Non-Performing Loans, Prospective Bailouts, and Japan's Slowdown

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Abstract

Over the last thirteen years Japan has experienced a prolonged slowdown in economic activity, accompanied by a significant deterioration in the financial position of its banking sector. In this paper I argue that the delay in the government bailout of the financial sector has played a key role in Japan's ongoing stagnation. I construct a dynamic general equilibrium model in which the government provides deposit insurance to the financial sector. The model has the following property: the existence of non-performing loans, combined with a delay in the government bailout, leads to a persistent decline in economic activity. The decline in output is caused not only by a fall in investment, but also by an endogenous decline in labor and total factor productivity. These features are consistent with Japan's experience over the last decade. Quantitative results indicate that the delay in the government bailout contributes significantly to Japan's slowdown.

Keywords: Japan, slowdown, non-performing loans, bad loans, total factor productivity.

JEL Classification: E00, E32, E65.

1   Introduction

Over the last thirteen years Japan has experienced a prolonged slowdown in economic activity. During this period the growth rate of Japan's per capita GDP was 1.2% per year, versus 3.5% per year in the 1980s. This drop has been accompanied by declines in the growth rate of total factor productivity (TFP), investment-output ratio, aggregate labor (see Figure 1.1), as well as a collapse of bank loans to Japan's nonfinancial corporate sector (see Figure 1.2).

It has been widely argued that the large amount of non-performing loans (so called *bad loans*) held by Japanese financial institutions lies at the heart of Japan's ongoing economic stagnation. However, the exact mechanism underlying the link between these two phenomena remains unknown. This paper begins with the premise that bad loans represent a public liability. I then argue that the delay in expected government bailouts is the main link between the failing banking system and Japan's slowdown. I articulate this argument by constructing a dynamic general equilibrium model with the following key property: when the government provides deposit guarantees to the banks, the existence of bad loans, combined with a delay in a government bailout, leads to a persistent decline in aggregate economic activity. Using a version of the model calibrated to Japanese data I argue that this mechanism has played a quantitatively important role in Japan's slowdown.

The basic intuition behind the central argument of the paper is as follows: when the government provides full deposit guarantees to the banks, losses incurred by the banks (i.e., bad loans) translate into prospective government debt. Suppose the government postpones the actual payment of this debt, but insists that banks fully honor their obligations to depositors. Now the banks face a problem: how to honor their obligations to old depositors, given some of their assets have disappeared. The only thing the banks can do is to run a Ponzi scheme: pay the flow obligations to old depositors using funds from new deposits. As long as the interest rate is positive, the amount of new deposits used by banks to pay old depositors rises over time. This leads to a smaller fraction of savings being used to finance capital purchases. If Ricardian Equivalence does not hold, total private savings will not rise enough to offset the increase in the present value of future tax liabilities stemming from the prospective bailout. Consequently, in equilibrium, less total loans will be allocated for capital purchases. This in turn implies that the capital stock will fall over time, leading to a persistent decline in output. Note that a positive interest rate and the failure of Ricardian Equivalence imply that the banks cannot run the Ponzi scheme forever – eventually the new deposits will not be

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enough to pay off old depositors. At this stage, the government will have no option but to bail the banks out.

The delay in the government bailout acts similarly to the crowding out effect that, in many models, the government debt has on capital. One way to see this in my model is to suppose that the government immediately bails the banks out, financing the bailout by issuing new debt. Absent Ricardian Equivalence, private savings will not rise enough to offset the new government debt. Consequently, the capital stock will fall, and so will output. The same effect arises in a number of cases that do not rely on the failure of Ricardian Equivalence, for example, when taxes are distortionary, or when the government finances the bailout by decreasing government purchases. In an earlier version of this paper, Barseghyan (2002), I provide an extensive discussion of such cases. Dekle and Kletzer (2003) show that in an economy in which the government taxes the interest earned by the depositors to pay for the bailout, aggregate savings decline and so does investment.

The existing literature has provided alternative hypotheses linking Japan's weak financial sector and its slowdown. For example, it is often claimed that the weak financial sector caused a credit crunch, i.e., an inability of Japanese firms to finance profitable projects.[1] A related argument is that Japanese firms found it difficult to borrow because the value of their collateral (mostly real estate) declined precipitously over the past decade.[2] While a priori appealing, these explanations have received little support from existing empirical studies.[3]

A third hypothesis is that Japan's slowdown is due to an inefficient allocation of resources. For example, Kashyap (2002a), (2002b) argues that the slowdown partly reflects the presence of a large number of inefficient and unprofitable firms, so called "zombies", which "...distort competition. Other firms that could enter an industry or gain market share are held back..."(Kashyap (2002b), p.54).[4] The basic idea is that banks are unwilling to disclose bad loans. Consequently they support

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[1] See, for example, Bayoumi (2000) and Shimizu (2000).

[2] Ramaswamy (2000) discusses a number of possible reasons behind the decline in Japanese business investment.

