model rent extraction by including a premium in the interest rate, all the results that follow will persist qualitatively (detailed results are available on request). The main reason for this indifference is that both *ex ante* and *ex post* rent extraction determine *ex ante* decisions in a similar way. The analysis can survive even if liquidation in the bad state is replaced by continuation due to a rescue by the main bank, a well-known feature of the main bank system (Aoki, 1990). Debt forgiveness in the bad state is surely a boon to the rescued firm, but a higher interest rate premium is likely to be imposed on all client firms just like in the insurance business. In principle, the rescued firm is no different from a new firm in making the same investment and financing decisions again.

[4] For a successful firm, the *ex post* rent extracted by the main bank includes higher interest charges for unfinished projects that need new financing, required compensating deposits at the main bank, charges for premium insurance and financial services that the firm may not really need, the firm-bank relationship related consumption covered by the firm's entertainment expenses, and the like. The main bank enjoys this rent because of its information monopoly power and favourite regulations. As a result, the firm is in no way to get only the perfect market interest rate, r.
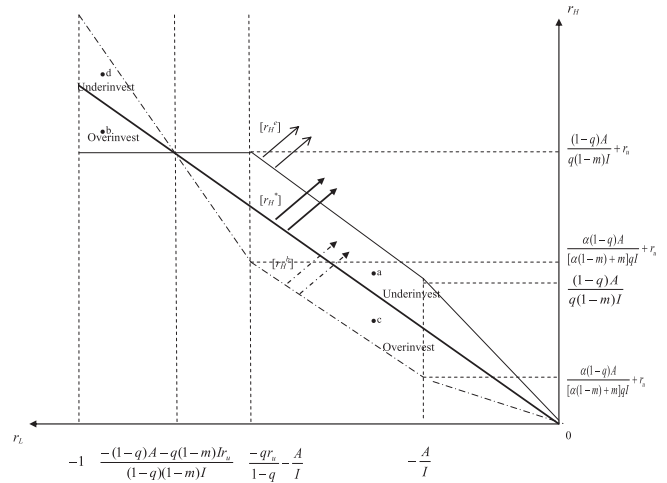

Fig. 1. The first best investment policy and other investment policies in Scenario I.

Definition 1. An investment policy which accepts a project for $r_H > r_H^0 = f(r_L)$ will be denoted as investment policy $[r_H^0]$, in which r_H^0 is a function of r_L.

Thus, the investment policy (with hurdle rate in terms of r_H) that maximizes the firm's value can be expressed as $[r_H^*]$, where $r_H^* = -\frac{(1-q)r_L}{q}$. This decision rule is illustrated in a numerical example in Section A.1 of Appendix A.

2.3. Scenario I: Investment decisions with bank debt only

To focus on the conflicts between the firm's shareholders and the main bank, assume that a potential project will be financed by bank debt only. As a result, the manager on behalf of shareholders would like the firm to undertake the project if it promises a non-negative return on equity,

$$NPV_{equity} = q[A + (1 - m)I(r_H - r)]$$
$$+ (1 - q)Max\{A + I(r_L - r), 0\} - A \geqslant 0. \tag{2}$$

The return on equity in (2) depends on the perfect market interest rate for the risky debt, which is rationally determined by the zero expected debt payoff (under risk neutrality), $qI(1 + r) + (1 - q) Min\{A + I(1 + r_L), I(1 + r)\} - I = 0$. This gives:

$$r = 0 \quad \text{if } r_L \geqslant -\frac{A}{I}, \tag{3}$$

$$r = \frac{-(1 - q)(A + Ir_L)}{qI} \quad \text{if } \frac{-qr_u}{1 - q} - \frac{A}{I} \leqslant r_L < -\frac{A}{I}, \tag{4}$$

$$r = r_u \quad \text{if } -1 < r_L < \frac{-qr_u}{1 - q} - \frac{A}{I}. \tag{5}$$

Note that the interest rate cannot exceed r_u due to the upper bound assumption. The fact that a market interest rate can be positive comes from the concave payoff structure for the risky debt (not from risk aversion). Also note that A is the collateral value. If $I = A$, r is zero for any $r_L \geqslant -1$ and there is no bankruptcy. Bankruptcy occurs if $A + I(1 + r_L) < I(1 + r)$, or $A/I < r - r_L$.

Proposition 1. *With bank financing only, the manager, on behalf of the shareholders, chooses the investment policy $[r_H^e]$, in which*

$$r_H^e = \frac{-(1 - q)r_L}{q(1 - m)} \quad \text{if } r_L \geqslant -\frac{A}{I}, \tag{6}$$

$$r_H^e = \frac{(1 - q)mA}{q(1 - m)I} - \frac{(1 - q)r_L}{q} \quad \text{if } \frac{-qr_u}{1 - q} - \frac{A}{I} \leqslant r_L < -\frac{A}{I}, \tag{7}$$

$$r_H^e = \frac{(1 - q)A}{q(1 - m)I} + r_u \quad \text{if } -1 < r_L < \frac{-qr_u}{1 - q} - \frac{A}{I}. \tag{8}$$

For the proof, see Appendix B.1.

As depicted in Fig. 1, a project will be chosen only if it is located to the right of the light solid kinked line, as indicated by the double arrow, labelled $[r_H^e]$. A numerical example is presented in Section A.2 of Appendix A.

Corollary 1. *With bank financing only, the manager, on behalf of the shareholders, implements a sub-optimal investment policy $[r_H^e]$ in which r_H^e is higher than r_H^* if $r_L \geqslant \frac{-(1-q)A-q(1-m)Ir_u}{(1-q)(1-m)I}$ and in which r_H^e is lower than r_H^* if $-1 < r_L < \frac{-(1-q)A-q(1-m)Ir_u}{(1-q)(1-m)I}$.*

This suboptimal investment policy $[r_H^e]$ can result in either under- or overinvestment.[5] First, the manager will pass up project (r_L, r_H) that satisfies $\left(r_L \geqslant \frac{-(1-q)A-q(1-m)Ir_u}{(1-q)(1-m)I}, \; r_H^* < r_H < r_H^e \right)$, such as the one labelled "a" in Fig. 1. This underinvestment occurs because the rent extracted by the bank can render even a profitable project unattractive to the firm. This effect is different from the debt overhang described by Myers (1977), which is caused by old debt. At the same time, the manager will undertake project (r_L, r_H) that satisfies $\left(-1 < r_L < \frac{-(1-q)A-q(1-m)Ir_u}{(1-q)(1-m)I}, \; r_H^e < r_H < r_H^* \right)$, such as the one labelled "b" in Fig. 1. This overinvestment occurs because limited liability or risk shifting enables the firm to benefit from even a negative NPV project. The bank cannot fully factor this risk-shifting into the market interest rate it charges because of government regulations that put a ceiling on interest rates to subsidize investment. Nevertheless, the main result of underinvestment here (point "a") occurs despite the introduction of r_u.

If the main bank can make investment decisions directly it will use an investment policy different from that detailed in Eqs. (6)–(8). The bank's payoff at time $t = 2$ comes from three possible sources. As a shareholder, the bank has a share, α, of the firm's residual value. As the only creditor, the bank collects debt repayment including interest if the firm is financially solvent. In addition, the bank can reap a holdup profit if the good state obtains. As an insider, the bank also knows the value of q. Thus with sufficient control, the bank will force the manager to implement a different policy at $t = 1$ which brings the bank a non-negative NPV:

$$
\begin{aligned}
NPV_{Bank} = {} & q[\alpha[A + (1-m)I(r_H - r)] + I(1+r) + mI(r_H - r)] \\
& + (1-q)[\alpha Max\{A + I(r_L - r), 0\} + Min\{I(1+r), A \\
& + I(1+r_L)\}] - (\alpha A + I) \geqslant 0.
\end{aligned}
\tag{9}
$$

Proposition 2. *With bank financing only, the manager, on behalf of the bank, will choose investment policy $[r_H^b]$, in which*

$$
r_H^b = -\frac{(1-q)r_L}{q\left[1 + m\left(\frac{1-\alpha}{\alpha}\right)\right]} \quad \text{if } r_L \geqslant -\frac{A}{I},
\tag{10}
$$

$$
r_H^b = -\frac{(1-\alpha)(1-q)mA}{[\alpha(1-m)+m]qI} - \frac{(1-q)r_L}{q} \quad \text{if } \frac{-qr_u}{1-q} - \frac{A}{I} \leqslant r_L < -\frac{A}{I},
\tag{11}
$$

$$
r_H^b = -\frac{(1-\alpha)(1-q)A + (1-m)(1-\alpha)qIr_u + (1-q)Ir_L}{[\alpha(1-m)+m]qI}
$$
$$
\text{if } -1 < r_L < \frac{-qr_u}{1-q} - \frac{A}{I}.
\tag{12}
$$

For the proof, see Appendix B.2.

As shown in Fig. 1, a project will be chosen only if it is located to the right of the dash-dotted kinked line. $[r_H^b]$ is also suboptimal. See the numerical example presented in section A2 of Appendix A.

Corollary 2. *With bank financing only, the manager, working on behalf of the bank, implements a suboptimal investment policy $[r_H^b]$ in which r_H^b is lower than r_H^* if $r_L \geqslant \frac{-(1-q)A-q(1-m)Ir_u}{(1-q)(1-m)I}$ and in which r_H^b is higher than r_H^* if $-1 < r_L < \frac{-(1-q)A-q(1-m)Ir_u}{(1-q)(1-m)I}$.*

The suboptimal investment policy $[r_H^b]$ can also cause either under- or overinvestment. In the case of overinvestment, the manager will undertake the project (r_L, r_H) that satisfies $\left(r_L \geqslant \frac{-(1-q)A-q(1-m)Ir_u}{(1-q)(1-m)I}, \; r_H^b < r_H < r_H^* \right)$ such as the one labelled "c" in Fig. 1. The bank's equity holdings may not create sufficient incentives to restrain the bank from prodding the firm to overinvest because the bank's marginal income from debt can be greater than its equity loss caused by overinvestment. On the other hand, in the case of underinvestment, the bank will pass up the project (r_L, r_H) that satisfies $\left(-1 < r_L < \frac{-(1-q)A-q(1-m)Ir_u}{(1-q)(1-m)I}, \; r_H^* < r_H < r_H^b \right)$, such as the one labelled "d" in Fig. 1. Such underinvestment occurs when choosing among highly risky projects with positive NPVs, because the interest rate ceiling prevents the bank from charging an interest rate high enough to factor in the higher downside risk. The interest rate ceiling has nothing to do with overinvestment here (point "c"). Note that the results represented by points "b" and "d" exist only if r_u is binding. In other words, if r_u is non-binding, the main results as represented by points "a" and "c" in Fig. 1 still stand.

This analysis demonstrates how under- and overinvestment can always exist as long as there is a conflict of interest between the firm's shareholders and its main bank. Main bank control does indeed help mitigate the under- and overinvestment problems that are caused by suboptimal investment policies undertaken on behalf of shareholders, but the bank-controlled investment is not Pareto optimal either, and can lead to different kinds of under- and overinvestment. This is largely consistent with the findings of previous work in this area (Rajan, 1992; Weinstein and Yafeh, 1998). The severity of the main bank controlled overinvestment problem is mainly determined by m and α. The greater the scope for rent extraction, m, and the lower the bank's equity incentive, α, the further $[r_H^b]$ will deviate from $[r_H^*]$.

