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The Optimal Basel Capital Requirement to Cope with Pro-cyclicality: A Theoretical Approach

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Various Proposals for Minimum Capital Requirement exist

1, Adjustable minimum capital requirement ratio

-->raise in good times and reduce in bad times

2, Boom country → higher capital requirement

Sluggish country → Lower requirement

3, Adjustment Factors to the Basel Capital Requirement

(i)GDP growth rate, (ii) Stock Price (iii) Land Price,

(iv) Credit growth, (v) CDS (credit default swap)

4, Ryozo Himino (2009) → Stock Price Index

This paper address the following issues

(1)The Basel capital requirement ratio should depend on various macroeconomic factors such as GDP, stock prices, interest rates and land prices, based on a simple general equilibrium model.

Previous papers do not show any specific model and conclude that the capital requirement ratio would be better if adjusted based on stock price or economic growth, etc.

(2)The Basel minimum capital requirement rule should be different from country to country, since the economic structures are different from each other. A simple general equilibrium model suggests that the optimal minimum capital requirement ratio does depend on the structure of the economy and the behavior of the bank.

(3)The Basel capital requirement ratio should vary during the period of economic boom and during the period of economic downturn since the coefficient obtained from the theoretical model varies.

(4) Each country should obey different minimum capital requirement ratio.

Regulator's monitoring in each country is important. Cross-border

A Simple General Equilibrium Model

1, **Objective** of the Basel Minimum Capital Requirement → **Stabilize bank lending (L)**

2, **Banks** are assumed to **maximize their profits** based on the given minimum capital requirement and given macroeconomic variables such as GDP.

3, Macroeconomic variables (**land price (q1), Stock price (q2), GDP (Y)** and **interest rate (i)**) are determined from **a simple general equilibrium model**.

Banks are maximizing their profits

$$\pi^e = i_l \times L + i_B \times B - \rho^e(q_1, q_2, Y, i_B) \times \mathrm{L} - i_m \times D - C(L, B, q_1, q_2),$$

- π^e : **Expected profit of Bank**
- i_l : **interest rate on risky asset**
- **L: Risky assets (bank loans etc.)**
- i_B: **interest rate on safe assets**
- **B: safe assets (such as government bond)**
- ρ^e: **ratio of the expected default loan losses**
- **D: deposits and funds absorbed from the short term market**
- i_m: **the rate of interest charged to deposits or short term borrowing from the market**
- **C(L,B,q_1,q_2): various costs, q1=land price, q2=stock price**

Banks are maximizing their profits based on the following budget constraints, where K(.) denotes the default risk asset

$$L + B = D + A(q_2) \tag{2-1}$$

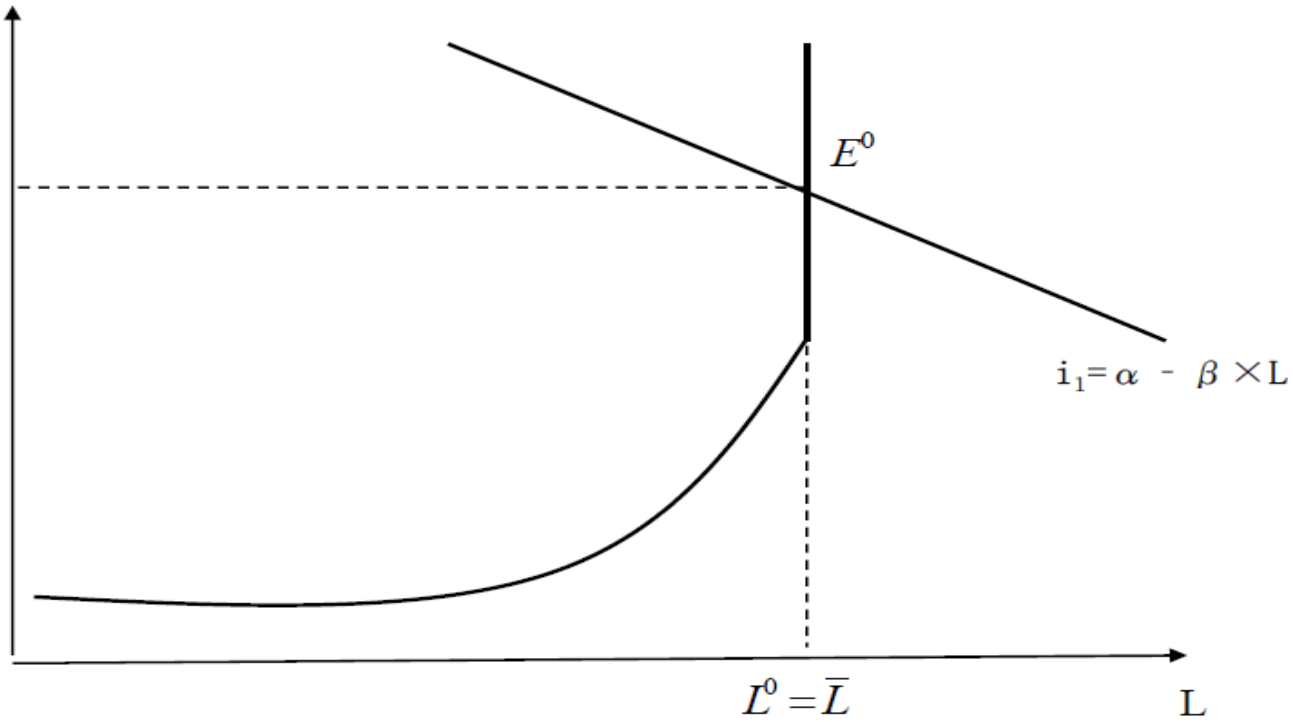
$$\frac{A(q_2)}{K\left\{F\left[\rho^e(q_1, q_2, Y, i_B)\right]\right\} \times \mathrm{L}} \geq \theta \tag{2-2}$$

$$\overline{L} \equiv \frac{A(q_2)}{\theta \times K\left\{F\left[\rho^e(q_1, q_2, Y, i_B)\right]\right\}}, \tag{2-3}$$

where $K = F(\rho^e)$, $F' > 0$

$$L = \bar{L} = \frac{A(q_2)}{\theta \times K(q_1, q_2, Y, i_B)}.$$

=Capital/(Basel minimum capital requirement ratio) x (Risk Assets) (3)



A Simple Macroeconomic Model

$$q_1 = f(Y, i_B, \alpha) \qquad \text{land price} \qquad (4)$$

$$q_2 = g(Y, i_B, \beta) \qquad \text{stock price} \qquad (5)$$

$$Y = \varphi(L, i_B, q_1, q_2, \delta) \qquad \text{Output (GDP)} \qquad (6)$$

$$i_B = h(q_1, q_2, Y, i_m, M, \gamma). \qquad \text{Interest rate on bond} \qquad (7)$$

How much % would the Based Minimum Capital Requirement better be adjusted in Japan?