[3] After analyzing several data sources, Hayashi and Prescott (2002) conclude that "there is no evidence of profitable investment opportunities not being exploited due to lack of access to capital markets". Also, based on a review of the existing literature, they argue that a "credit crunch" could have occurred only for a very short period between the end of 1997 and the beginning of 1998, as a result of tighter capital requirements imposed by the Basel Accord. For more details, see Hayashi and Prescott (2002) and references therein.

[4] In more general terms, Hubbard (2002) states that "...the real problem is that capital is not being allocated to its most productive uses."

non-performing zombie firms by offering low cost loans.[5] Because of this, zombie firms continue to operate, and drag overall productivity down.

Finally, Hayashi and Prescott (2002) argue that the decline in the growth rate of TFP has played a significant role in the slowdown of Japan's economy.[6]

In this paper I argue that the decline in TFP observed in Japan can be caused by the delay in the government bailout. This decline reflects a rise in the fraction of low productivity firms that are operating, as, it is argued, has been the case in Japan. In my model, output is a function of a firm's productivity, capital, and labor. In addition, there is an operating cost, which consists of a fixed amount of capital and a wage to be paid to a manager. A delay in the bailout results in a fall of the capital stock, which reduces the average firms' profits and puts downward pressure on the managers' wage. The decline in the managers' wage implies that the operating costs are low. For firms with less gross profits, i.e. lower productivity firms, the lower operating costs mean that the net profits (gross profits minus the operating costs) become positive. Consequently, low productivity firms choose to operate. To summarize, in my model the delay in the bailout causes the average quality of the operating firms to fall, resulting in a decline of TFP. While the decline in TFP is caused by an increase in the fraction of low productivity firms, this increase is not caused by quantity rationing of either bank loans or capital, as it is typically suggested. Instead, it reflects the response of a perfectly competitive economy to a fall in capital stock that is generated by the delay in the government bailout.

To assess the quantitative effect of the delay in the government bailout I calibrate a version of my model using Japanese data. The effect of the bad loans on the economy is the least when the bailout is expected to start as soon as possible and is expected to be financed by a lump sum tax increase. To this end, I construct a conservative estimate of the impact of the delay in the government bailout by assuming that the bailout will start in year 2003, and it will be financed

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[5]Bergoeing at al. (2002) have a related discussion in the context of Mexico and Chile. Chu (2002) shows that a similar argument applies when there are barriers to exit rising from government's policies.

[6]More recent evidence by Jorgenson and Motohashi (2003) suggests that the decline in the growth rate of TFP in the 1990s was smaller than it was originally thought. Chakraborty (2005) conducts the business cycle accounting exercise of Chari et al. (2006) for Japan and finds that though technology shocks are important, "they are by no means enough to account for the observed economic fluctuations during this period. Shocks that propagate themselves as investment wedges play a major role."

by increasing the labor income tax.[7] Under these assumptions, the estimated decline in output due to the delay in the bailout ranges between 0.22 and 0.71 percent per year. However, when the magnitude of the bad loans problem and the expectations about the bailout are such that the resulting decline in the investment-output ratio coincides with the decline in the investment-output ratio observed in the data,[8] the impact of delaying the bailout is a 0.92% yearly decline in output. Absent such a decline, the growth rate of Japan's per capita GDP would have exceeded 2%. Since 2% growth rate is a rough benchmark for a satisfactory economic performance, I conclude that the delay in the resolution of the bad loans problem can be viewed as the main reason for Japan's poor performance in the 1990s.

The rest of the paper is organized as follows. In Section 2 I briefly review the conditions of Japan's financial sector during the period 1990-2001. Then I present the basic version of the model in Section 3. Section 4 presents a more elaborate model which I use to conduct a quantitative analysis. Section 5 concludes.

2 The Conditions of Japan's Financial Sector in 1990-2001: An Overview[9]

Japan's economy is highly bank dependent. While large corporations (especially in manufacturing) have a relatively easy access to alternative ways of fund-raising, small and medium enterprises[10] rely heavily on banks and other domestic lending institutions for their borrowing needs. Bond financing for small and medium enterprises is essentially nonexistent, and the equity financing is rare.[11] The main sources of funds for these enterprises are domestic banks, followed by government affiliated financial institutions.[12]

The profitability of Japanese banks has been declining over the last two decades, and has been

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[7]This tax is non-distortionary in the model.

[8]The decline in the investment-output ratio is the measure of the crowding out effect on capital caused by the delay in the bailout.

[9]A detailed analysis of the Japanese banking system and of the origins of the crisis is provided, for example, by Hoshi and Kashyap (2000) and (2001).

[10]As Table 2.1 indicates, these enterprises play a very significant role in Japan's economy.

[11]For small and medium enterprises, the equity is only about 1/8 of their total liabilities. This number is more than twice larger for large enterprises.