2.4. Scenario II: Investment and financing decisions under main bank control

Consider now the case where the main bank controls the firm and a project can be financed by a mix of debt and new equity. That is, $I = D + e$, where D is bank debt and e is new equity. To keep a stable share, α, of the firm's equity, the bank will purchase the same share of any new equity issue, specifically $\alpha e = \alpha(I - D)$ where $D \leqslant I$. This represents the situation in pre-deregulation Japan where a main bank had great influence on a firm's investment and financing decisions.[6]

The bank's total NPV comes from its equity holdings, the debt and rent extraction:

$$
\begin{aligned}
NPV_b = {} & q[\alpha(A + I(1+r_H) - D(1+r) - mD(r_H - r)) + D(1+r) \\
& + mD(r_H - r)] + (1-q)[\alpha Max\{A + I(1+r_L) - D(1+r), 0\} \\
& + Min\{D(1+r), A + I(1+r_L)\}] - (\alpha A + \alpha e + D)
\end{aligned}
\tag{13}
$$

---

[5] Under- or overinvestment should be interpreted in an aggregate sense. Given I and q for each firm, firms differ in the project payoffs (r_L, r_H) they have available. With the suboptimal investment policy, some may skip good projects and yet launch ones that should not be undertaken by the First Best standard.

[6] Morck et al. (2000) describe how, "shares held by the banks and by other entities in the group are generally regarded as 'stable shareholdings' and display little variation over time." Aoki et al. (1994) also point out that, "the main bank maintains a substantial stockholding in the firms to which it acts as main bank, usually at, or close to, the level permissible by law", and "the main bank seldom sells its shares in the market unless it abandons its main bank position".

Note that while α and I are exogenously given, D is a decision variable here, and that the market interest rate should be rationally determined according to the zero expected NPV of risky debt (under risk neutrality), $qD(1 + r) + (1 - q)Min\{A + I(1 + r_L), D(1 + r)\} - D = 0$.

The financing policy optimization problem the bank faces can be summarised as

$$\underset{D}{Max} \{q[\alpha(A + I(1 + r_H) - D(1 + r) - mD(r_H - r)) + D(1 + r)$$
$$+ mD(r_H - r)] + (1 - q)[\alpha Max\{A + I(1 + r_L) - D(1 + r), 0\}$$
$$+ Min\{D(1 + r), A + I(1 + r_L)\}] - [\alpha(A + e) + D]\} \quad (14)$$

$$s.t. : \quad \alpha e = \alpha(I - D) \quad (15)$$

$$r = 0 \quad \text{if } r_L \geqslant \frac{D - A - I}{I}, \quad (16)$$

$$r = \frac{(1 - q)\{D - [A + I(1 + r_L)]\}}{qD} \quad \text{if } \frac{(1 - q)(D - I) - qDr_u}{(1 - q)I} - \frac{A}{I}$$
$$\leqslant r_L < \frac{D - A - I}{I}, \quad (17)$$

$$r = r_u \quad \text{if } r_L < \frac{(1 - q)(D - I) - qDr_u}{(1 - q)I} - \frac{A}{I}. \quad (18)$$

Solving this optimization problem yields the optimal financing policy, D^*. With D^* determined, we can then obtain the investment policy if the bank requires $NPV_b \geqslant 0$.

Proposition 3. *In the case of financing with new equity and debt, the manager, on behalf of the bank, will choose optimal financing policy, D^*, and investment policy $[r_H^b]$ such that*

$$D^* = I \quad \text{if } r_L \geqslant -\frac{A}{I} \text{ or } \left(\frac{-qr_u}{1 - q} - \frac{A}{I} \leqslant r_L \leqslant -\frac{A}{I} \text{ and } r_H \geqslant \frac{1 - q}{q}\right) \quad (19)$$

$$D^* = A + I(1 + r_L) \quad \text{if } -1 \leqslant r_L \leqslant -\frac{A}{I} \text{ and } r_H < \frac{1 - q}{q}, \quad (20)$$

and

$$r_H^b = -\frac{(1 - q)r_L}{q[1 + m(\frac{1 - \alpha}{\alpha})]} \quad \text{if } r_L \geqslant -\frac{A}{I}, \quad (21)$$

$$r_H^b = -\frac{\alpha(1 - q)Ir_L}{\alpha qI + (1 - \alpha)qm[A + I(1 + r_L)]} \quad \text{if } -1 \leqslant r_L \leqslant -\frac{A}{I}, \quad (22)$$

For the proof, see Appendix B.3.

The optimal financing policy, D^*, varies with the quality of the project as specified in Eqs. (19) and (20). For example, if the project's downside risk is limited, e.g. $r_L \geqslant -\frac{A}{I}$, the bank will finance the project only with debt, as described in (19). If the project is exposed to considerable downside risk and the upside potential is capped, as specified in (20), the bank will prefer that the firm use a mix of debt and new equity. Some new equity is needed because the bank counts on others to share the project's downside risk, a risk that is too big for the bank to bear alone. In other words, as long as the main bank controls the firm, the main bank is happy to open up of equity financing, because this risk-sharing is to the bank's benefit.[7] But from the firm's point of view, risk sharing here causes overinvestment.

In Fig. 2, the investment policy $[r_H^b]$ in Eqs. (21) and (22) is depicted as a light solid curve labelled "B". All the acceptable projects must lie to the right of this curve. It is apparent that overinvestment occurs, as some acceptable projects are located below the first best investment policy $[r_H^*]$, depicted with a bold straight line labelled "O".

---

[7] Since the bank always keeps a constant share of the firm's equity, the pricing of new equity does not influence the bank's payoff. The bank thus has no incentive to unfairly price the new equity. In effect, the costs of overinvestment are passed on entirely to the old shareholders as a whole.
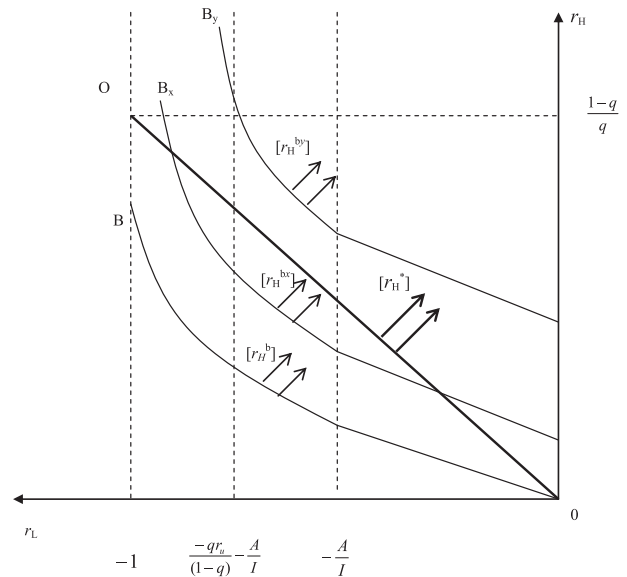
Fig. 2. Main bank controlled investment policies in Scenario II.

Here, r_H^b is always less than r_H^*. (The proof is available on request.) In other words, curve B is always below line O as shown in Fig. 2. Thus, unlike the situation in Fig. 1 where highly risky but profitable projects are skipped when the ceiling on the interest rate becomes binding, this underinvestment problem disappears when new equity is available. The opening up of the equity market helps mitigate the underinvestment problem. The overinvestment problem remains, however, because the bank can still extract rent from the firm.

Now suppose the bank has a shortage of loanable funds—a situation that reflects the high growth period in postwar Japan. This shortage will force the main bank to fund the most profitable projects first. With capital constraints, the bank must require a higher cutoff NPV_b. The more severe the capital shortage, the higher the NPV_b cutoff the bank will require. Suppose the bank requires a cutoff level of $X > 0$. This does not fundamentally affect the way the bank determines the optimal financing policy, D^*, but the shortage of loanable funds will change the investment policy, as summarised in the following corollary.

Corollary 3. *In the case of financing with new equity and debt, when the bank requires a higher cutoff level of X on its payoff, i.e. $NPV_b \geqslant X > 0$, the manager, working on behalf of the bank, will choose the investment policy $[r_H^{bx}]$ in which*

$$r_H^{bx} = \frac{X}{\alpha qI(1 + m(\frac{1 - \alpha}{\alpha}))} - \frac{(1 - q)r_L}{q[1 + m(\frac{1 - \alpha}{\alpha})]} \quad \text{if } r_L \geqslant -\frac{A}{I}, \quad (23)$$

$$r_H^{bx} = \frac{X - \alpha(1 - q)Ir_L}{\alpha qI + (1 - \alpha)qm[A + I(1 + r_L)]} \quad \text{if } -1 \leqslant r_L \leqslant -\frac{A}{I}, \quad (24)$$

The proof is straightforward. Repeat all the calculations for the investment policy described in Eqs. (21) and (22) using $NPV_b \geqslant X$ instead of $NPV_b \geqslant 0$. Then, conditions (23) and (24) obtain.

The investment policy $[r_H^{bx}]$ is illustrated in Fig. 2. The shortage of loanable funds shifts the original investment policy $[r_H^b]$ in Proposition 2 upward. If the cutoff is raised only slightly, most of the bank-controlled investment decision curve, labelled B_x, will still be below the first best investment policy line, labelled O. Although the overinvestment problem remains, it is obvious that the shortage of loanable funds helps shrink it, as the area of overinvestment is smaller. If the cutoff level is raised sufficiently, reflecting a severe shortage of loanable funds, the bank-controlled investment policy
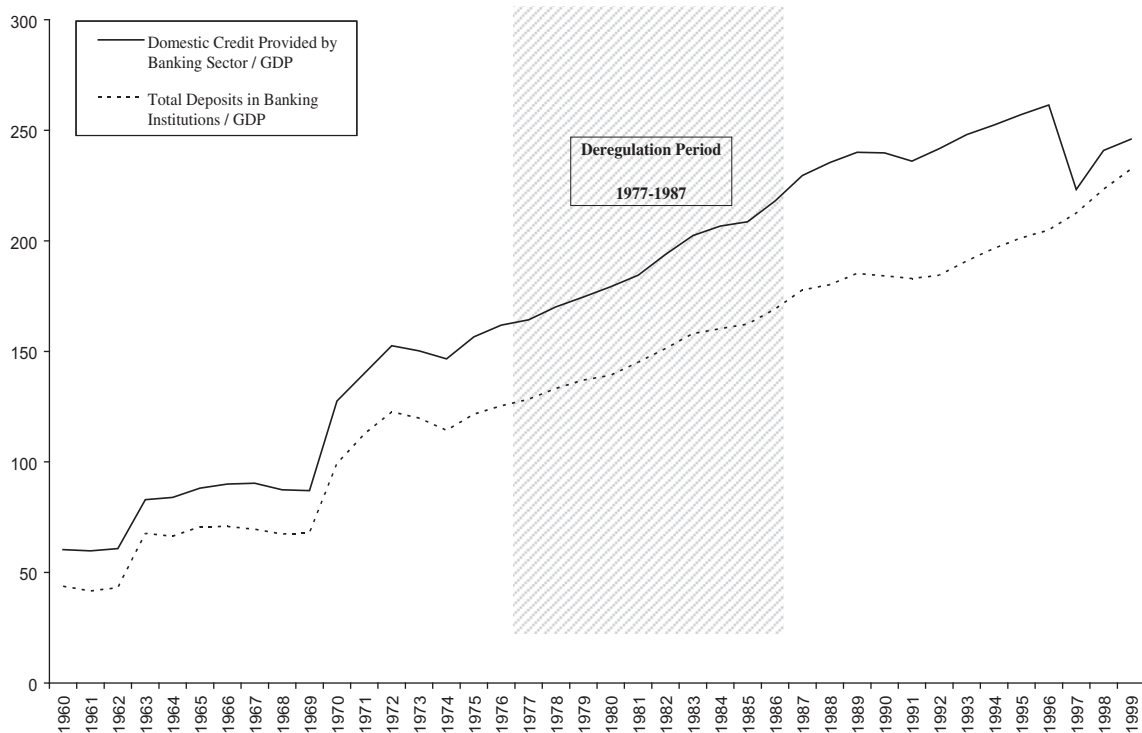
Fig. 3. Domestic credit provided by Japan's banking sector and total deposits in banking institutions, each scaled by GDP (in percent). *Data source*: DataStream.