based on Japanese Data

1987Q1-2009Q2

land price, stock price, GDP, interest rate

$$d\theta = -\frac{\theta}{K} \times \frac{\partial K}{\partial q_1} dq_1^* + \left[\frac{1}{K \times \bar{L}} \frac{\partial A}{\partial q_2} - \frac{\theta}{K} \times \frac{\partial K}{\partial q_2} \right] dq_2^* - \frac{\theta}{K} \times \frac{\partial K}{\partial Y} dY^* - \frac{\theta}{K} \times \frac{\partial K}{\partial i_B} di_B^*.$$

$$-1.447524 = -0.0533\, dq_1^* + \{0.5162 - 0.00172\} dq_2^* \quad -0.041427 dY^* \quad -0.01910 di_B^*$$

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$$-1.447524 = -0.0533\, dq_1^* + \{0.5162 - 0.00172\} dq_2^* \quad -0.041427 dY^* \quad -0.01910 di_B^*$$

1 Changes in Land price (dq_1) → **K** (default risk)

2 Changes in Stock price (dq_2) → **K**, **A**(bank's cap.)

2 Changes in business condition (d**Y**) → **K**

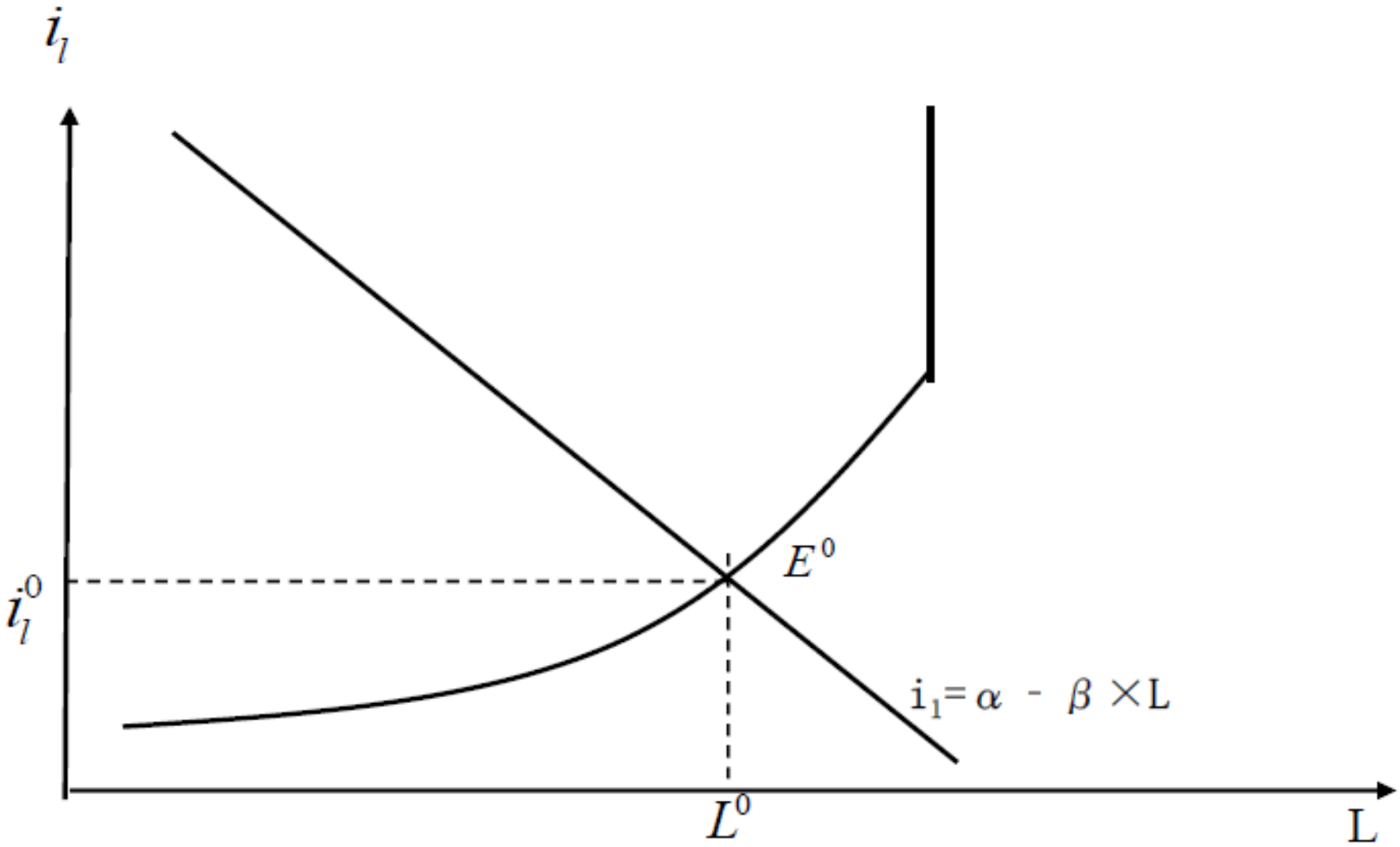
3 Changed in interest rate (di_B) → **K** (default risk)

→ Risk Asset ratio (K) changes

→ Bank's Capital (A(q1))changes

→ **Optimal minimum capital requirement ratio**

Case of Inner Solution (Loan Market)



Bank Loan Market Equilibrium

The loan market equilibrium can be obtained by the intercept of loan supply and the demand for bank loans. Namely, equations (10) and (12) determine the equilibrium for the loan market where q_1, q_2, Y, i_B are exogenously given. A more rigorous analysis of bank behavior which captures both the micro behavior of banks and its relation to macro demand for loans can be seen in Revankar and Yoshino (2008).

$$a_0 - a_1 \times L = \rho^e(q_1, q_2, Y, i_B) + i_m(\bar{L} - L) - i_m'(\bar{L} - L) \times [L + B(i_B) - A(q_2)] + \frac{\partial C}{\partial L}[L, B(i_B), q_1, q_2]. \quad (13)$$

How much should the Basel Minimum Capital Requirement be adjusted?

$$\frac{d\theta}{dx} = \left[\frac{\frac{\theta}{\overline{L}} \frac{\partial \rho^e}{\partial q_1} + (-i'_m + i''_m D) \frac{\theta}{\mathrm{K}} \frac{\partial \mathrm{K}}{\partial \mathrm{q_1}} + \frac{\theta}{\overline{L}} \frac{\partial^2 C}{\partial L \partial q_1}}{-i''_m D + i'_m} \right] \frac{\mathrm{dq_1^*}}{\mathrm{dx}}$$

$$+ \left[\frac{\frac{\theta}{\overline{L}} \frac{\partial \rho^e}{\partial q_2} + (i'_m - i''_m D)\left(\frac{1}{\mathrm{K} \times \overline{\mathrm{L}}} \frac{\partial \mathrm{A}}{\partial \mathrm{q_2}} - \frac{\theta}{\mathrm{K}} \frac{\partial \mathrm{K}}{\partial \mathrm{q_2}}\right) + i'_m \frac{\theta}{\overline{L}} \frac{\partial A}{\partial q_2} + \frac{\theta}{\overline{L}} \frac{\partial^2 C}{\partial L \partial q_2}}{-i''_m D + i'_m} \right] \frac{\mathrm{dq_2^*}}{\mathrm{dx}}$$

$$+ \left[\frac{\frac{\theta}{\overline{L}} \frac{\partial \rho^e}{\partial Y} + (-i'_m + i''_m D) \frac{\theta}{\mathrm{K}} \frac{\partial \mathrm{K}}{\partial \mathrm{Y}}}{-i''_m D + i'_m} \right] \frac{\mathrm{dY^*}}{\mathrm{dx}}$$

$$+ \left[\frac{\frac{\theta}{\overline{L}} \frac{\partial \rho^e}{\partial i_B} + (-i'_m + i''_m D) \frac{\theta}{\mathrm{K}} \frac{\partial \mathrm{K}}{\partial \mathrm{i_B}} + \left(-i'_m + \frac{\partial^2 C}{\partial B \partial L}\right) \frac{\theta}{\overline{L}} \frac{\partial B}{\partial i_B}}{-i''_m D + i'_m} \right] \frac{\mathrm{di_B^*}}{\mathrm{dx}}. \qquad (14)$$