[12]Source: White Paper on Small and Medium Enterprises (2001). See Table 2.2 for more details.

negative most of the last decade. As Hoshi and Kashyap (2000) extensively argue, the primary reason for this decline is the financial deregulation which took place in Japan during the 1980s. Hoshi and Kashyap (2000) predict that to regain profitability, the banking sector must shrink at least by 30%. As long as the massive reduction in the number of operating banks does not occur, the profits will remain low or even negative. Perhaps not surprisingly, during the same period of time there has been no entry into Japan's banking sector.[13]

A major source of problems for Japan's banks is bad loans. A bad loan is one where payment has been suspended or renegotiated.[14] On average, repayment on these loans has been about 12% of the original amount.[15] Hence, banks would bear significant losses if they wrote the debt off. According to official sources, the bad loans held by Japan's private deposit taking institutions amount to ¥53 trillion (10.5% of GDP).[16] However, most observers agree that this number is highly understated. For example, analysts of Goldman Sachs estimate the bad loans to be ¥236 trillion (47% of GDP), and similarly, Credit Suisse First Boston estimates that the actual amount of bad loans is about four times higher than the disclosed figure.[17]

The origins of the bad loans are seen in a continued decline in real estate and stock prices, which followed the real estate and stock market collapse of 1991.[18] As some borrowers could not repay their obligations towards the banks, the banks were reluctant to liquidate the loans through the sale of collateral (mostly real estate), since the recovered amount would fall short of the original loan, and result in significant losses. The policy of *regulatory forbearance and non-transparency*

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[13] The role of foreign banks in Japan's domestic market has remained negligible: their shares of loan and deposits markets are below .75% and 1.4% respectively. Also, fund raising of Japan's non-financial sector via overseas markets is about 30 times less than via domestic markets. Source: Flow of Funds Accounts, available on-line at http://www.boj.or.jp/en/siryo/siryo_f.htm.

[14] Japan's Financial Services Agency defines *risk management loans* as 1) loans to borrowers in legal bancruptcy, 2) past due loans in arrears by 6 months or more, 3) past due loans arrears by more than 3 months and less than 6 months, and 4) restructured loans.

[15] Author's calculation, based on Figure 2-1-2 of "Annual Report on Japan's Economy and Public Finance, 2000-2001".

[16] The total cumulative loss on Disposal of Non-Performing Loans by the end of fiscal year 2001 was ¥81.5 trillion (16.3% of GDP). A significant part of these losses had occurred in recent years. In fiscal year 2001 alone the loss was ¥9.7 trillion.

[17] This estimates are from Kashyap (2002b).

[18] See, for example, Ueda (2001).

pursued by Japan's financial authorities, combined with wishful thinking that the economy (and the non-performing loans with it), would recover,[19] led to an increase in the amount of bad loans throughout the decade. Public opposition to the attempts of using government funds for helping troubled banks[20] further delayed the resolution of the problem.

Bad loans are held not only by the private sector, but also by public financial institutions, which play a significant role in Japan's economy. For example, the share of government sponsored financial institutions in the loan market is 26%, in the deposit market is 34%, and in the life insurance market is 40%.[21] As Doi and Hoshi (2002) indicate, by March 2001 Fiscal and Investment Loan Program, Japan's primary public lender, held as much as ¥266.6 trillion of bad loans, most of which were loans to insolvent public corporations. The estimated taxpayers cost for cleaning up the bad debt held by public financial institutions is around ¥78.3 trillion. The most conservative estimates of the cost for cleaning up banks' balance sheets is about ¥40 trillion (Kashyap (2002b)). Therefore, the total cost to the government for resolving the bad loans problem is at least ¥118.3 trillion (24% of GDP).

Finally, an important feature of Japan's financial sector is the presence of government guarantees. Until March 2002 all domestic deposits to the banks were protected by deposit insurance provided by the government. As a result of Japan's deposit insurance reform, starting March 2003 only deposits up to ¥10 million will be fully insured. Despite such guarantees and numerous public statements by Japanese government officials in support of the banking system, the confidence in Japan's banking sector has not been very high. For example, households heavily favored government's Postal Savings deposits to bank deposits (between 1991 and 1999, Postal Savings Deposits have increased by 62%, while deposits to banks increased only by 18%[22]). Further, in the second half of the last decade, Japanese banks found it difficult to borrow abroad, and at times they

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[19]Italics are from Cargill (2001), who also provides a thourough discussion highlighting the main aspects of the Bank of Japan and Ministry of Finance policies regarding the bad loan problem.

[20]Government funds were used to fight the bad loans problem for the first time in 1996, in the case of the loans to the so called *jusen*. The jusen are housing loan cooperatives, which heavily borrowed from the banks before 1991's real estate market crush. As the real estate prices dropped, the jusen became incapable to fulfill their obligations to the lenders. Amid public opposition, the government intervention to solve the problem was delayed by more than 3 years. See Ito (2001) for more details on the jusen problem.

[21]Source: Fukao (2002).

[22]Source: Flow of Funds Accounts, available on-line at http://www.boj.or.jp/en/siryo/siryo_f.htm.

faced significantly higher interest rates on interbank loans than non-Japanese banks. The so called *Japan's premium,* at its peak, was about 10 basis points on *recorded* transactions.

3   Bad Loans in an Overlapping Generations Model with Banking Sector and Deposit Insurance

The origins of Japan's bad loans problem have been widely studied. In this paper I do not offer new explanations for its causes. Rather, I focus on the impact that the bad loans and the delay in the bailout have on the aggregate economic activity. To this end, I model the bad loans as a consequence of a one time unanticipated shock to the return on bank loans.