curve, labelled B_y, $(Y > X)$, can be above line O. In this case, the overinvestment problem vanishes totally. (Of course, this may result in underinvestment, a well-understood problem in the situation of severe capital shortage.) In short, a shortage of loanable funds restrains bank-controlled overinvestment. Conversely, when the bank's lending capacity increases substantially so that the funding shortage is no longer an issue, the bank will tend to prod the firm to overinvest.[8]

During the early postwar period, Japan's economy struggled to recover. The many necessary investments and the shortage of capital at that time made overinvestment virtually out of the question. As a result, the main bank system, which provided hands-on governance for the client firms in mitigating classic asymmetric information and agency problems, mainly facilitated the growth of Japan's economy during that time, despite rent extraction.

The main banks' methods of operation, however, became onerous as the banks accumulated more and more loanable funds. Fig. 3 shows the domestic credit provided by Japan's banking sector and the total deposits in banking institutions, each scaled by GDP. These ratios, in percent, measuring the banks' lending capacity, surged at the beginning of the 1970s. The abundance of loanable funds (relative to domestic investment opportunities) meant that the main banks now had more incentive to prod their client firms to overinvest. This occurred right before Japan's financial deregulation, which was launched slowly in the mid 1970s and in fact only took effect in the early 1980s (see the detailed descriptions by Hoshi and Kashyap, 2000, and Morck et al., 2000). Eventually,

deregulation undercut the main banks' influence over their client firms. Perhaps the Japanese regulators realized that the main banks' traditional methods of operation would result in investment inefficiency in the new economic environment of abundant loanable funds. But this movement towards a more market-oriented financial system caused new problems (because market imperfections in a new regulatory environment often have unexpected implications).

2.5. Scenario III: Firm controlled financing decisions under funding competition

Now consider the situation where the manager makes investment and financing decisions on behalf of the existing shareholders, and uses either bank debt or equity to finance a project. This scenario reflects the situation during and after deregulation in Japan. While the main bank remained an insider through its monitoring activities, opening up the capital markets allowed many firms access to funding alternatives. The main banks' equity holdings in their client firms were expected to be diluted by the deregulation. Consequently, the main banks' practice of hands-on governance became difficult to continue.

We can directly compare the costs of debt versus equity financing. The agency costs of debt will not affect the optimal investment policy because the firm will instead use equity financing if the agency costs of debt are too high. We will argue later that asymmetric information costs of equity do not cause investment distortions in our setting. If the firm uses debt, it yields part of its expected NPV to the bank under the optimal investment policy because of the agency costs of bank debt. In other words, if the project is fully financed with bank debt, the bank will impose—as previously assumed—a holdup cost of $mI(r_H - r)$ if the good state obtains. The bank enjoys this rent because it still has information superior to that of other possible fund providers. Note that for simplicity we have ignored the upper bound of interest rates, r_u, in this section. The firm's expected cost of using debt is thus $qmI(r_H - r)$.

---

[8] The theoretical analysis of Weinstein and Yafeh (1998) also concludes that bank monopoly power leads to corporate overinvestment. Their insight flows from a property that with a positive interest rate charged to the client firm (assumed to be the same as the cost of equity), the perceived corporate cost of capital—if the bank has a hand in the firm's investment decisions—is lower than the firm's actual cost. Our model differs in that it uses a different setup and is able to consider risk profiles associated with bank and equity financing because the investment risk profiles, especially in the presence of default risk, affect the costs of debt and equity differently. This helps elucidate how the downside risk affects the main bank itself when the bank loses its influence over corporate investment.

Alternatively, the firm could seek full equity financing for the project from new outside investors. The new investors would require a certain share of the firm's total assets at $t = 2$. This required share, denoted as β, may yield a non-zero NPV to the new equity investors. In other words, under asymmetric information, with a zero expected net payoff to new shareholders under risk neutrality they may end up with either a positive or negative NPV depending whether they under- or overestimate q. Any positive NPV for the new shareholders is the firm's asymmetric information cost. We will show later that β is rationally determined under asymmetric information.

Proposition 4. *When using either debt or new equity to finance a project, the manager, working on behalf of the existing shareholders, weighs the agency costs of debt and the asymmetric information costs of new equity. The firm's agency costs of using debt are:*

$$C_{Bank} = qmIr_H \qquad \text{if } r_L \geqslant -\frac{A}{I}, \tag{25}$$

$$C_{Bank} = qmIr_H + (1-q)m(A + Ir_L) \qquad \text{if } r_L < -\frac{A}{I}. \tag{26}$$

The firm's asymmetric information cost of new equity at time $t = 1$ is equal to the share, β, of the firm's expected total value minus the new equity investment,

$$C_{Equity} = \beta\{A + I[1 + qr_H + (1-q)r_L]\} - I. \tag{27}$$

For the proof, see Appendix B.4.

To obtain the financing decision rule we must understand how β is determined in the market. This is because, as shown in Eq. (27), β affects the asymmetric information cost of new equity. The equity market is unable to observe the inside information, q. It can only form an expected value of q based on its uniform distribution over $[q_l, q_u]$—the range of guesses by the market about the project's quality. Note that r_L and r_H as public information in our model are also part of the project's quality. The lower bound q_l (reflecting the most conservative guess by the market about q) is exogenously given. On the other hand, the upper bound, q_u, is endogenously determined. Denote the expected value of q as $E[q]$. Since the market knows (r_L, r_H) at $t = 1$, β is related to $E[q]$ according to the rational pricing principle under risk neutrality $\beta\{A + I\{1 + E[q]r_H + (1 - E[q])r_L\}\} = I$, or

$$\beta = \frac{I}{A + I\{1 + E[q]r_H + (1 - E[q])r_L\}}. \tag{28}$$

In Eq. (28), the share required by the new shareholders, β, and hence the cost of new equity, decreases with $E[q]$.

The firm prefers new equity over debt only if $C_{Equity} < C_{Bank}$. According to Eqs. (25)–(27), this decision rule corresponds to:

$$\beta\{A + I(1 + qr_H + (1-q)r_L)\} - I < mqIr_H \qquad \text{if } r_L \geqslant -\frac{A}{I}, \tag{29}$$

$$\beta\{A + I(1 + qr_H + (1-q)r_L)\} - I < mqIr_H + m(1-q)(A + Ir_L)$$
$$\text{if } r_L < -\frac{A}{I}. \tag{30}$$

In effect, $E[q]$, which determines β, is endogenously determined with the firm's financing decisions. If the firm uses new equity instead of debt, the market can infer the best possible quality for the project and hence form $E[q]$ using the presumed uniform distribution over $[q_l, q_u]$. We can describe the determination of q_u and $E[q]$ with the follow proposition.

Proposition 5. *When using either debt or new equity to finance a project, the manager, acting on behalf of the existing shareholders, may prefer new equity over debt. If so, the market can infer the best possible quality for the project as follows:*

$$q_u = \frac{E[q]I(r_H - r_L)}{I(r_H - r_L) - m\{A + I(1 + E[q]r_H + (1 - E[q]r_L)\}r_H}$$
$$\text{if } r_L \geqslant -\frac{A}{I}, \tag{31}$$

$$q_u = \frac{E[q]I^2(r_H - r_L) + m(A + Ir_L)\{A + I(1 + E[q]r_H + (1 - E[q])r_L)\}}{I^2(r_H - r_L) + m\{A + I(1 + E[q]r_H + (1 - E[q])r_L)\}\{A + I(r_L - r_H)\}}$$
$$\text{if } r_L < -\frac{A}{I}, \tag{32}$$

where

$$E[q] = \frac{q_l + q_u}{2}. \tag{33}$$

For the proof, see Appendix B.5.

We are now ready to determine the financing decision rule based on all of the exogenous variables. We can summarise the results in the follow proposition.

Proposition 6. *When using either debt or new equity to finance a project, the manager, acting on behalf of the existing shareholders, prefers new equity over debt as long as $C_{Bank} > C_{Equity}$, specifically,*

$$\left(\frac{A + I(1 + qr_H + (1-q)r_L)}{A + I\{(1 + E[q]r_H + (1 - E[q])r_L)\}} - 1\right) < mqr_H \quad \text{if } r_L \geqslant -\frac{A}{I}, \tag{34}$$

$$\left(\frac{A + I(1 + qr_H + (1-q)r_L)}{A + I\{(1 + E[q]r_H + (1 - E[q])r_L)\}} - 1\right)I$$
$$< mqIr_H + m(1-q)(A + Ir_L) \quad \text{if } r_L < -\frac{A}{I}, \tag{35}$$

where $E[q]$ is determined by the following implicit functions:

$$E[q] = \frac{1}{2}\left(q_l + \frac{E[q]I(r_H - r_L)}{I(r_H - r_L) - m\{A + I(1 + E[q]r_H + (1 - E[q]r_L)\}r_H}\right)$$
$$\text{if } r_L \geqslant -\frac{A}{I}, \tag{36}$$

$$E[q] = \frac{1}{2}$$
$$\left(q_l + \frac{E[q]I^2(r_H - r_L) + m(A + Ir_L)\{A + I(1 + E[q]r_H + (1 - E[q])r_L)\}}{I^2(r_H - r_L) + m\{A + I(1 + E[q]r_H + (1 - E[q]r_L))\}\{A + I(r_L - r_H)\}}\right)$$
$$\text{if } r_L < -\frac{A}{I}. \tag{37}$$

The proof is straightforward. Inserting β from Eq. (28) into conditions (29) and (30) easily gives conditions (34) and (35). Eqs. (31)–(33) in Proposition 5 directly produce Eqs. (36) and (37).