Conclusion 1

1, Adjustable minimum capital requirement ratio

-->raise in good times and reduce in bad times

2, Boom country → higher capital requirement

Sluggish country → Lower requirement

3, Adjustment Factors to the Basel Capital Requirement

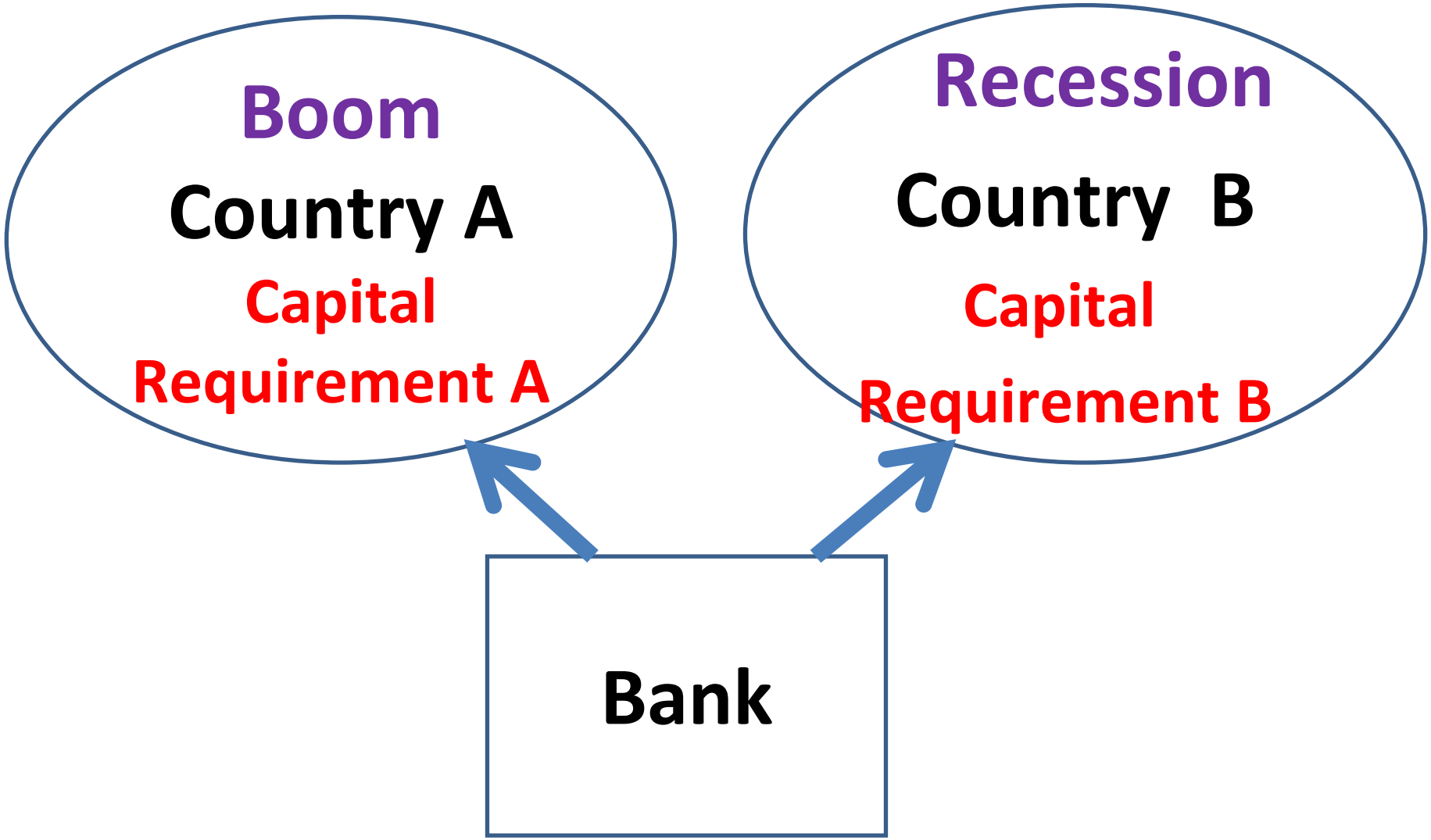
(i)Land Price

(ii) Stock Price

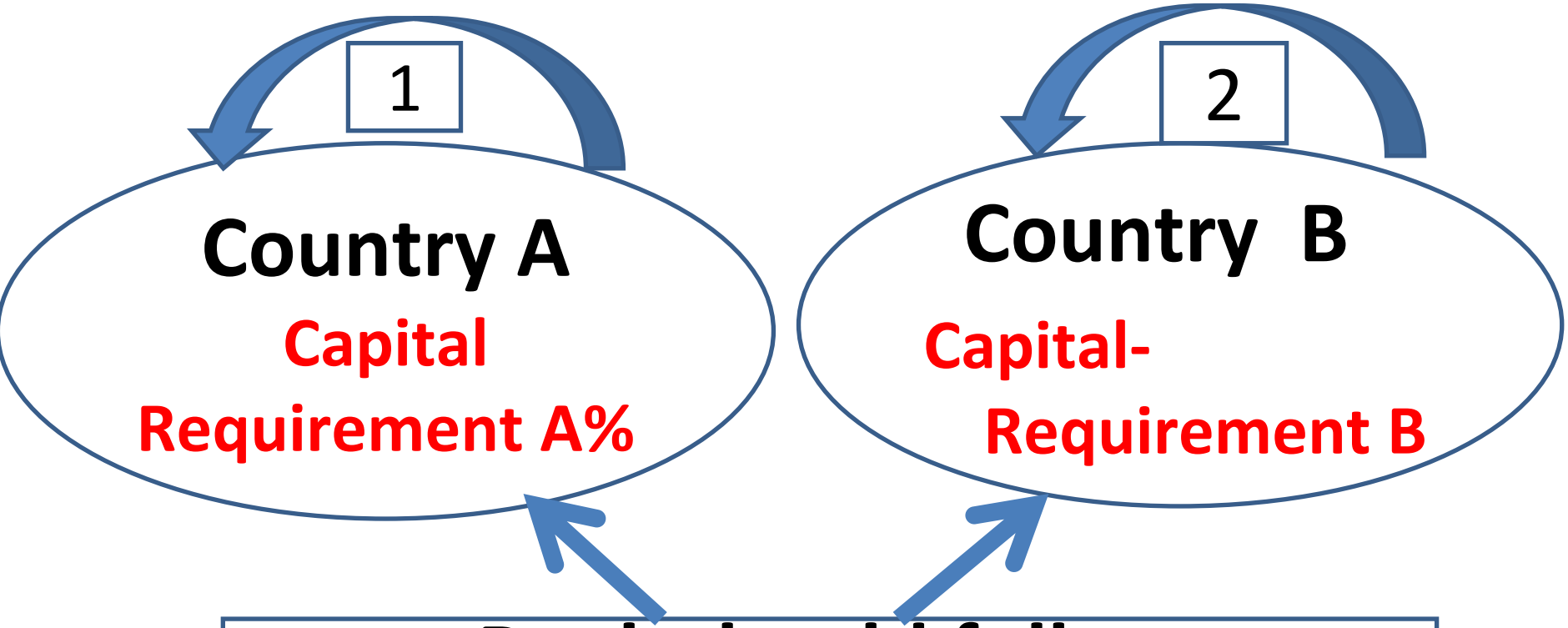
(iii) GDP