In this section, to highlight the main idea of the paper, I present a two period overlapping generations model with a banking sector based on the model of Diamond (1965). In the next section, for quantitative analysis, I substitute Diamond's overlapping generation framework with the Blanchard's (1985) model of perpetual youth, and modify the production side of the economy to show that the model is broadly consistent with the data.

The banks in this economy are financial intermediaries which transform savings into loans. They are competitive both in the savings and loan markets, owned by the households and regulated by the government. The government serves as guarantor for bank deposits and can commit public funds to back up its guarantees.

3.1   The Model

The economy is populated by two period lived households and firms, infinitely lived banks and government.

3.1.1   Households

Households live for two periods. In the first period they inelastically supply one unit of labor. They use their wage earnings, net of taxes, to finance their consumption and savings. Households deposit their savings into banks, and withdraw them in the next period to purchase consumption goods.

The households' problem is given by:

$$\max \log(c_t^Y) + \beta \log(c_{t+1}^O)$$

s.t.

$$c_t^Y + S_t = w_t - \tau_t,$$
$$c_{t+1}^O = R_{t+1}S_t;$$

where c_t^Y is the consumption, w_t is the wage, τ_t is the lump sum tax, S_t are the savings – all at time t – R_{t+1} is the gross interest rate paid by the banks on the time t deposits, and c_{t+1}^O is the consumption at time $t+1$. The government guarantees insure that households receive $R_{t+1}S_t$ on their deposits. The households' saving decision is a function of the wage, and the lump sum tax:

$$S_t = \frac{\beta}{1-\beta}(w_t - \tau_t). \tag{3.1}$$

In particular, it does not depend on the future taxes.

3.1.2 Firms

Firms live for two periods. They are perfectly competitive and are owned by the households. In the first period they borrow from the banks to purchase capital. In the next period they hire labor and production takes place. Firms sell their output and capital stock, and pay wages and their debt to the banks. Thus, the firms' problem is given by:

$$\max_{k_{t+1},L_t,n_{t+1}}\{F(k_{t+1}, n_{t+1}) - R_{t+1}L_t - w_{t+1}n_{t+1} + (1-\delta)k_{t+1}\}$$

s.t.

$$L_t \geq k_{t+1};$$

where L_t is the amount of loans borrowed from the banks, k_{t+1} is the purchase of capital, n_{t+1} is the amount of labor hired in period $t+1$, and δ is the depreciation rate of capital. The production function is $F(k,n) = k^\alpha n^{1-\alpha}$.

The first order conditions (FOC) for the firms' problem with respect to capital and labor are given by

$$R_{t+1} = F_k(k_{t+1}, n_{t+1}) + (1-\delta),$$
$$w_{t+1} = F_n(k_{t+1}, n_{t+1}).$$

3.1.3 Banks

Banks are infinitely lived agents owned by the households. They operate in a perfectly competitive environment, but are regulated by the government. They transform households' savings into loans to entrepreneurs. At date zero *all* banks suffer losses on previously made loans. The government provides insurance against this type of aggregate shocks.[23] In particular, let B_0 denote the loss incurred by the representative bank, and $\{G_t\}$ denote the sequence of government transfers to it. Then:

$$B_0 = \sum_{t=0}^{\infty} \frac{1}{\prod_{j=0}^{t-1} R_{j+1}} G_t.$$

That is, the net present value of government transfers is equal to the losses (bad loans from now on) incurred by the bank. It is convenient to denote B_t as the stock of bad loans at the beginning of period t, that is, the present value of banks' losses for which they have not yet been compensated:

$$B_t = R_t[B_{t-1} - G_{t-1}].$$

The definition above states that the bad loans at the beginning of the next period are equal to the present value of the current bad loans minus the government transfer.

Each period banks perform the following actions:

- collect new deposits
- collect payments on loans made in the previous period
- receive government transfers (if any)
- pay off previous period depositors
- make loans to entrepreneurs

The government guarantees that the deposits are always paid back. Banks must also satisfy the following constraints:

- Capital Adequacy Requirement:[24]

$$D_t \leq Q_t; \tag{3.2}$$
$$Q_t \equiv L_t + [B_t - G_t],$$

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[23] The losses incurred by a bank could also be covered by the bank's own capital. However, in the case when the amount of losses is sufficiently large, the government's intervention is necessary in order to honor deposit guarantees. To this end, introducing equity capital will not change the conclusions of the model.

[24] Here, the minimum required bank capital is zero. That is, the banks must sustain non-negative net worth.

where D_t is the total amount of deposits the bank collects at date t, and Q_t is the total amount of assets the bank has at the same date. The bank's assets consist of new loans the bank makes at date t and the outstanding amount of bad loans at the end of the period: the bad loans B_t at the beginning of the period minus the government transfer.