Investment inefficiency is absent here. There is no underinvestment problem á la Rajan (1992) due to the firms' access to new equity. There is no underinvestment problem of the adverse selection type either, because asymmetric information about growth alone never deters new equity issues (Myers and Majluf, 1984; Myers, 2003; Wu and Wang, 2005). In other words, when the assets in place are not subject to information asymmetry, the adverse selection that would have caused the firm to skip some profitable projects is not a concern. Asymmetric information about growth can give rise to asymmetric information costs as we have shown in Eq. (27), but such information costs only affect profit sharing between existing and new equity holders rather than deterring investment.

Overinvestment is also not a concern, because the manager, if he is acting on behalf of the existing shareholders, has no incentive to overinvest. Note that C_{Equity} in (27) can be negative, indicating a benefit from new equity. But even in this case, the firm has an incentive to stick to the optimal investment policy because holding the cash from new equity financing (as a zero NPV project) is better than throwing the cash into a negative NPV project (see Myers and Majluf, 1984). The financing decision rule is therefore the only issue in this section.

The financing decision rule in (34) and (35), where E[q] is endogenously determined at equilibrium, can be depicted on the (r_L, r_H) plane. The rule is, however, an implicit function. For simplicity we can use the following numerical procedure to produce an indifference curve on the (r_L, r_H) plane:

(a) set parameters A, I, q, m, and q_l;
(b) pick a value for r_L;
(c) insert the parameters along with a selected value for r_L into conditions (34)–(37) so that there are only two unknown variables, r_H and $E[q]$;
(d) try values of r_H (starting small and increasing);
(e) inset r_H into Eqs. (36) and (37) to get $E[q]$;
(f) inset $E[q]$ along with r_H into conditions (34) and (35);
(g) if the inequality in (34) and (35) holds, return to step (d) and try another value of r_H;
(h) if the inequality in (34) and (35) becomes an equality, the procedure yields a point (r_L, r_H) on the indifference curve. Then, restart from step (b) and pick another r_L.

This procedure will produce a set of points (r_L, r_H) that define the indifference curve for the financing decisions. For example, set $A = 4$, $I = 25$, $m = 0.2$, $q = 0.6$, and $q_l = 0.4$. Try $r_L = (0, -0.1, -0.2, -0.3, -0.4, -0.5)$ consecutively using the numerical procedure described above. The procedure will generate a corresponding series, $r_H = (0, 0.21, 0.45, 0.71, 0.94, 1.15)$, and thus specify one indifference curve. Appendix C shows the series to plot the indifference curves in Fig. 4.

In Panel A of Fig. 4, the light solid curve in the middle with six black dots represents one of the indifference curves. In this case, a project in the area below this indifference curve (i.e., in region I or II) will be financed with bank loans. A project in the area above this curve (regions III and IV) will be financed with equity. Any project in the area below the first best investment line (the bold solid line) will not be accepted.

The financing decision rule suggests that a project with a lower value of r_L is more likely to be financed with bank debt, and a project with a higher value of r_H to be financed with equity. In other words, when the main bank cannot control the firm, equity investors are more likely to be called into finance projects with better upside potential whereas the bank is more likely to end up financing projects with higher downside risk. Such a downside risk bias against the bank is factored into a high perfect market interest rate such that the expected ex-rent NPV to the bank equals zero under risk neutrality. A funding separation equilibrium thus prevails.

The intuition behind this financing decision rule can be understood as follows. Since the bank extracts rent in the good state, the holdup costs it imposes will be higher if the firm uses bank debt rather than equity to finance projects with better upside potential. The asymmetric information costs of equity are determined by the required share, β, which is negatively related to $E[q]$. Note that the asymmetric information costs of equity here are fundamentally different from classic adverse selection costs, because in the model of this paper there is no asymmetric information about assets in place.[9]

A static analysis with various parameter values shows some interesting results. Panel A of Fig. 4 presents two more indifference

curves where only the parameter value for q_l was reset. The curve with $q_l = 0.3$ is the one with solid squares, and the curve with $q_l = 0.5$ is the one with hollow squares. q_l is the most conservative guess by the market about q, reflecting the market's confidence about business prospects (and the managerial skills). Recall that $E[q]$ increases with q_l according to Eqs. (36) and (37). This means that the firm's cost of new equity decreases with market confidence. In effect, the greater the confidence, the lower is the indifference curve, and the more likely it is that projects will be financed with new equity. For example, with lower confidence of, say, $q_l = 0.3$, the debt financing area spreads over regions I + II + III and the equity financing area covers only region IV. But with greater confidence indicated by, say, $q_l = 0.5$, the debt financing area shrinks to region I and the equity financing area expands to regions II + III + IV. A stock market boom which reflects investor confidence thus aggregates the downside risk bias against bank financing.

Bank rent extraction should decrease with greater funding competition (Petersen and Rajan, 1995), but during Japan's transition toward a more competitive financial system banks still had information monopoly power, and firms that were able to access arm's-length financing risked falling captive again if they stayed within the main bank system. Bank financing thus lost its traditional appeal because of its perceived rent extraction costs for profitable firms.

The extent of the main banks' holdup behaviour affects the financing decision rule. In Panel B of Fig. 4, given $q_l = 0.4$, there are two more indifference curves where only the proportional rent extraction, m, has been reset. The curve with $m = 0.15$ is the one with solid squares, and $m = 0.3$ is shown with hollow squares. The value of m measures the aggressiveness of the main bank's rent extraction. The more aggressive the bank's rent extraction, the lower the indifference curve is, and hence the more likely it is that projects will be financed with equity. Worse, rent extraction not only discourages bank financing, it also leaves the main bank financing only those projects with greater downside risk.

Is there any evidence for the "equity for upside potential and bank debt for downside risk" bias against banks which the model predicts? Fig. 5 shows that such funding separation is evident in the Japanese data. We calculated an up-down payoff ratio for each listed firm in the PACAP database by letting X denote the firm's annual average positive EBIT/Assets ratio and Y its annual absolute average negative EBIT/Assets ratio for the years 1977–1989. The up-down payoff ratio is defined as $(1 + X)/(1 + Y)$. It measures the firm's asymmetric payoff structure. For each year, we sorted the firms by their up-down payoff ratios and selected two extreme groups. The highest up-down ratio group refers to the one third of firms with the highest up-down ratios, and the lowest up-down ratio group refers to the bottom third of firms. We then calculated the within-group mean of bank loan/assets ratios and of equity/assets ratios for the two groups.

Panel A of Fig. 5 plots the evolution of the annual bank loan/assets ratios for the lowest up-down ratio group (solid line) and for the highest up-down ratio group (dotted line). Note first the general pattern of separation: firms with more downside risk on average used much more bank financing than firms with better upside potential. Second, from 1977 to the end of the 1980s, there was an overall decrease in bank financing (see also Hoshi, 2001), but it is the firms with better upside potential that reduced bank financing the most relentlessly.

The patterns for annual equity/assets ratios, as shows in Panel B of Fig. 5, are consistent with the results in Panel A. Firms with more downside risk on average used much less equity (solid line) than firms with better upside potential (dotted line). Indeed, the plots in Panel B look like a mirror image of those in Panel A, confirming the "equity for upside potential and bank debt for downside risk" bias predicted by our model. As a result, if a severe adverse and

---

[9] In a generalized Myers–Majluf framework similar to that of Cooney and Kalay (1993) but with incentive compatibility imposed, Wu and Wang (2005) show that the classic adverse selection discount at the announcement of new equity issues comes from asymmetric information about the assets in place, and that the discount can even be reversed for firms with asymmetric information arising mainly from growth instead of assets-in-place. Myers and Majluf (1984) also point out that asymmetric information about growth alone never deters new equity issues but they stop short of suggesting that an increase in information asymmetry about growth can facilitate new equity issues (in a rational expectations setting).
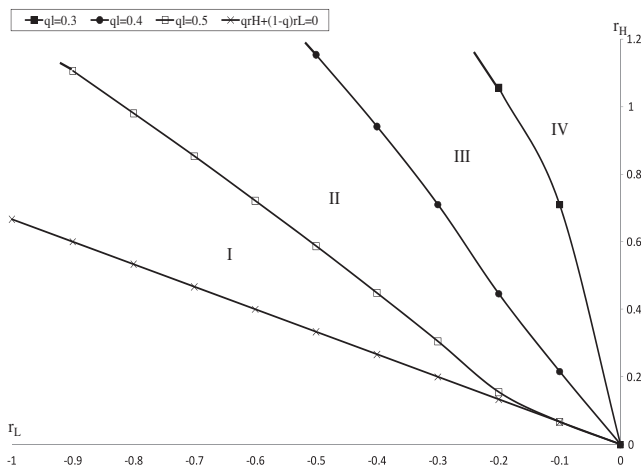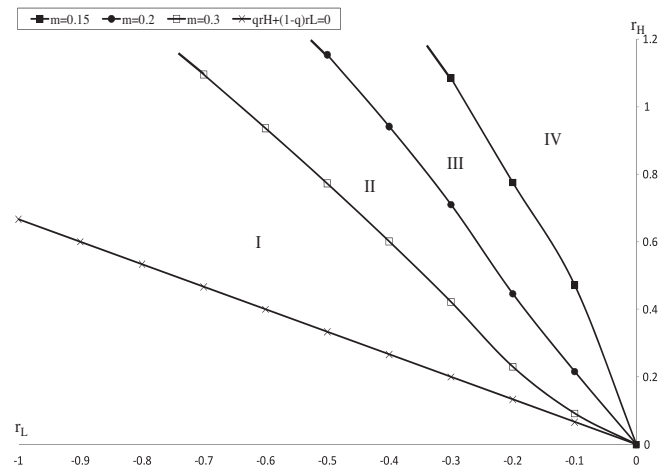
Panel A: Bank versus equity financing regions with various q_l Panel B: Bank versus equity financing regions with various m

Fig. 4. Corporate financing decisions in Scenario III.

systemic shock occurred, the main banks were bound to pile up more bad debts than usual.

3. Understanding the rise and decline of the main bank system

Table 1 summarizes the postwar history of Japanese corporate finance under the main bank system in terms of the model's predictions. This presentation may help explain many questions which have long remained unresolved. For example, why did the main bank system work well in the period before the financial deregulation when the main banks were at their most powerful? If the main bank system helped Japan's economy to overcome classic market imperfections during the early postwar period, what was the rationale behind the financial deregulation which eventually undermined the main bank system? Did the main banks benefit from the opening up of the capital markets, or were they only hurt by it? Why did the financial deregulation eventually hurt the banking system even though the reform was well intentioned? The model can help address all of these issues.

One of the main features of the model is the rent extraction by the main banks. Rent extraction can cause underinvestment if a firm makes decisions in the interest of its shareholders, as was originally suggested by Rajan (1992). This underinvestment problem disappears, however, if a main bank controls the firm's decisions, as is shown by Propositions 1 and 2 in Scenario I. There are actually two kinds of underinvestment problem. The first is the well understood problem of asymmetric information and agency conflicts described by Powers (1990) and by Berglof and Perotti (1994). The second is the holdup induced underinvestment of Rajan (1992). A strong main bank system mitigates both of these problems.