(iv) Interest rate

1 Two country model (Cross-Border)

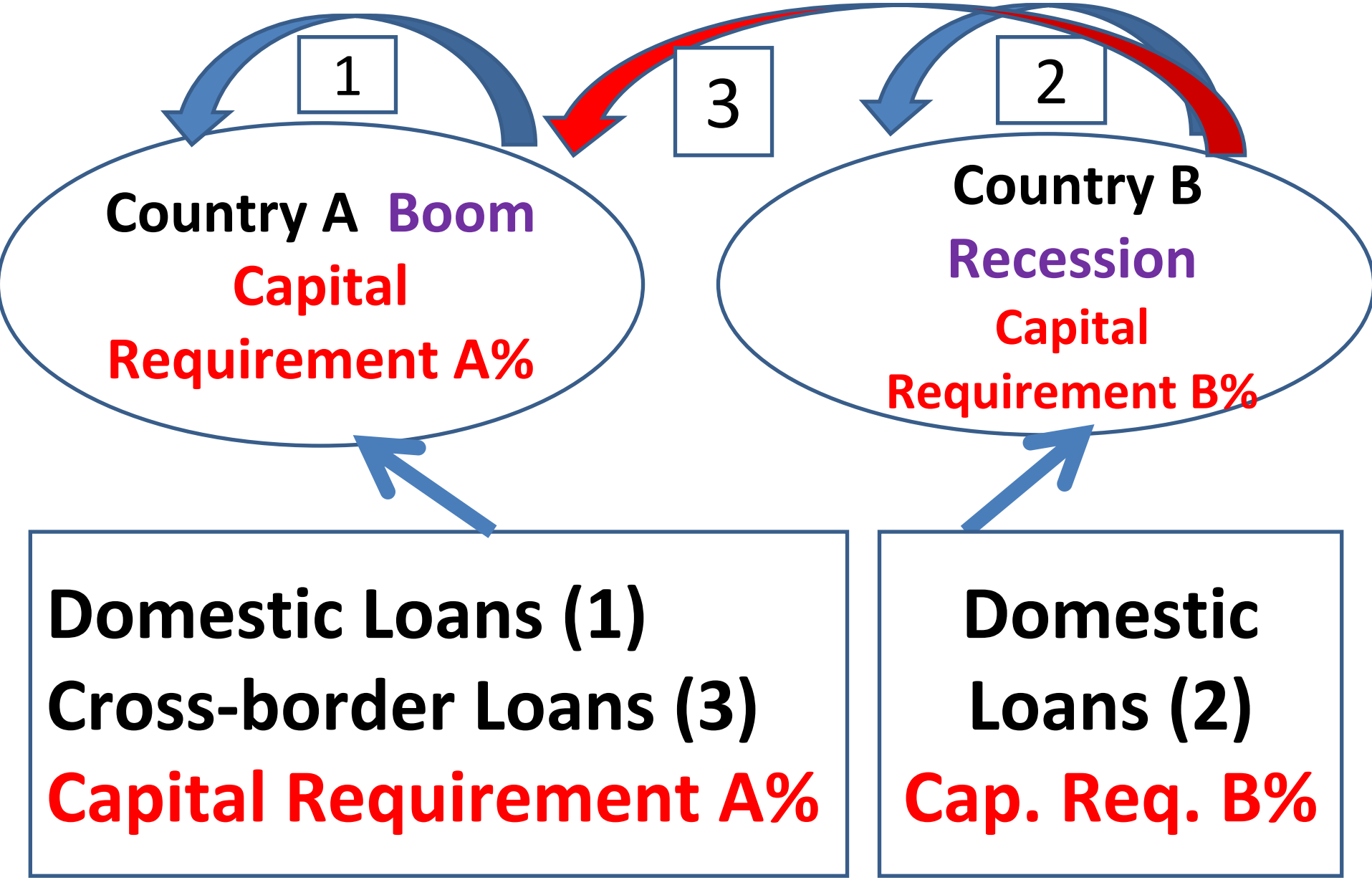


2 Two country model (Cross-Border)



Bank should follow Each country's minimum capital requirement ratio (A% or B%)

3 Two country model (Cross-Border)



Conclusion 2 Cross-border Case

1 **Boom country** – **higher minimum capital** (A)

contracted country – **lower minimum capital** (B)