- Lending constraint:

$$
\begin{aligned}
L_0 &\leq D_0 + [(R_0^L - \frac{B_0}{L_{-1}})L_{-1} - R_0 D_{-1}] + G_0; \\
L_t &\leq D_t + [R_t^L L_{t-1} - R_t D_{t-1}] + G_t, \ t > 0,
\end{aligned}
\tag{3.3}
$$

where R_t^L denotes the rate of return on loans for $t > 0$. At time 0, the banks' expected rate of return is R_0^L, but the actual return is $(R_0^L - \frac{B_0}{L_{-1}})$. The lending constraint simply states that the bank cannot loan more funds then it has available. The bank's funds consist of new deposits, the payment on loans made in the previous period, and the government transfer minus the payment on previous deposits.

First notice that, as long as the banks are profit maximizing agents operating in a perfectly competitive environment, then in equilibrium

$$
R_{t+1}^L = R_{t+1}.
$$

Otherwise banks could make infinite profits. Next, I integrate the lending constraint (3.3) using the definitions of bad loans B_t and the result above to get:

$$
L_t \leq \prod_{j=0}^{t} R_j [L_{-1} - D_{-1}] + D_t - B_t + G_t.
$$

I assume that assets and liabilities of the bank were initially equal: $L_{-1} = D_{-1}$. Therefore,

$$
L_t \leq D_t - B_t + G_t.
$$

Comparing this expression with the capital adequacy requirement (3.2), one can immediately see that:

$$
L_t = D_t - B_t + G_t.
\tag{3.4}
$$

This equation is the key to understanding the effect of bad loans on economic activity. It states that loans to firms are equal to the deposits minus the outstanding amount of bad loans. Therefore,

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as long as the deposits do not rise by the amount of the outstanding bad loans or more, the bad loans will cause a reduction in loans to firms.

Finally, note that banks' profits are zero in all periods. This is an immediate consequence of the perfect competition in the banking sector and of the full deposit guarantees. Because of perfect competition, the interest rate on deposits is equal to the expected rate of return on loans. The expected and actual rates of return on loans coincide in all periods but period 0. On the other hand, banks are fully compensated by the government for the losses incurred in period 0. Therefore, banks do not make any profits or losses.

3.1.4 The government

The government provides deposit guarantees and can transfer funds to banks from the current young generation through lump sum taxes. The government's budget constraint is

$$G_t = \tau_t.$$

3.1.5 Resource constraint

The resource constraint is given by:

$$c_t^Y + c_t^O + k_{t+1} \leq F(k_t, n_t) + (1 - \delta)k_t.$$

3.1.6 Equilibrium

The equilibrium is defined as sequences of prices $\{R_t, w_t\}$, quantities $\{k_{t+1}, n_t, c_t^Y, c_t^O, S_t, L_t, D_t\}$, and a government policy $\{\tau_t\}$ such that the government policy is feasible, i.e. $\tau_t \leq w_t$ for all t, and given prices and the government policy:

- consumption and savings sequences solve the households' problem in each period;

- capital, labor and loan sequences solve the firms' problem in each period;

- savings and loan sequences solve the banks problem in each period;

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- markets clear in each period:[25]

$$S_t = D_t;$$
$$c_t^Y + c_t^O + k_{t+1} = F(k_t, n_t) + (1 - \delta)k_t;$$
$$n_t = 1.$$

3.1.7 The steady state

In the steady state there are no bad loans. In addition, taxes and transfers to the banks are zero. Thus, the steady state of the economy is identical to the one in the standard model:

$$k^{ss} = S^{ss}.$$

3.2 The Dynamics of the Economy

Initially, the economy's capital stock is at its steady state level. At date zero, unexpectedly, a fraction q of firms does not pay back the amount borrowed from banks, which generates bad loans in the amount of

$$B_0 = qR^{ss}k^{ss}.$$

In this economy there are full deposit guarantees. This implies that the old generation must receive its savings in full. I consider two extreme cases:

1. The government chooses to tax the young generation by the amount of bad loans, $\tau_0 = G_0 = B_0$, and transfer the latter to the banks.

2. The government postpones any intervention.

In the first case, the transfer from the government offsets the bad loan shock. The banks use the transfer along with the amount collected back from the firms to repay the depositors in full, and loan out the savings collected in the period of the shock:

$$L_0 = S_0 - B_0 + G_0 = S_0.$$

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[25] To avoid notational burden, I have not included the shares of firms and banks as saving instruments. The reason is that in equilibrium the prices of these shares are zero.

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Savings decrease because of the tax imposed on the current savers. Consequently, the capital in the next period falls. However, from the next period on the economy will grow until it reaches the steady state.

Next, consider the case in which the government postpones the intervention until time T,[26] that is, the government transfers are zero for all periods prior to period T :

$$
\begin{aligned}
G_t &= \tau_t = 0 \text{ for } 0 \le t < T, \\
G_T &= \tau_T = B_T.
\end{aligned}
\tag{3.5}
$$

In this case the bad loans will grow at the rate of interest:

$$
B_{t+1} = R_{t+1}B_t = \prod_{s=0}^{t} R_{s+1}B_0, \ t < T.
$$

Therefore, the dynamics of the economy prior to the bailout is characterized by the following system of equations:

$$
\begin{aligned}
L_t &= S_t - B_t \\
B_{t+1} &= R_{t+1}B_t \\
L_t &= k_{t+1}
\end{aligned}
\tag{3.6}
$$