The main bank's holdup behaviour can, however, lead to overinvestment when a main bank has control (Weinstein and Yafeh, 1998). One of the new insights of the model, as shown by Proposition 3 in Scenario II, is that financing with a mix of debt and new equity tends to aggravate main bank controlled overinvestment. With main bank controlled financing and investment, new equity plays only a risk-sharing role in projects with downside risk too severe for the bank to bear alone. The bank controlled financing and investment hurts the existing shareholders because the firm undertakes some otherwise unacceptable projects. The new shareholders would not be hurt because

the new equity should be fairly priced. This suggests that as long as the main banks retain control, opening up the capital markets works to their benefit.

Main bank controlled overinvestment becomes constrained if loanable funds are in shortage, because the cutoff level to accept new projects will be raised. The effect of using new equity to relieve the funding shortage is limited because new equity only helps to share the downside risk. It is in the bank's own interest for the firm to invest in the most profitable projects (the projects with best upside potential). The bank's non-interest payoff comes from its equity holdings and rents it extracts, both increased by successful new projects. This explains why bank controlled overinvestment was not a main concern until the banks' lending capacity had increased substantially in the 1970s. In view of the benefits of the main bank system when loanable funds were in shortage, it becomes understandable how Japanese corporations were able to enjoy such well-respected rapid growth, especially before the financial deregulation when the main banks were at their most powerful.

After Japan accumulated a glut of savings and capital, however, the main bank controlled overinvestment posed a problem to the system. The financial deregulation that undercut main bank power was justified, but the effect of shifting control rights back to the firms was profound, as shown by Proposition 6 in Scenario III. If a firm made decisions in the interests of its existing shareholders, it was more likely to seek new equity rather than bank financing for projects with better upside potential. This is because the main bank could extract proportionally more rent if a project had a better positive outcome. As a result, the main bank's payoff remains *ex ante* optimal, but the bank is more likely to end up funding projects with relatively greater downside risk (such as less creditworthy small firms and bubble-prone real estate investments). The insight that bank rent extraction can backfire in this regard is completely new.[10]

Panel A of Fig. 5 shows that toward the Japanese stock market's peak around 1989, even firms with high downside risk accelerated

---

[10] John et al. (1994) also studied bank risk, but in light of the universal banking debate in the US. Their analysis shows how bank equity holdings can influence both business investment efficiency and bank portfolio risk, and how bank equity holdings optimally mitigate a firm's risk-shifting against banks in a traditional sense of imperfect information and moral hazard. Our model differs in that it considers bank rent extraction as the main source of the firm-bank conflicts of interest (the dark side of intrusive banks) and how bank risk lurks during an equity and real estate market boom.

Panel A: Evolution of annual loan-to-total-assets ratios

Panel B: Evolution of annual equity-to-total-assets ratios
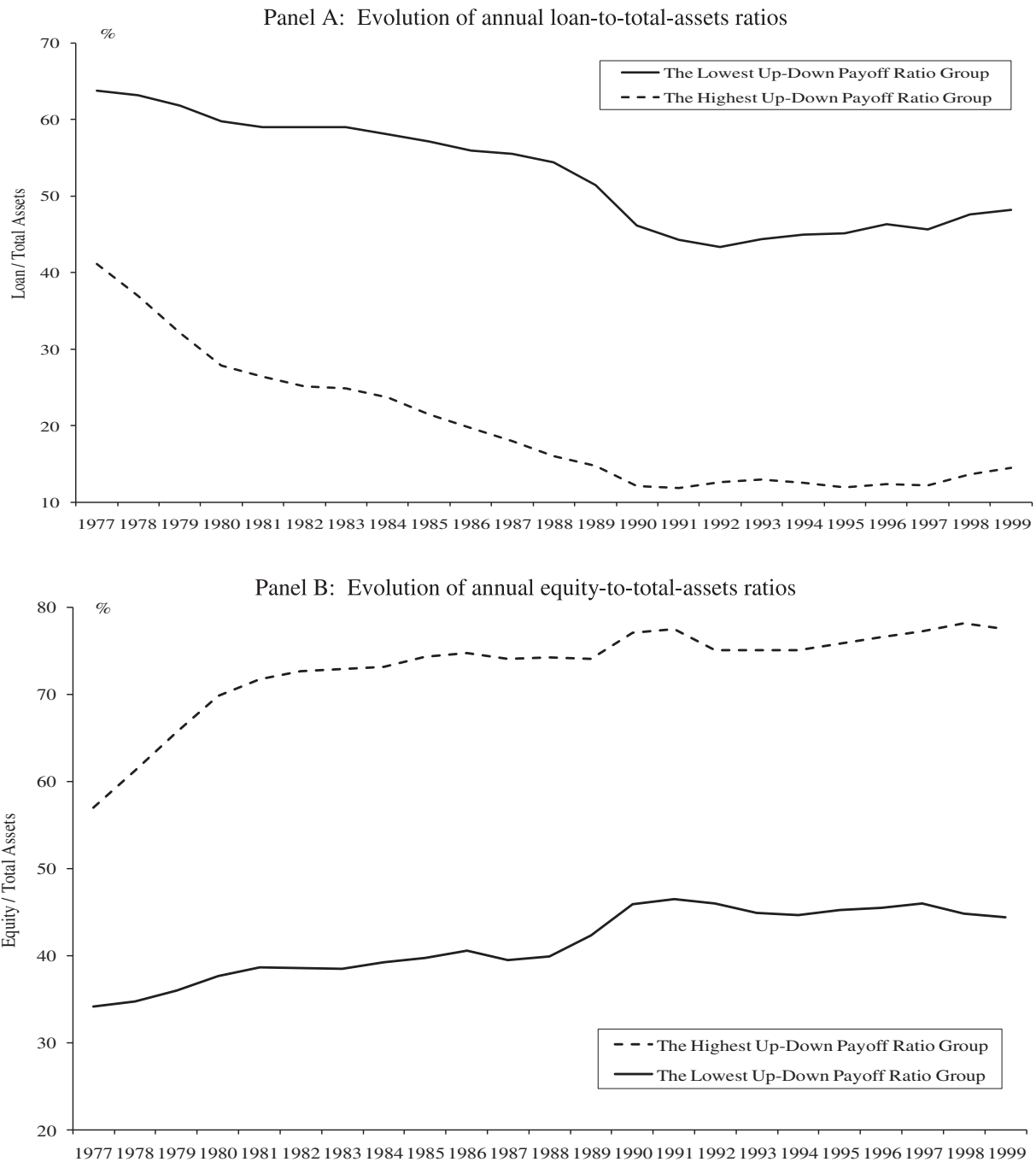
Fig. 5. Bank versus equity financing based on project risk profile. For each Japanese listed firm in the PACAP database, if X = annual average positive EBIT/Assets and Y = annual absolute average negative EBIT/Assets for 1977–1989, the up-down payoff ratio is $(1 + X)/(1 + Y)$. This measures the up and down payoff asymmetry or firm/project risk profile. The highest up-down payoff ratio group means the one third of firms with the highest up-down payoff ratios and the lowest group means the bottom one third of firms. The total number of firms sorted is 1501.

their bank debt reduction (solid line). A natural question arises: Where did the "redundant" bank loans go? Hoshi and Kashyap (2000) and Hoshi (2001) provided an excellent answer that more and more loanable funds were pushed into less creditworthy small businesses and, notably, into bubble-prone real estate investments. In many cases these investments had even more downside risk than the listed firms with the lowest up-down payoff ratios in Fig. 5. This explains why bank assets become highly sensitive to adverse shocks, foreshadowing the troubles of the Japanese banking system in the 1990s and beyond. But during the market and real estate boom that accompanied the financial reforms in the

1980s, who could have anticipated the unprecedented adverse shocks later?

What actually happened? Japan's financial deregulation was launched in the mid-1970s (see Hoshi and Kashyap, 2000; for a detailed timeline of deregulation), but the opening up of arm's-length capital markets actually started in the early 1980s—a delay perhaps reflecting the reluctance of main banks to give up their traditional governance practices and their control over business firms. A significant increase in corporate equity financing and bond issues occurred in the mid-1980s (Campbell and Hamao, 1994). Some funds, instead of becoming deposits, were diverted into the stock

Table 1
Timeline for the rise and decline of the main bank system.

Period	Model results	Highlights
Rise of the main bank system		
Postwar (Until the 1960s)	Scenario I, Propositions 1 and 2	Main banks helped mitigate classic underinvestment problems.
	Scenario II, Proposition 3, Figs. 1 and 2	Overinvestment was a remote concern because loanable funds were in shortage. The strong main bank system facilitated investment efficiency
Pre-deregulation (Early-mid 1970s)	Scenario II, Proposition 3, Figs. 2 and 3	National wealth rapidly accumulated and loanable funds started to abound due to the postwar economic miracle. Corporate overinvestment promoted by the main banks lurked on the horizon
Decline of the main bank system		
Deregulation (1977–1987)	Scenario II, Proposition 3, Figs. 2 and 3	Main bank impelled overinvestment became more evident. Deregulation to undercut the main banks' influence was well intended and necessary
	Scenario III, Proposition 6, Figs. 4 and 5	But as their role in corporate governance started to weaken, rent extraction backfired. Projects with more downside risk were more likely to be bank financed whereas projects with limited downside risk or better upside potential were more likely to be equity financed
Post-deregulation (Late 1980s)	Scenario III, Proposition 6, Figs. 4 and 5	During an equity and real estate market boom, the project risk profile bias against main banks became even stronger
Adverse shock period (Early 1990s)	Implication of Scenario III, Proposition 6	Large adverse shocks occurred and banks piled up bad debt, producing a long-lasting credit crunch

and bond markets as a result (Hoshi and Kashyap, 2000; Hoshi, 2001).

Wu et al. (2009) have recently shown that Japanese firms with better growth prospects tended to use more external finance through either bonds or equity and that among them, those with relatively stable earnings (usually arising from assets-in-place) were able to issue bonds or public debt, consistent with the holdup argument of Rajan (1992). Since only a certain type of firm is able to issue bonds, the existence of public debt does not in reality undermine the main result that there was a downside risk bias against bank debt due to the banks' rent extraction.[11] The evidence on the whole suggests that competition from alterative funding sources was inevitable and tended to weaken the main banks' position. This was accompanied by the late-1970s regulatory decision to lower the cap on banks' equity holdings from 10% to 5% of any single firm by 1987. These changes profoundly affected the main bank system.

If a firm has access to new equity as well, bank debt (because of rent extraction) is chosen mainly for projects with greater downside risk. This causes the main banks' rent extraction policy to backfire. A glut of loanable funds made the main banks' lending policy loose. The main banks, which used to finance mainly *keiretsu* firms, were willing to finance new, mostly less creditworthy firms, during the 1980s boom. These risky firms, without the legacy of a main bank relationship, were more likely to make decisions largely free of the main bank's influence. Additionally, the main banks' governance capability was stretched thin during the boom in the 1980s; perhaps the main banks had not come to realize that more stringent risk management was especially required in that situation.