2 **Different minimum capital requirement A% & B%.**

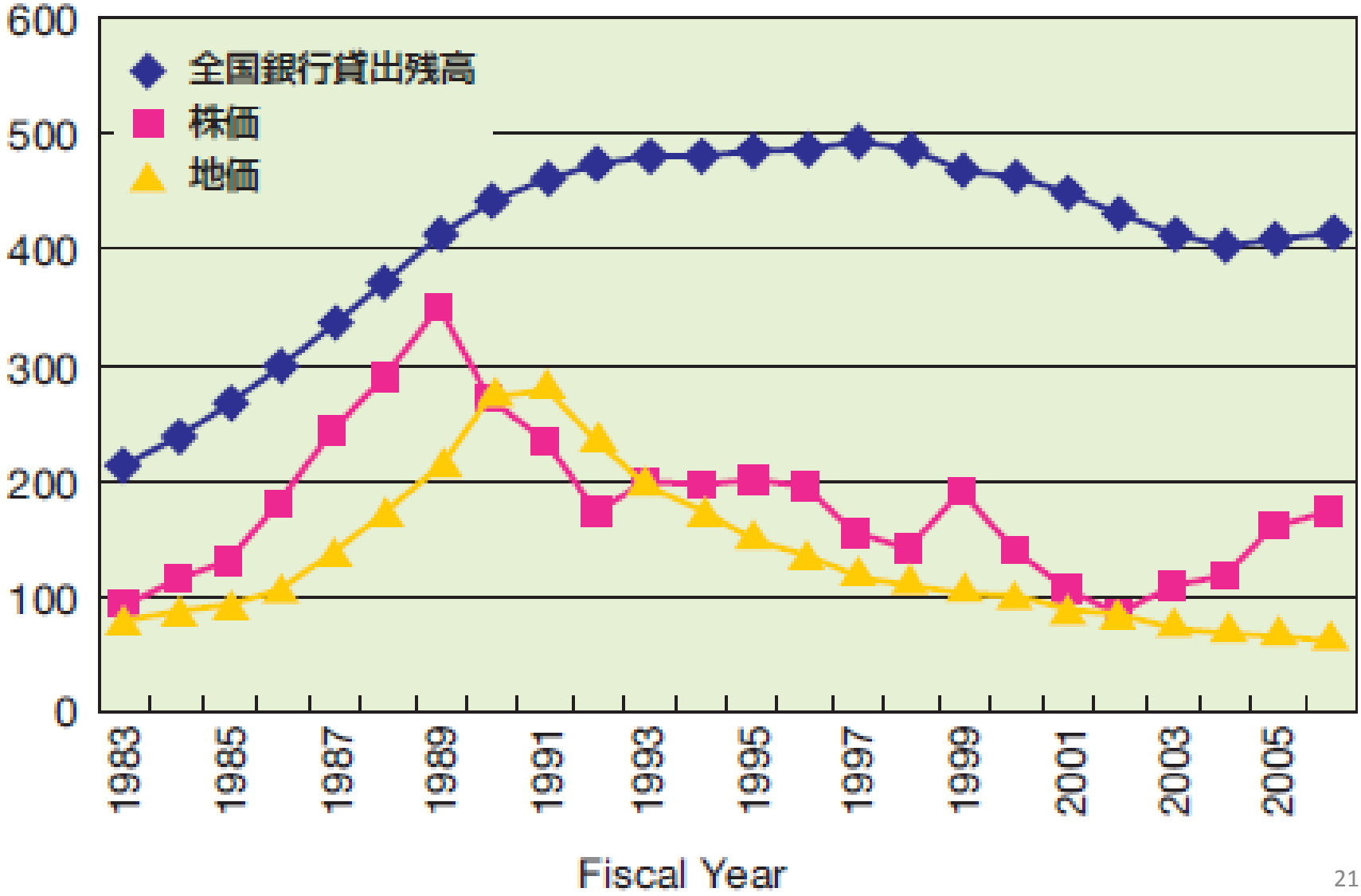
lending and asset management in each country

should follow each minimum capital requirement

3 Regulator has to be able to **monitor each country**

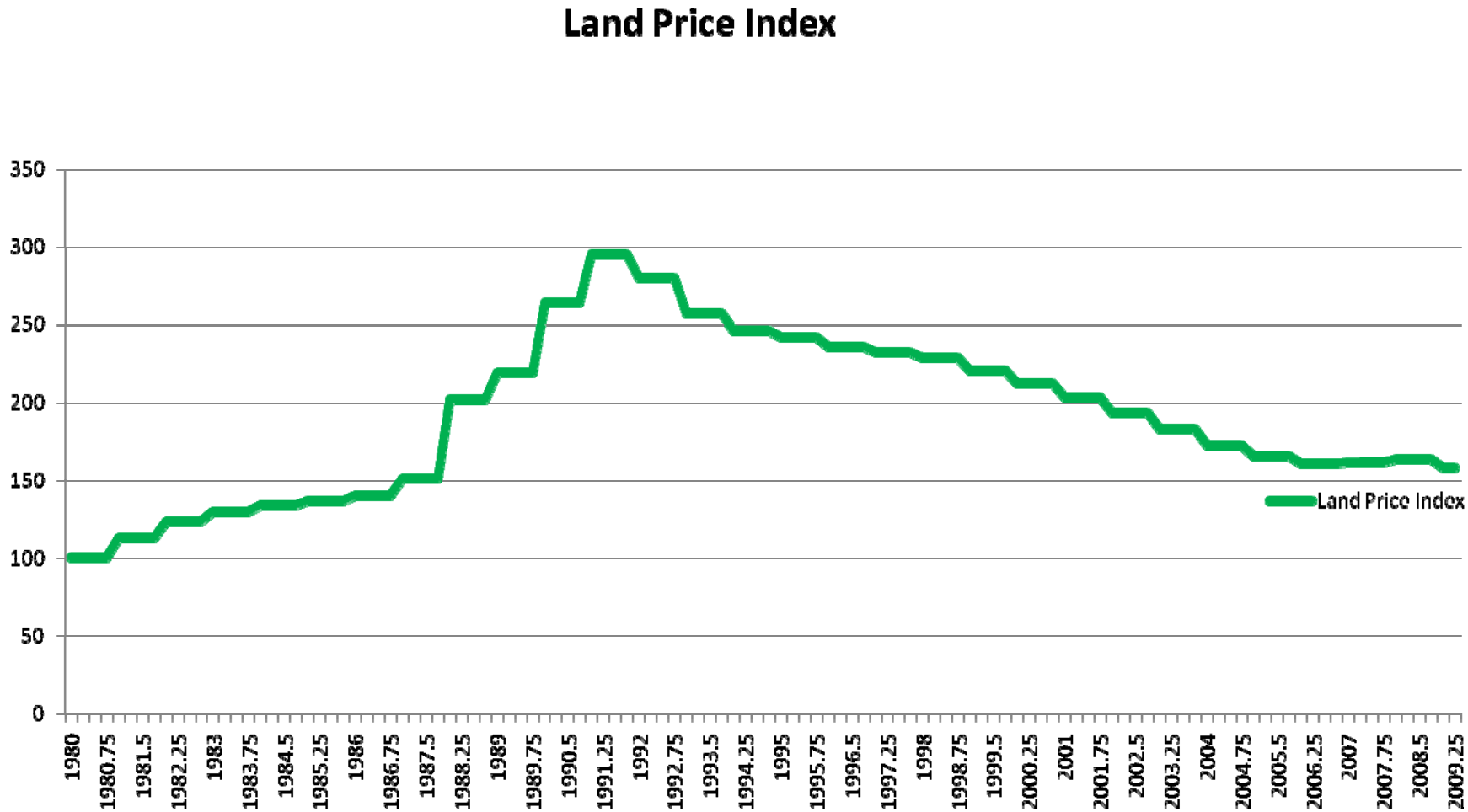
sources of absorbed assets → Asset management