Figure 3.1 highlights the intuition behind the dynamics of the economy in this case. Originally the economy is in the steady state, and savings and loans curves coincide. When the shock hits the economy, the loan curve ($L(0)$ in the figure) shifts down by the amount of bad loans B_0. If the amount of bad loans was constant over time (i.e. the interest rate was one), the economy would converge to the new steady state (point $X(0)$ in the figure). The capital stock and output would be lower than before the bad loan shock. However, with positive interest rates the amount of bad loans rise over time, forcing the banks to use larger fractions of new savings to pay old depositors, that is the loan curve shifts down even more ($L(1)$ in the figure), causing a further fall in the capital stock. Thus, until the bailout occurs, capital stock and output decline. Once the bailout occurs, the banks loan to firms all new deposits, and the economy starts converging back to the steady state.

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[26] The condition which determines the upper bound on T will be derived below.

The recession in the model economy is a direct consequence of the crowding out effect of bad loans on the capital stock. As banks are forced to use larger fractions of households' savings to pay off old depositors, the amount of funds available for capital purchases decreases.

In this economy, the crowding out effect of the bad loans on capital is identical to the classical crowding out effect of government debt on capital, as, for example, in Diamond (1965). Indeed, consider a case when the government conducts an immediate bailout, but finances it by issuing debt. As long as the government keeps the debt rolling over, less savings would be allocated for loans to firms, causing the capital stock to fall, exactly as in the case of the bad loans. This fact implies that a bailout financed by issuing debt will not stop a decline in the capital stock. Instead, a bailout financed by raising taxes will eliminate the crowding out effect on the capital stock, and the economy will be on its way back to the steady state.

The recession generated by the bad loans can last as long as the banks have enough resources to fully cover their obligations to the old depositors, i.e.

$$S_t - B_t \geq 0.$$

Eventually the amount of bad loans will exceed the new savings, i.e. the banks will not be able to honor their obligations on deposits collected in the previous period.[27] At this stage, the government will have to conduct the bailout.

The government's ability to raise funds in the bailout period to fully repay banks' obligations to the depositors is essential for the recession to occur. Consider an economy in which there are no government guarantees. In this case an unanticipated negative shock to the return on loans results in losses for the banks. Because perfect competition implies that the deposit rates R_t are equal to the returns on loans R_t^L, the banks cannot offset these losses by higher profits in the following periods. On the other hand, if it attempts to run a Ponzi scheme and finance the deficit by using new deposits, in a finite period of time it will run out of funds. In other words, new savings will not be enough to pay the old deposit obligations in full. Knowing this, households will not make deposits to such banks prior to the bankruptcy period. By backwards induction, banks would not be able to collect deposits in any other period. However, with government guarantees, from the

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[27]The bad loans in this economy are an asset equivalent to government debt. As Tirole (1985) shows, no (unproductive) asset can grow faster than the economy's growth rate, because eventually the resources of the economy will not be enough to purchase all outstanding stock of this asset.

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banks' point of view, the bad loan is not "bad". Indeed, the net present value of a bad loan is exactly the same as the net present value of new loans. The only difference is that the new loans pay off next period, while the bad loans pay off on the day of the bailout. Thus, the net present value of the banks' assets is unaffected by the bad loans.[28]

Finally, the results above do not rely on frictions in the credit market: firms in this model are not credit rationed, nor they are facing borrowing constraints of any type. In each period, given the interest rate and the price of capital, they acquire the optimal amount of capital. Therefore, the predictions of the model would remain valid even if firms had a direct access to the households savings. Under full deposit protection, households would be indifferent between lending to banks or directly to firms, as both activities in equilibrium would guarantee the same return, while the banks still would use the necessary amounts of new deposits to cover the deficits arising from the bad loans.

4   Quantitative Analysis

In this section I access how much of Japan's slowdown can be explained by the bad loans problem. I also illustrate that the recession generated by the delay in the bailout, is consistent with the Japan's experience in the last decade.

The main difficulty in quantifying the effect of the bad loans problem on Japan's economy is the uncertainty regarding the actual amount of the bad loans and the expectations regarding the government's bailout policy. As described in Section 2, at the time of this writing, the estimates for the actual size of non-performing loans vary significantly, while the timing and financing of the bailout remain uncertain.[29] To this end, I proceed in two different directions.

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[28] An interesting question is whether the dynamics of the economy would be different if the government guarantees were limited, that is, if only a particular amount of deposits were to be repaid in the period of the bailout. In this case, in the period prior to the bailout, the deposits to the banks would not exceed the guaranteed amount. If the latter is lower than the households' desired level of savings, savings would decline, causing the price of capital to decline. In all other periods the behavior of the households would not change. Therefore, the dynamics of the economy would be identical to the one described above, except in the period prior to the bailout the savings and the price of capital would be lower, with respective adjustments in the interest rates.

[29] In the end of 1990s, in a series of measures to fundamentally restructure the financial sector (so called "Big Bang"), Japan's government had committed about ¥60 trillion for deposit protection, bank recapitalization, and

First, I study the case in which the expectations regarding the bailout policy are such that the effect of the bad loans problem on the model economy is the smallest. My finding is that the delay in the bailout slows the economy at least by 0.22-0.71% per year.