Taken together, our analysis provides an explanation for Kang and Stulz (2000)'s finding that firms with more bank borrowings in the late 1980s had more equity losses during the stock market slump in the early 1990s. According to the model's predictions, more bank borrowings during this period indicate higher real risk,

consistent with Kang and Stulz's claim that their finding is beyond a pure leverage effect.

What happened to the *keiretsu*? The legacy of the main bank relationship was not totally lost during the deregulation process. To some extent the main bank's influence remains for *keiretsu* firms, but that legacy has largely become a burden. Morck et al. (2000) find that main banks' equity holdings have a significant negative effect on firm value, consistent with the work of Morck and Nakamura (1999) who argue that bank oversight yields less effective corporate governance than shareholder oversight (see also Inoue et al., 2008). In addition, Wu and Xu (2005) find that the valuation effects of investment and financing decisions during the 1980s differed significantly between *keiretsu* and non-*keiretsu* firms, reflecting an adverse *keiretsu* membership effect. The low average return on investment of *keiretsu* firms is widely documented for the deregulation period (Nakatani, 1984; Weinstein and Yafeh, 1998; Wu et al., 2000).

Financial deregulation has moved Japan toward a more market-oriented system but brought unexpected consequences. Dewenter and Warther (1998) have shown that stock prices did not respond to the dividend policies of keiretsu firms in the 1980s. They interpret this as evidence that the keiretsu firm–bank relationship mitigates the well-understood market imperfections which prevail in a market-oriented economy. As a result, the keiretsu firms' dividend policies were meant for internal capital allocation and did not need to be market-oriented. Wu and Xu (2005) confirm those findings but find that the value information of the dividend policy became significant in the early 1990s, indicating a fundamental shift of Japanese corporate finance toward market-oriented practices. This explains why in the 1990s the *keiretsu* firms, after an extended period of overinvestment and main bank relationships being weakened as a result of the deregulation, were not good candidates to rescue their bad debt-ridden main banks. It also explains why Japan's banking system has suffered for so long.

4. Conclusion

Scholars used to praising the merits of the Japanese main bank system were surprised by the system's poor performance during and after financial deregulation. This paper has developed a model that explains the agency problem at the heart of Japanese main bank relationships. The model's main predictions and their implications can be summarized as follows:

---

[11] Wu et al. (2009) also show that firms with very high growth potential tended to use more bank loans than public debt. But this occurs when rent extraction is low. Footnote 3 mentioned an alternative version of rent extraction based on a cum-rent-interest rate. In Scenario III under this new setting, only when the rent is low, bank loans are used to finance not only projects with more downside risk but also projects with best upside potential. The low rent condition is consistent with the argument that funding competition from new equity helps curb bank rent extraction at high growth firms that have difficulty issuing bonds but are able to tap cost-effective new equity (see also Kutsuna et al., 2007). The bottom line is that the downside risk bias against bank debt exists even when the rent is low and hence is prevalent (the proof is available on request).

1. With only bank financing available, a firm that maximizes shareholder value may underinvest because of main bank rent extraction. Rent extraction lowers the net payoff for shareholders and makes less profitable but otherwise acceptable projects unattractive. This is consistent with the idea of bank holdup. However, if the main bank is able to control the firm's investment decisions, the types of investment inefficiency will be reversed: Main bank control can mitigate underinvestment but introduce the possibility of overinvestment. The overinvestment problem will become more severe if the bank's rent extraction becomes more aggressive, or if the bank's equity holdings in the firm decrease, or both.

2. If a mix of bank debt and new equity is allowed, and the main bank maintains control by maintaining its share of the firm's equity, a bank controlled firm will use only bank debt to finance projects with better upside potential and limited downside risk. This enables the main bank to extract proportionally more rent. For an acceptable project with considerable downside risk, the bank will prefer that the firm use a mix of debt and new equity to finance it. The new equity plays a risk-sharing role when the risk is too big for the main bank to bear alone.

3. Risk sharing using new equity worsens overinvestment. A bank controlled firm may undertake a negative NPV project with marginally more downside risk, because fairly-priced new equity will help share this risk. In other words, as long as the main bank retains control, opening up the equity markets works in its favour and tends to aggravate overinvestment to the detriment of existing shareholders.

4. Main bank controlled overinvestment can, however, be contained by a shortage of loanable funds. Capital shortage raises the cutoff level for acceptable projects and naturally reduces overinvestment. The effect of the firm's using new equity to relieve the capital shortage is limited, because the main bank allows new equity only for downside risk sharing. Conversely, when a main bank has accumulated abundance of loanable funds, it will press its client firms to overinvest. This explains why the costs of the main bank system were contained during Japan's economic takeoff in the postwar period, and why they loomed large when loanable funds became more easily available as national savings accumulated.

5. When a main bank loses control of a firm and the firm becomes free to choose between bank debt and new equity, the bank's loan quality deteriorates, even though its lending policy remains *ex ante* rational. The firm, acting in the interests of its existing shareholders, is more likely to seek bank financing for projects with greater downside risk, and to seek new equity investors for projects with better upside potential. A main bank extracts rent when a project has a positive outcome, so bank holdup costs will be higher if a firm uses bank debt instead of equity to finance projects with better upside potential. Financial deregulation significantly weakened the main banks' control over Japanese firms and caused the *ex ante* rational main banks to take on more downside risk. This "equity for growth and bank debt for downside risk" bias made it harder than ever for main banks to diversify their risks.

6. If the market's confidence about the quality of projects improves, the firm's asymmetric information costs of new equity decrease (a situation similar to that in late-1980s Japan). Thus, the increase in the market's confidence made it even more likely that the holdup costs of bank financing will be higher than the asymmetric information costs of external equity for financing projects with better upside potential. As a result, the risk profile bias against the main banks will become even stronger during an equity market boom. If an adverse systemic shock occurs, it is likely to hit the main banks much harder than the

traditional business sector. This helps explain why the main banks were almost impervious to the oil shocks in the 1970s, but were much more vulnerable to shocks in the early 1990s.

In summary, this model provides an explanation for the rise and decline of the Japanese main bank system in the second half of the 20th century. Financial deregulation which coincided with an equity market boom increased bank risk—making the post-boom recession much worse. This provides a plausible reason for the extended crisis in Japan's economy in the 1990s while allowing for the benefits from the main bank system in the early postwar period. These results illustrate the pitfalls of ignoring agency problems whose interactions with a changing environment during regulatory reforms can lead to extreme consequences. The findings may have relevance for the recent financial crisis in the US.

Appendix A. Numerical examples

A.1. The investment policy that maximizes the firm's value

Suppose the (collateral) value of a firm's initial assets in place is 4 million dollars at $t = 0$. The firm's main bank owns *10%* of its equity. So the main bank has an initial stake of *0.4 million dollars*. At $t = 1$, the firm has an investment opportunity that requires an investment of 25 million dollars. The returns on the investment from $t = 1$ to 2 are $(-0.2, 0.14)$ in the bad and good states, respectively. The firm's manager knows that the probability of the project's realising the good state is 60%. Should she accept this project? To maximize the firm's total value, the manager should implement an investment policy that undertakes all positive NPV projects. Such a policy can be expressed as $[r_H^*]$ where $r_H^* = -\frac{(1-q)r_L}{q} = -\frac{0.4 \ast (-0.2)}{0.6} = 0.13$. In this example, r_H for the new project is 0.14 which is higher than r_H^*, so this project should be accepted.

A.2. The investment policies in Scenario I

The manager has to finance the project by borrowing 25 million dollars from the main bank. Otherwise, she has to skip the project. In addition to interest charges, the main bank can extract a proportional rent, $m = 20\%$, from the firm's payoff in the good state. Suppose r_u is non-binding here. Since $r_L = -0.2$ and $-A/I = -0.16$, $r_L < -A/I$. Thus, the bank will charge a market interest rate,

$r = \frac{-(1-q)(A+Ir_L)}{qI} = \frac{-0.4*(4-25*0.2)}{0.6*25} = 2.67\%$. The manager, acting on behalf of the shareholders, will undertake investment policy $[r_H^e]$ where $r_H^e = \frac{(1-q)mA}{q(1-m)I} - \frac{(1-q)r_L}{q} = 0.145$. Since r_H for the new project is 0.14, $r_H^e > 0.14$ and the manager has to forgo the investment.

If the main bank controls the firm and makes the decisions, the investment policy $[r_H^b]$ where $r_H^b = -\frac{(1-\alpha)(1-q)mA}{[\alpha(1-m)+m]qI} - \frac{(1-q)r_L}{q} = 0.113$ will be softer. This time, $r_H^b < 0.14$ and the firm will undertake the investment.

Appendix B. Proofs for propositions

B.1. Proof for Proposition 1

If $r_L \geqslant -\frac{A}{I}$, according to (2) and (3), we have

$$
\begin{aligned}
NPV_e &= q[A + (1-m)I(r_H - r)] + (1-q)Max\{A + I(r_L - r), 0\} - A \\
&= q[A + (1-m)Ir_H] + (1-q)(A + Ir_L) - A \\
&= q(1-m)Ir_H + (1-q)Ir_L.
\end{aligned}
\tag{38}
$$

$NPV_e \geqslant 0$ only if $r_H \geqslant \frac{-(1-q)r_L}{q(1-m)}$. Thus, $r_H^e = \frac{-(1-q)r_L}{q(1-m)}$, i.e. (6).

If $\frac{-qr_u}{1-q} - \frac{A}{I} \leqslant r_L < -\frac{A}{I}$, according to (2) and (4), we have

$$
\begin{aligned}
NPV_e &= q[A + (1-m)I(r_H - r)] + (1-q)Max\{A + I(r_L - r), 0\} - A \\
&= q\left[A + (1-m)I\left[r_H + \frac{(1-q)(A+Ir_L)}{qI}\right]\right] - A \\
&= q(1-m)Ir_H + (1-q)[(1-m)(A + Ir_L) - A].
\end{aligned}
\tag{39}
$$

$NPV_e \geqslant 0$ only if $r_H \geqslant \frac{(1-q)mA}{q(1-m)I} - \frac{(1-q)r_L}{q}$. Thus, $r_H^e = \frac{(1-q)mA}{q(1-m)I} - \frac{(1-q)r_L}{q}$, i.e. (7).