Japan: Bank Loans, Share Price, Land Price

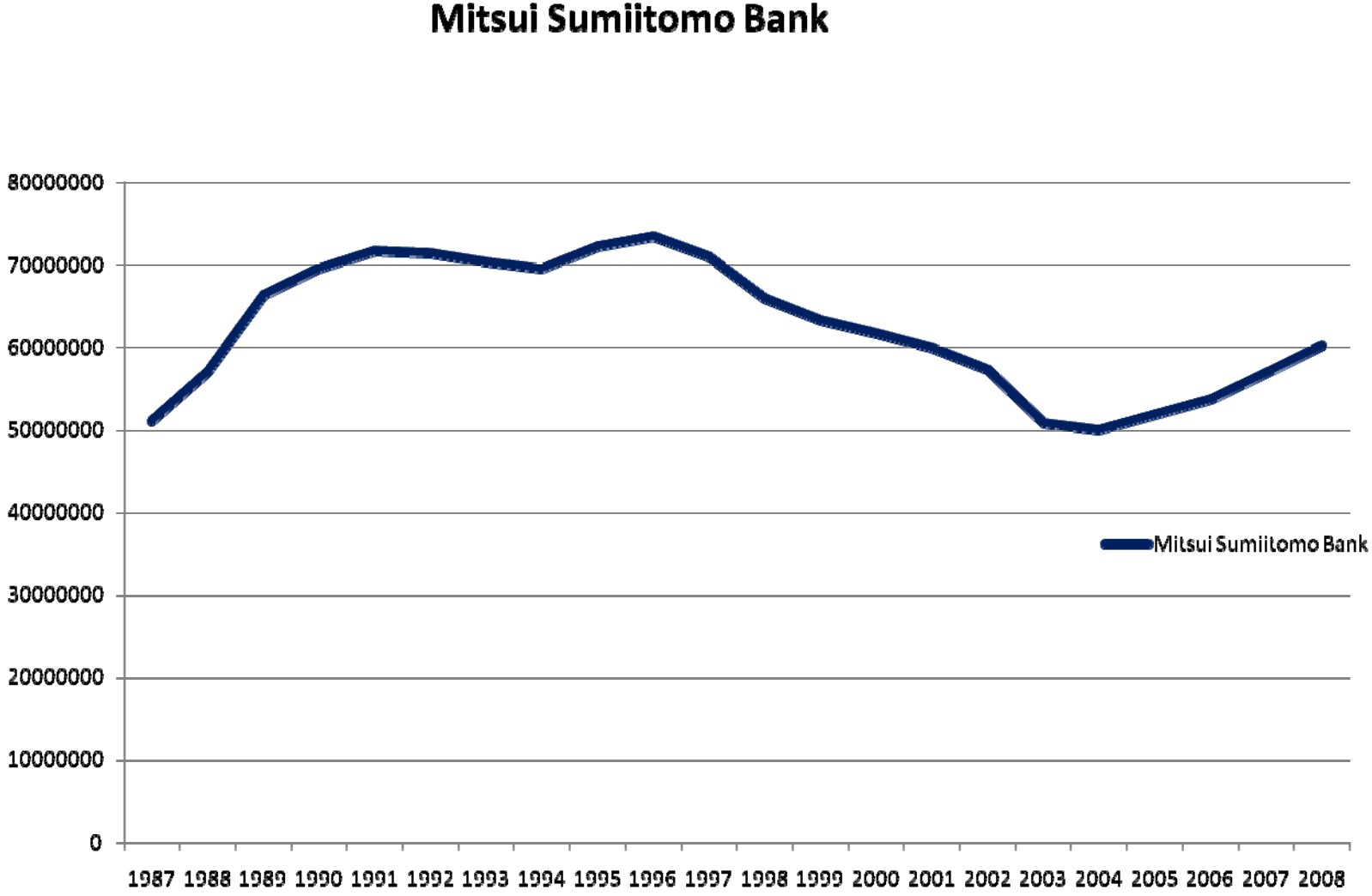


Nikkei Stock Price

Land Price Index