Second, note that the bad loans cause a decline in economic activity through the crowding out effect on capital. Therefore, under the assumption that the bad loans problem was the only force slowing down Japan's economy, then the observed decline in the investment-output ratio (see Figure 1.1) is solely due to the crowding out effect of the bad loans on capital. To this end, it is possible to actually *infer* a set of expectations regarding the bailout policy and the amount of the bad loans which are consistent with the data. That is, one can simulate a model calibrated to Japan's economy, with different bailout policies and the amount of the bad loans, and single out cases in which the resulting crowding out effect on capital comes closest to the one observed in Japan. The average yearly decline in output, which occurs in these cases, is the estimate of the impact of the bad loans problem on Japan's economy. I find that when the fall in the investment-output ratio generated by the model coincides with the one in the data, the implied average yearly decline in output is 0.92%. The actual growth of Japan's per capita GDP during the 1990s was 1.2%. Therefore, absent the bad loans problem, the growth rate of Japan's economy would have exceeded 2%. Most economists probably would agree that such performance would have been hard to qualify as a 'slump', especially because the growth rate of Japan's economy would have been higher than the average growth rates of both G-7 and OECD countries during the same period of time. This suggests that the bad loans problem can be the main reason for the Japan's slowdown in the 1990s.

In the rest of this section I construct the model, describe the nature of the experiments, and present the results.

4.1 The model

The model below is a modified version of the model in Section 3.

First, I substitute the overlapping generations framework with Blanchard's (1985) Perpetual Youth framework. A property of this framework is that it preserves the overlapping generations

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nationalization of failed banks. A part of these funds has been disbursed (See Hoshi and Kashyap (2001), Ch. 8, for more details). During the same period, Japan's budget deficit was financed by government debt.

structure, while permitting study of the dynamics of the economy at yearly frequencies.

Second, following Hayashi and Prescott (2002), I introduce a tax on capital. Capital taxes are very high in Japan, and revenues from them constitute a significant share of total government revenues. Therefore, the capital tax cannot be ignored. In the model below the rate of return on capital and the interest rate are related as follows:

$$R - 1 = (1 - \tau^K)(R^f - 1),$$

where R is the interest rate, $\tau^K \in [0, 1]$ is the capital tax, and R^f is the rate of return on capital.

Third, households elastically supply labor and managerial services.

Finally, I modify the production side of the economy to incorporate a model of endogenous TFP. The purpose of this modification is to illustrate that the bad loans problem can itself be responsible for the decline in TFP observed in Japan.

4.1.1   Households[30]

Households in this economy consume, save and work as labor and managers. Households differ by their age. In each period a new generation of households of measure p is born. Each household faces a constant probability p of dying in the next period; p is also the inverse of the expected life time of the household.

The economy is also populated by perfectly competitive insurance companies, which pay a premium $\frac{p}{1-p}$ per unit of non-human wealth the households possess. In exchange, insurance companies collect a household's wealth in the event of its death.

The utility function of a household born in time t in period s is given by

$$u_{s,t}(c(s,t), n(s,t), m(s,t)) = \begin{cases} \log\left(c(s,t) - \psi_n(s,t)\frac{n(s,t)^{1+\psi_0}}{1+\psi_0} - \psi_m(s,t)\frac{m(s,t)^{1+\psi_0}}{1+\psi_0}\right) & \text{if alive in period } t, \\ 0 \text{ otherwise}; \end{cases}$$

where $c(s,t)$ is consumption, $n(s,t)$ is the labor hours supplied, $m(s,t)$ is the manager hours supplied, $\psi_n(s,t)$ and $\psi_m(s,t)$ are the disutility coefficients from labor and managerial effort respectively.[31]

---

[30] In modeling households I follow closely Blanchard and Fischer (1989), Ch. 3. The noticable difference is that in my model the labor supply is endogenous. I use a functional form, originally proposed by Greenwood, Hercowitz, and Huffman (1988), to guarantee that the model allows to aggregate consumption and wealth.

[31] A slightly unusual part of the utility function above is the effort disutility coefficients $\psi_n(s,t)$ and $\psi_m(s,t)$, which

With this utility function the problem of a household which is born at time t and alive at time $\bar{s}$ is given by

$$\max p \sum_{s=\bar{s}}^{\infty} [\beta(1-p)]^{s-\bar{s}} \log \left(c(s,t) - \psi_n(s,t) \frac{n(s,t)^{1+\psi_0}}{1+\psi_0} - \psi_m(s,t) \frac{n(s,t)^{1+\psi_0}}{1+\psi_0} \right)$$
$$s.t. \ v(s+1,t) + c(s,t) = R_s[1 + \tfrac{p}{1-p}]v(s,t) + w_s^n n(s,t) + w_s^m m(s,t) - \tau(s,t);$$

where $v(s,t)$ is the (non-human) wealth in period s, w_s^n and w_s^m are the wages paid to workers and managers, $\tau(s,t)$ is the (generation specific) lump sum tax, and R_s is the interest rate. The term $R_s \frac{p}{1-p} v(s,t)$ is the premium received from the insurance companies.