If $-1 < r_L < \frac{-qr_u}{1-q} - \frac{A}{I}$, according to (2) and (5), we have

$$
\begin{aligned}
NPV_e &= q[A + (1-m)I(r_H - r)] + (1-q)Max\{A + I(r_L - r), 0\} - A \\
&= q[A + (1-m)I[r_H - r_u]] - A.
\end{aligned}
\tag{40}
$$

$NPV_e \geqslant 0$ only if $r_H \geqslant \frac{(1-q)A}{q(1-m)I} + r_u$. Thus, $r_H^e = \frac{(1-q)A}{q(1-m)I} + r_u$, i.e. (8). $\square$

B.2. Proof for Proposition 2

If $r_L \geqslant -\frac{A}{I}$, according to (3) and (9), we have

$$
\begin{aligned}
NPV_b &= q[\alpha[A + (1-m)I(r_H - r)] + I(1+r) + mI(r_H - r)] \\
&\quad + (1-q)[\alpha Max\{A + I(r_L - r), 0\} + Min\{I(1+r), A \\
&\quad + I(1+r_L)\}] - (\alpha A + I) \\
&= q[\alpha[A + (1-m)Ir_H] + I + mIr_H] + (1-q)[\alpha(A + Ir_L) \\
&\quad + I] - (\alpha A + I) \\
&= qI[\alpha(1-m) + m]r_H + (1-q)I\alpha r_L.
\end{aligned}
\tag{41}
$$

$NPV_b \geqslant 0$ only if $r_H \geqslant -\frac{(1-q)r_L}{q[1+m(\frac{1-\alpha}{\alpha})]}$. Thus $r_H^b = -\frac{(1-q)r_L}{q[1+m(\frac{1-\alpha}{\alpha})]}$, i.e. (10).

If $\frac{-qr_u}{1-q} - \frac{A}{I} \leqslant r_L < -\frac{A}{I}$, according to (4) and (9), we have

$$
\begin{aligned}
NPV_b &= q[\alpha[A + (1-m)I(r_H - r)] + I(1+r) + mI(r_H - r)] \\
&\quad + (1-q)[\alpha Max\{A + I(r_L - r), 0\} + Min\{I(1+r), A \\
&\quad + I(1+r_L)\}] - (\alpha A + I) \\
&= q\left[\alpha\left[A + (1-m)I\left(r_H + \frac{(1-q)(A+Ir_L)}{qI}\right)\right] \right. \\
&\quad + I\left(1 - \frac{(1-q)(A+Ir_L)}{qI}\right) + mI\left(r_H + \frac{(1-q)(A+Ir_L)}{qI}\right)\right] \\
&\quad + (1-q)(A + Ir_L + I) - (\alpha A + I).
\end{aligned}
\tag{42}
$$

$NPV_b \geqslant 0$ only if $r_H \geqslant -\frac{(1-\alpha)(1-q)mA}{(\alpha-\alpha m+m)qI} - \frac{(1-q)r_L}{q}$. Thus, $r_H^b = -\frac{(1-\alpha)(1-q)mA}{[\alpha(1-m)+m]qI} - \frac{(1-q)r_L}{q}$, i.e. (11).

If $-1 < r_L < \frac{-qr_u}{1-q} - \frac{A}{I}$, according to (5) and (9)

$$
\begin{aligned}
NPV_b &= q[\alpha[A + (1-m)I(r_H - r)] + I(1+r) + mI(r_H - r)] \\
&\quad + (1-q)[\alpha Max\{A + I(r_L - r), 0\} + Min\{I(1+r), A \\
&\quad + I(1+r_L)\}] - (\alpha A + I) \\
&= q[\alpha[A + (1-m)I(r_H - r_u)] + I(1+r_u) + mI(r_H - r_u)] \\
&\quad + (1-q)(A + Ir_u + I) - (\alpha A + I).
\end{aligned}
\tag{43}
$$

$NPV_b \geqslant 0$ only if $r_H \geqslant -\frac{(1-\alpha)(1-q)A+(1-m)(1-\alpha)qIr_u+(1-q)Ir_L}{(\alpha-\alpha m+m)qI}$. Thus, $r_H^b = -\frac{(1-\alpha)(1-q)A+(1-m)(1-\alpha)qIr_u+(1-q)Ir_L}{[\alpha(1-m)+m]qI}$, i.e. (12). $\square$

B.3. Proof for Proposition 3

If $r_L \geqslant -\frac{A}{I}$, according to (13) and (16), we have

$$
\begin{aligned}
NPV_b &= q[\alpha(A + I(1+r_H) - D(1+r) - mD(r_H - r)) + D(1+r) \\
&\quad + mD(r_H - r)] + (1-q)[\alpha Max\{A + I(1+r_L) - D(1+r), 0\} \\
&\quad + Min\{D(1+r), A + I(1+r_L)\}] - (\alpha A + \alpha e + D) \\
&= q[\alpha(A + I(1+r_H) - D - mDr_H) + D + mDr_H] \\
&\quad + (1-q)[\alpha[A + I(1+r_L) - D] + D] - [\alpha A + \alpha I + (1-\alpha)D],
\end{aligned}
\tag{44}
$$

and

$$
\begin{aligned}
\frac{dNPV_b}{dD} &= -q\alpha(1 + mr_H) + q + qmr_H - (1-q)\alpha + (1-q) - (1-\alpha) \\
&= qmr_H(1-\alpha) \geqslant 0.
\end{aligned}
\tag{45}
$$

Since NPV_b is an increasing function of D which is no larger than I, $D^* = I$. The investment decision rule thus is the same as in Scenario I (where $D = I$ by assumption): $r_H^b = -\frac{(1-q)r_L}{q[1+m(\frac{1-\alpha}{\alpha})]}$, as in (21).

If $\frac{(1-q)D - qDr_u - (1-q)I}{(1-q)I} - \frac{A}{I} \leqslant r_L \leqslant -\frac{A}{I}$, according to (13) and (17), we have

$$
\begin{aligned}
NPV_b &= q\{\alpha(A + I(1+r_H) - D(1+r) - mD(r_H - r)) + D(1+r) \\
&\quad + mD(r_H - r)\} + (1-q)[A + I(1+r_L)] - [\alpha A + \alpha I + (1-\alpha)D] \\
&= q\left\{\alpha\left(A + I(1+r_H) - D\left(1 + \frac{(1-q)D - (1-q)[A+I(1+r_L)]}{qD}\right)\right.\right. \\
&\quad \left. - mD\left(r_H - \frac{(1-q)D - (1-q)[A+I(1+r_L)]}{qD}\right)\right) \\
&\quad + D\left(1 + \frac{(1-q)D - (1-q)[A+I(1+r_L)]}{qD}\right) \\
&\quad \left. + mD\left(r_H - \frac{(1-q)D - (1-q)[A+I(1+r_L)]}{qD}\right)\right\} \\
&\quad + (1-q)[A + I(1+r_L)] - [\alpha A + \alpha I + (1-\alpha)D],
\end{aligned}
\tag{46}
$$

and

$$
\frac{dNPV_b}{dD} = qm(1-\alpha)\left(r_H - \frac{1-q}{q}\right).
\tag{47}
$$

Consider two cases: $r_H \geqslant \frac{1-q}{q}$ and $r_H < \frac{1-q}{q}$.

Case 1: If $r_H \geqslant \frac{1-q}{q}$, NPV_b is an increasing function in D, so $D^* = I$. Since the NPV of a project ($r_L r_H$) is always non-negative if $r_H \geqslant \frac{1-q}{q}$, NPV_b must always be non-negative as well. Thus, if $r_H \geqslant \frac{1-q}{q}$ there is neither overinvestment nor underinvestment. Note that for $D^* = I$ the condition $\frac{(1-q)D - qDr_u - (1-q)I}{(1-q)I} - \frac{A}{I} \leqslant r_L \leqslant -\frac{A}{I}$ can be simplified as $\frac{-qr_u}{1-q} - \frac{A}{I} \leqslant r_L \leqslant -\frac{A}{I}$. i.e. (19).

Case 2: If $r_H < \frac{1-q}{q}$, NPV_b is a decreasing function in D. According to (17), $r_L \leqslant \frac{D-A-I}{I}$, or D is no smaller than $A + I(1+r_L)$, so $D^* = A + I(1+r_L)$.

Thus, for $NPV_b \geqslant 0$, we have $r_H^b = -\frac{\alpha(1-q)Ir_L}{\alpha qI+(1-\alpha)qm[A+I(1+r_L)]}$.

Given $D = A + I(1 + r_L)$, then $\frac{(1-q)D-qDr_u-(1-q)I}{(1-q)I} - \frac{A}{I} = \frac{-qr_u(A+I+Ir_L)}{(1-q)I} + r_L < r_L$.

In other words, (18) is not permissible and the condition $\frac{(1-q)D-qDr_u-(1-q)I}{(1-q)I} - \frac{A}{I} \leqslant r_L \leqslant -\frac{A}{I}$ can be written as $-1 \leqslant r_L \leqslant -\frac{A}{I}$.

Thus, if $r_H < \frac{1-q}{q}$ and $-1 \leqslant r_L \leqslant -\frac{A}{I}$, then $r_H^b = -\frac{\alpha(1-q)Ir_L}{\alpha qI+(1-\alpha)qm[A+I(1+r_L)]}$. With the two cases taken together, also noting that $-\frac{\alpha(1-q)Ir_L}{\alpha qI+(1-\alpha)qm[A+I(1+r_L)]} \leqslant \frac{1-q}{q}$, the decision rule of the second case automatically covers the first case.

Thus, if $-1 \leqslant r_L \leqslant -\frac{A}{I}$, then $r_H^b = -\frac{\alpha(1-q)Ir_L}{\alpha qI+(1-\alpha)qm[A+I(1+r_L)]}$, i.e. (22).

It is worth mentioning here that in Proposition 3, r_u does not appear in the investment policy (21) and (22). r_u affects NPV_b and the financing strategy in (19) but not the investment decisions. If the bank uses a mix of debt and equity in financing, then $r = 0$, by setting $D = A + I(1 + r_L)$ in (17). Note that the condition of (18) is not permissible. The situation for $r > 0$ to hit r_u occurs if the firm uses full debt in financing (i.e., $D = I$). But we know there is no impact on the investment policy because, based on the proof in the first case where $D = I$ when $r_H \geqslant \frac{1-q}{q}$, NPV_b in (46) is always non-negative and there is neither overinvestment nor underinvestment. $\square$

B.4. Proof for Proposition 4

If the project is financed by bank debt, the holdup cost is $qmI(r_H - r)$.

If $r_L \geqslant -\frac{A}{I}$, then $r = 0$. Thus, $C_{Bank} = qmI(r_H - r) = qmIr_H$, i.e. (25).

If $r_L < -\frac{A}{I}$, then $r = \frac{(1-q)I-(1-q)[A+I(1+r_L)]}{qI}$. Thus,

$$
\begin{aligned}
C_{Bank} &= qmI(r_H - r) \\
&= qmI\left(r_H - \frac{(1-q)I-(1-q)[A+I(1+r_L)]}{qI}\right) \\
&= qmIr_H - (1-q)mI + (1-q)m(A + I + Ir_L) \\
&= qmIr_H + (1-q)m(A + Ir_L),
\end{aligned}
$$

i.e. (26).