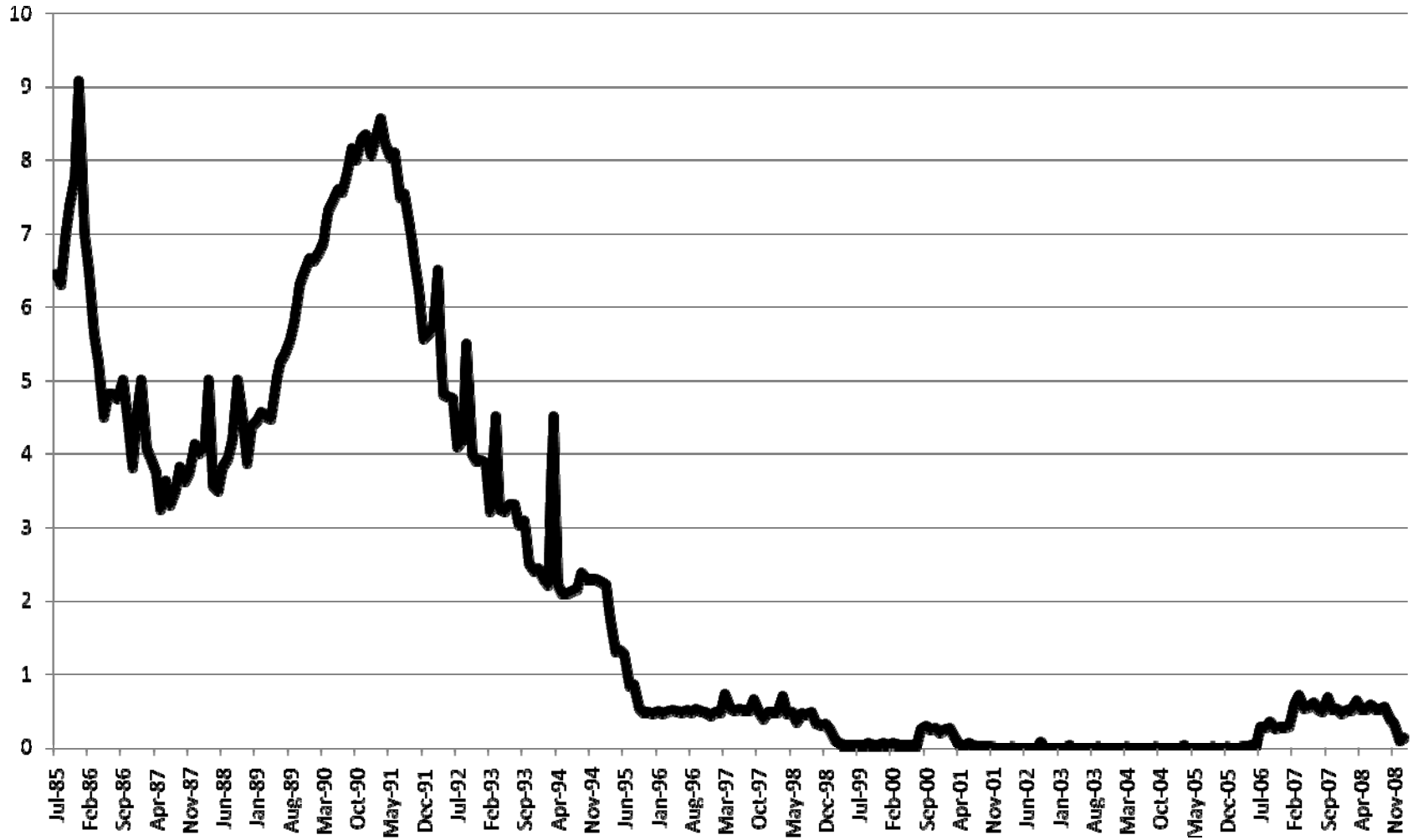


Mitsui Sumitomo Bank

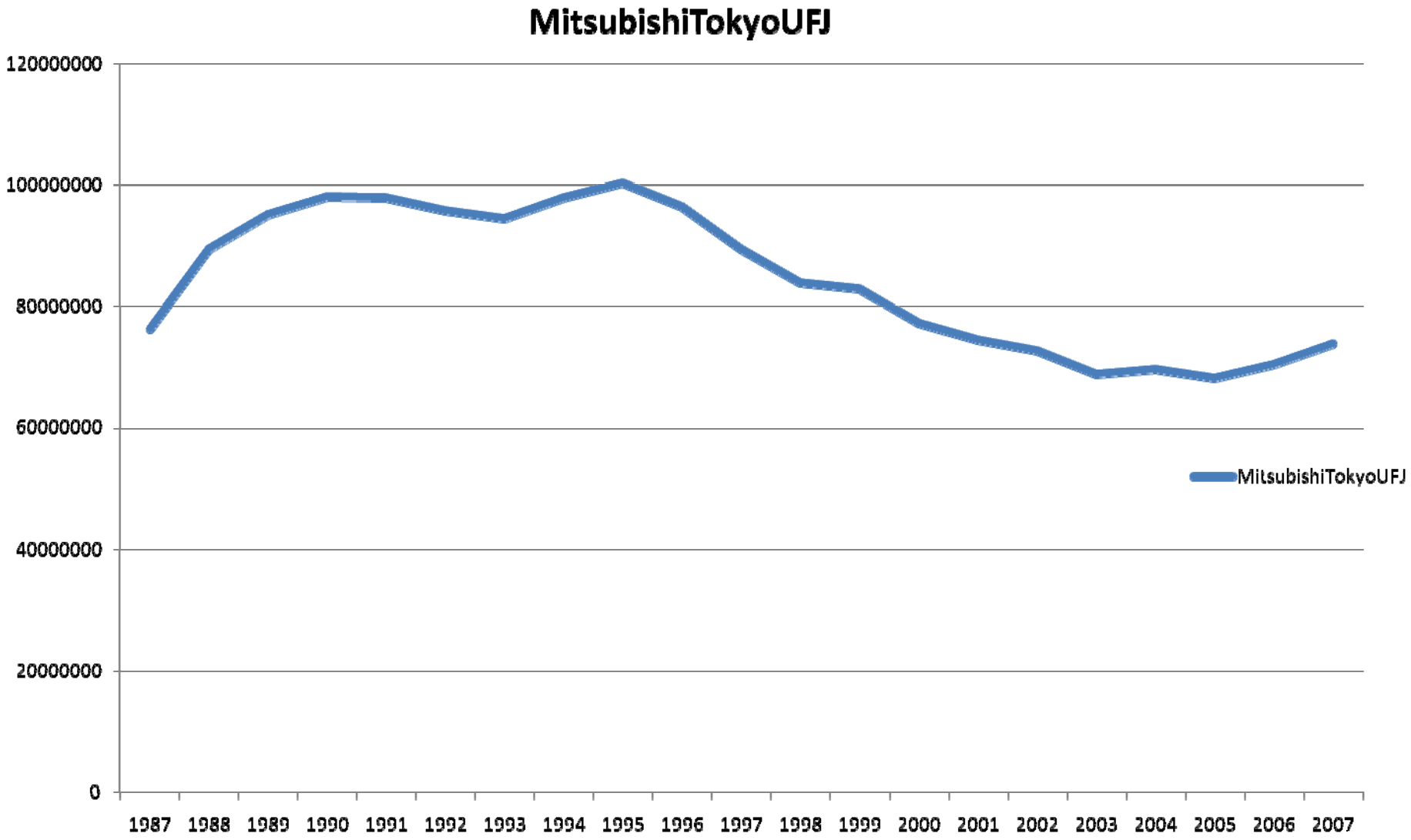


Short term interest rate (Japan)