If the project is financed with new equity, new investors require a payoff of $\beta\{A + I[1 + qr_H + (1 - q)r_L]\}$. The cost of using new equity for the firm is thus $C_{Equity} = \beta\{A + I[1 + qr_H + (1 - q)r_L]\} - I$, i.e. (27). $\square$

B.5. Proof for Proposition 5

If $r_L \geqslant -\frac{A}{I}$, given $\beta\{A + I + I[qr_H + (1 - q)r_L]\} - I < mqIr_H$ and $\beta = \frac{I}{A+I+I[E[q]r_H+(1-E[q])r_L]}$, we have

$$
\begin{aligned}
q &< \frac{I-\beta A-\beta I-\beta Ir_L}{\beta Ir_H-\beta Ir_L-mIr_H} \\
&= \frac{I^2[E[q]r_H+(1-E[q])r_L-r_L]}{I^2[r_H-r_L-mr_H-mr_H(E[q]r_H+(1-E[q])r_L)]-mAIr_H} \\
&= \frac{E[q]I(r_H-r_L)}{I(r_H-r_L)-m\{A+I+I[E[q]r_H+(1-E[q])r_L]\}r_H},
\end{aligned}
$$

i.e. (31).

If $r_L < -\frac{A}{I}$, given $\beta\{A + I + I[qr_H + (1 - q)r_L]\} - I < mqIr_H + m(1 - q)(A + Ir_L)$ and $\beta = \frac{I}{A+I+I[E[q]r_H+(1-E[q])r_L]}$, we have

$$
\begin{aligned}
q &< \frac{I+m(A+Ir_L)-\beta A-\beta I-\beta Ir_L}{\beta Ir_H-\beta Ir_L-mIr_H+m(A+Ir_L)} \\
&= \frac{I^2[E[q]r_H+(1-E[q])r_L-r_L]+m(A+Ir_L)\{A+I+I[E[q]r_H+(1-E[q])r_L]\}}{I^2[r_H-r_L-mr_H-mr_H(E[q]r_H+(1-E[q])r_L)]-mAIr_H+m(A+Ir_L)\{A+I+I[E[q]r_H+(1-E[q])r_L]\}} \\
&= \frac{E[q]I^2(r_H-r_L)+m(A+Ir_L)\{A+I+I[E[q]r_H+(1-E[q])r_L]\}}{I^2(r_H-r_L)+m\{A+I+I[E[q]r_H+(1-E[q])r_L]\}(A+Ir_L-Ir_H)},
\end{aligned}
$$

i.e. (32).

Given that q is uniformly distributed in $[q_l, q_u]$, the outside equity investors' expected payoff will be:

$$
\begin{aligned}
E(payoff) &= \int_{q_l}^{q_u} \frac{1}{q_u - q_l}\beta\{A + I + I[qr_H + (1 - q)r_L]\}dq \\
&= \int_{q_l}^{q_u} \frac{1}{q_u - q_l}\{A + I + I[qr_H + (1 - q)r_L]\} \\
&\quad \times \frac{I}{A + I + I[E[q]r_H + (1 - E[q])r_L]}dq.
\end{aligned}
$$

A fair market price under risk neutrality makes the investors' expected earnings exactly equal to their initial investment I. Thus, $E = I$. Solving, $E[q] = \frac{q_l+q_u}{2}$, i.e. (33). $\square$

Appendix C. Data for plots in Fig. 4

$A = 4, I = 25, q = 0.6$		r_L	0.0	−0.1	−0.2	−0.3	−0.4	−0.5	−0.6	−0.7	−0.8	−0.9
$m = 0.2$	$q_L = 0.3$	r_H	0.000	0.710	1.056							
		$E[q]$	0.430	0.450	0.450							
	$q_L = 0.4$	r_H	0.000	0.216	0.446	0.710	0.941	1.153				
		$E[q]$	0.573	0.500	0.500	0.500	0.500	0.500				
	$q_L = 0.5$	r_H	0.000	0.067	0.155	0.305	0.448	0.587	0.721	0.853	0.980	1.106
		$E[q]$	0.716	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550
$q_L = 0.4$	$m = 0.15$	r_H	0.000	0.472	0.775	1.084						
		$E[q]$	0.507	0.352	0.500	0.500						
	$m = 0.2$	r_H	0.000	0.216	0.446	0.710	0.941	1.153				
		$E[q]$	0.573	0.500	0.500	0.500	0.500	0.500				
	$m = 0.3$	r_H	0.000	0.092	0.230	0.422	0.601	0.772	0.936	1.095		
		$E[q]$	0.858	0.500	0.500	0.500	0.500	0.500	0.500	0.500		

References

Allen, F., 1996. The future of the Japanese financial system. Working paper (in English), Wharton Financial Institutions Center, University of Pennsylvania. Gendai Finance (in Japanese), vol. 2, 1997, pp. 3–22.

Aoki, M., 1990. Toward an economic model of the Japanese firm. Journal of Economic Literature 28 (1), 1–27.

Aoki, M., Patrick, H., Sheard, P., 1994. The Japanese main bank system: an introductory overview. In: Aoki, M., Patrick, H. (Eds.), The Japanese Main Bank System: Its Relevance for Developing and Transforming Economics. Oxford University Press, Oxford, pp. 1–50.

Berglof, E., Perotti, E., 1994. The governance structure of the Japanese financial keiretsu. Journal of Financial Economics 36, 259–284.

Campbell, J., Hamao, Y., 1994. Changing patterns of corporate financing and the main bank system in Japan. In: Aoki, M., Patrick, H. (Eds.), The Japanese Main Bank System: Its Relevance for Developing and Transforming Economics. Oxford University Press, Oxford, pp. 325–352.

Cooney, J., Kalay, A., 1993. Positive information from equity issue announcements. Journal of Financial Economics 33, 149–172.

Dewatripont, M., Maskin, E., 1995. Credit and efficiency in centralized and decentralized economics. Review of Economic Studies 62, 541–555.

Dewenter, K., Warther, V.A., 1998. Dividends, asymmetric information, and agency conflicts: evidence from a comparison of the dividend policies of Japanese and U.S. firms. Journal of Finance 53, 879–904.

Fama, E., 1985. What's different about banks? Journal of Monetary Economics 15, 29–39.

Hoshi, T., 2001. What happened to Japanese banks? Bank of Japan Monetary and Economic Studies, 1–29.

Hoshi, T., Kashyap, A., 2000. The Japanese banking crisis: where did it come from and how will it end? In: Bernanke, B.S., Rotemberg, J.J. (Eds.), NBER Macroeconomics Annual 1999. MIT Press, Cambridge, Massachusetts, pp. 129–201.

Hoshi, T., Kashyap, A., 2001. Corporate Financing and Governance in Japan: The Road to the Future. MIT Press, Cambridge, Massachusetts.

Hoshi, T., Kashyap, A., Scharfstein, D., 1990a. Bank monitoring and investment: evidence from the changing structure of Japanese corporate banking relationships. In: Hubbard, R.G. (Ed.), Asymmetric Information, Corporate Finance, and Investment. University of Chicago press, Chicago, pp. 105–126.

Hoshi, T., Kashyap, A., Scharfstein, D., 1990b. The role of banks in reducing the costs of financial distress in Japan. Journal of Financial Economics 27, 67–88.

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

Houston, J., James, C., 1996. Bank information monopolies and the mix of public and private debt claims. Journal of Finance 51, 1863–1889.

Inoue, K., Kato, H., Bremer, M., 2008. Corporate restructuring in Japan: who monitors the monitor? Journal of Banking and Finance 32, 2628–2635.

Jacobs, M.T., 1993. Short-term America. Harvard Business School Press, Cambridge, Massachusetts.

John, K., John, T., Saunders, A., 1994. Universal banking and firm risk-taking. Journal of Banking and Finance 18, 307–323.

John, T., John, K., 1993. Top-Management compensation and capital structure. Journal of Finance 48, 949–974.

Kang, J-K., Shivdasani, A., 1997. Corporate restructuring during performance declines in Japan. Journal of Financial Economics 46, 29–65.

Kang, J-K., Stulz, R., 2000. Do banking shocks affect borrowing firm performance? An analysis of the Japanese experience. Journal of Business 73, 1–23.

Kaplan, S., Minton, B., 1994. Appointments of outsiders to Japanese boards: determinants and implications for managers. Journal of Financial Economics 36, 225–258.

Kutsuna, K., Smith, J., Smith, R., 2007. Banking relationships and access to equity capital markets: evidence from Japan's main bank system. Journal of Banking and Finance 31, 335–360.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 2002. Government ownership of banks. Journal of Finance 57, 265–301.

Mankiw, G., 1988. Comments on new issues in corporate finance. European Economic Review 32, 1183–1186.

Mayer, C., 1988. New issues in corporate finance. European Economic Review 32, 1167–1183.

Morck, R., Nakamura, M., 1999. Banks and corporate control in Japan. Journal of Finance 54, 319–339.

Morck, R., Nakamura, M., Shivdasani, A., 2000. Banks, ownership structure, and firm value in Japan. Journal of Business 73, 539–567.

Myers, S.C., 1977. The determinants of corporate borrowing. Journal of Financial Economics 5, 147–175.

Myers, S.C., 2003. Financing of corporations. In: Constantinides, G.M., Harris, M., Stulz, R.M. (Eds.), Handbook of the Economics of Finance, vol. 1A. North-Holland, Amsterdam, pp. 215–253.

Myers, S.C., Majluf, N.S., 1984. Corporate financing and investment decisions when firms have information the investors do not have. Journal of Financial Economics 13, 187–221.

Nakatani, I., 1984. The economic role of financial corporate grouping. In: Aoki, M. (Ed.), The Economic Analysis of the Japanese Firm. North Holland, Amsterdam, pp. 227–258.

Petersen, M., Rajan, R., 1995. The effect of credit market competition on lending relationships. Quarterly Journal of Economics 110, 407–443.

Pinkowitz, L., Williamson, R., 2001. Bank power and cash holdings: evidence from Japan. Review of Financial Studies 14, 1059–1082.

Porter, M.E., 1992. Capital choice: changing the way America invests in industry. Journal of Applied Corporate Finance 5, 4–16.

Prowse, S.D., 1990. Institutional investment patterns and corporate financial behaviour in the U.S. and Japan. Journal of Financial Economics 27, 43–66.

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

Rajan, R., Zingales, L., 1995. What do we know about capital structure? Some evidence from international data. Journal of Finance 50, 1421–1460.

Sapienza, P., 2004. The effect of government ownership on banking lending. Journal of Financial Economics 72, 357–384.

Sharpe, S.A., 1990. Asymmetric information, bank lending, and implicit contracts: a stylized model of customer relationships. Journal of Finance 45, 1069–1087.

Weinstein, D.E., Yafeh, Y., 1998. On the costs of a bank centered financial system: evidence from the changing main bank relations in Japan. Journal of Finance 53, 635–672.

Wu X., Sercu, P., Chen, C.J.P., 2000. Keiretsu membership, size, and returns on value and cost. Working paper, KU Leuven, Belgium.

Wu, X., Sercu, P., Yao, J., 2009. Does competition from new equity mitigate bank rent extraction? Insights from Japanese data. Journal of Banking and Finance 33, 1884–1897.

Wu, X., Wang, Z., 2005. Equity financing in a Myers–Majluf framework with private benefits of control. Journal of Corporate Finance 11 (5), 915–945.

Wu, X., Xu, L., 2005. The value information of financing decisions and corporate governance during and after the Japanese deregulation. Journal of Business 78 (1), 243–280.