Zero Interest rate Policy 2001-2006



Mitsubishi-Tokyo-UFJ Bank



Japanese Banks' Behavior

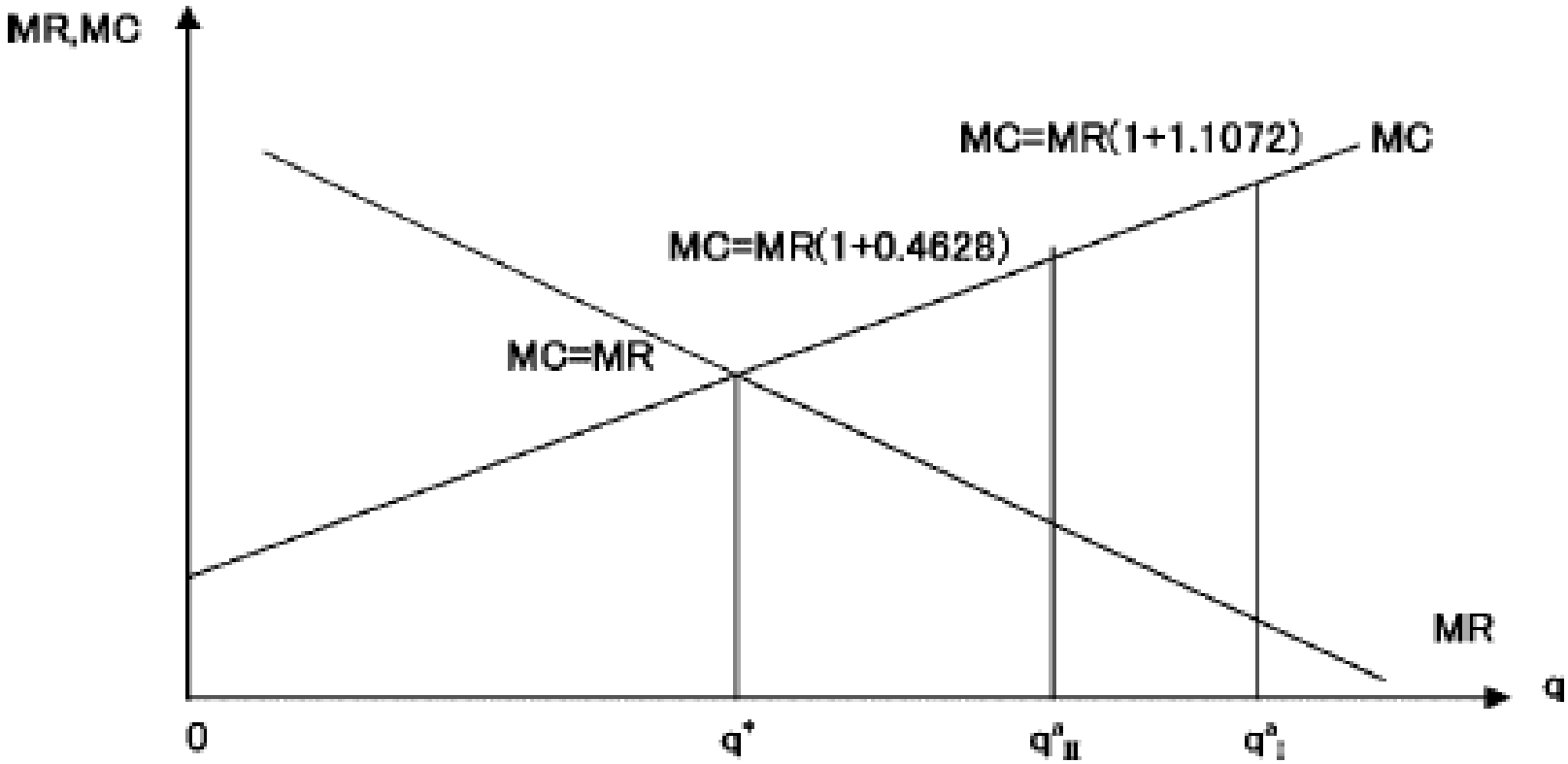


Figure 1. Typical profit-maximizing and actual loan amounts.
q^* = profit-maximizing loan
q_I^a =Actual loan supply in Period I
q_{II}^a = Actual loan supply in Period II

Marginal Revenue = Marginal Cost

$$MR_i = \frac{d}{dq_i}[q_i(f(X) - d_2(q_1 + Q_1)]$$
$$= f(X) - d_2 Q_i - 2d_2 q_i \qquad (2.2)$$
$$= r - d_2 q_i, \quad i = 1, \ldots, N .$$

Further, we take the total cost function of the i-th bank as

$$TC_i = c_{0i} + c_{1i} q_i + (1/2) c_2 q_i^2$$

so that its marginal cost function is

$$MC_i = c_{1i} + c_2 q_i . \qquad (2.3)$$

Profits of Japanese Banks

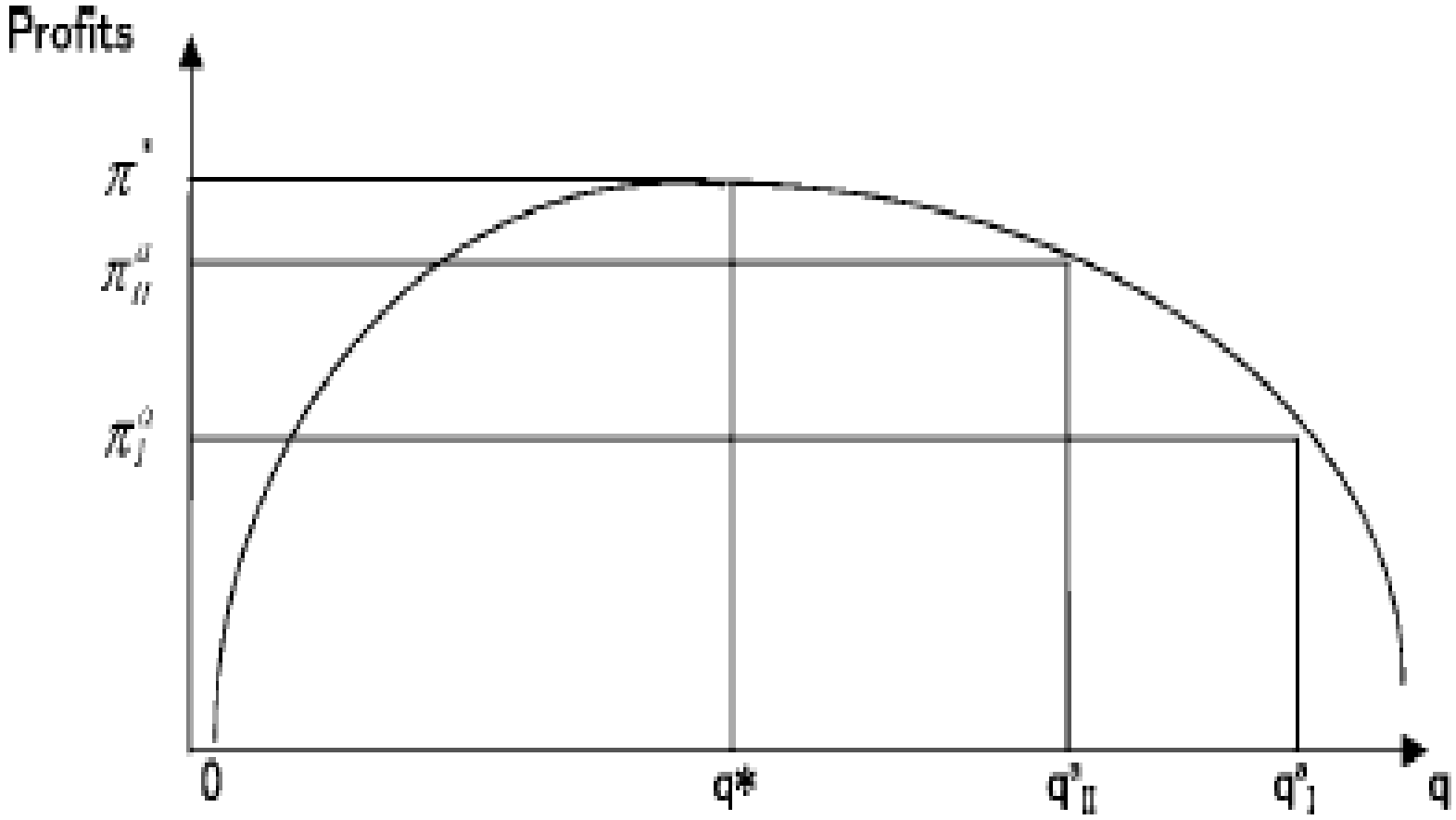


Figure 2. Actual profits (π^a_I, π^a_{II}) and maximum profits (π^*).

Estimates of Bank Loans, Japan

Table 1. Estimated loan supply function (SS equation)*

Dependent Variable q_{it} (bankloan)	Period I (1982–1989)		Period II (1990–1995)
DEP_{it} (Bank deposit)		0.658	
		(19.69)	
MS_i (Market Share)		0.426	
		(1.48)	
$r_t - CR_t$ (Loan Rate –Call Rate)	16.298		21.351
	(2.611)		(3.028)
CR_t (Call Rate)	8.564		6.755
	(2.568)		(2.904)
BIS_{it} (BIS-ratio)		8.658	
		(2.353)	
$Q^*_{it} = Q_{i(t-1)}$	0.066		0.038
(Rival Bank's Previous Period Loan)	(3.675)		(2.333)
LP_t (Land Price)	0.123		−1.760
	(2.546)		(−1.449)
Constant		−36.302	
		(−0.874)	
Adjusted-R^2 0.892, Hausman Statistic, CHI-SQUARE=0.923, P-Value=0.820			

* Figures in parentheses are t-values.

Table 3. Actual loan relative to profit-maximizing loan: Select banks

Bank	Period I	Period II
Hokkaido Takushoku Bank	13.1% (1982–1989)	8.5% (1990–1995)
Nippon Credit Bank	13.7% (1982–1989)	9.1% (1990–1995)

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