I assume that $\tau(s,t)$ is proportional to the labor income of each generation:

$$\tau(s,t) = \tau_s[n(s,t)w_s^n + m(s,t)w_s^m]$$

where τ_s is the tax rate at time s.

To capture the life-cycle pattern of the households' labor income, it is assumed that for a household born in generation t in period $\bar{s}$ $\psi(\bar{s},t)$ is given by:

$$[\psi_n(\bar{s},t)]^{-\frac{1}{\psi_0}} = \left(a_1^n[1-\theta_1]^{\bar{s}-t} + a_2^n[1-\theta_2]^{\bar{s}-t} \right);$$
$$[\psi_m(\bar{s},t)]^{-\frac{1}{\psi_0}} = \left(a_1^m[1-\theta_1]^{\bar{s}-t} + a_2^m[1-\theta_2]^{\bar{s}-t} \right);$$

where $a_1^n, a_1^m < 0$, $a_2^n, a_2^m > 0$, $0 < \theta_1 < \theta_2 < 1$.

It is convenient to denote the following sums as Ψ_n and Ψ_m

$$\Psi_n \equiv p \sum_{t=-\infty}^{\bar{s}} \psi_n(\bar{s},t)^{-\frac{1}{\psi_0}} [1-p]^{\bar{s}-t};$$

$$\Psi_m \equiv p \sum_{t=-\infty}^{\bar{s}} \psi_m(\bar{s},t)^{-\frac{1}{\psi_0}} [1-p]^{\bar{s}-t}.$$

Then, one can show that the solution of the problem above yields the following equations for

vary over the life-cycle of the households. The purpose of this modification is to capture the life- cycle pattern of the labor income, as it is described below.

the aggregate consumption C_t and (non-human) wealth V_{t+1}:

$$C_t = [1 - \beta(1-p)][R_t V_t + [W_{1,t} + W_{2,t}]] + \frac{1}{1+\psi_0}\Psi_n {w_t^n}^{\frac{1+\psi_0}{\psi_0}} + \frac{1}{1+\psi_0}\Psi_m {w_t^m}^{\frac{1+\psi_0}{\psi_0}};$$

$$V_{t+1} = R_t V_t + (1-\tau_t)\left[\Psi_n {w_t^n}^{\frac{1+\psi_0}{\psi_0}} + \Psi_m {w_t^m}^{\frac{1+\psi_0}{\psi_0}}\right] - C_t;$$

$$W_{1,t+1} = \frac{R_{t+1}}{[1-\theta_1][1-p]}\left[W_{1,t} - (\frac{\psi_0}{1+\psi_0} - \tau_t)\left[\frac{a_1^n p}{\theta_1+p-\theta_1 p}{w_t^n}^{\frac{1+\psi_0}{\psi_0}} + \frac{a_1^m p}{\theta_1+p-\theta_1 p}{w_t^m}^{\frac{1+\psi_0}{\psi_0}}\right]\right];$$

$$W_{2,t+1} = \frac{R_{t+1}}{[1-\theta_2][1-p]}\left[W_{2,t} - (\frac{\psi_0}{1+\psi_0} - \tau_t)\left[\frac{a_2^n p}{\theta_2+p-\theta_2 p}{w_t^n}^{\frac{1+\psi_0}{\psi_0}} + \frac{a_2^m p}{\theta_2+p-\theta_2 p}{w_t^m}^{\frac{1+\psi_0}{\psi_0}}\right]\right];$$

where $W_{1,t}$ and $W_{2,t}$ denote the following quantities:[32]

$$W_{1,t} = \sum_{s=t}^{\infty}(\frac{\psi_0}{1+\psi_0} - \tau_s)\left[\frac{a_1^n p}{\theta_1+p-\theta_1 p}{w_s^n}^{\frac{1+\psi_0}{\psi_0}} + \frac{a_1^m p}{\theta_1+p-\theta_1 p}{w_s^m}^{\frac{1+\psi_0}{\psi_0}}\right][1-\theta_1]^{s-t}R(t,s);$$

$$W_{2,t} = \sum_{s=t}^{\infty}(\frac{\psi_0}{1+\psi_0} - \tau_s)\left[\frac{a_2^n p}{\theta_2+p-\theta_2 p}{w_s^n}^{\frac{1+\psi_0}{\psi_0}} + \frac{a_2^m p}{\theta_2+p-\theta_2 p}{w_s^m}^{\frac{1+\psi_0}{\psi_0}}\right][1-\theta_2]^{s-t}R(t,s);$$

and

$$R(t,s) \equiv \begin{cases} \frac{[1-p]^{s-t}}{\prod_{m=t+1}^{s} R_m} & \text{if } s \geqslant t+1; \\ 1 & \text{if } s = t. \end{cases}$$

Finally, the aggregate labor N_t and the aggregate managers M_t are given by the following equations:

$$\begin{aligned} N_t &= [w_t^n]^{\frac{1}{\psi_0}}\Psi_n; \\ M_t &= [w_t^m]^{\frac{1}{\psi_0}}\Psi_m. \end{aligned} \tag{4.1}$$

4.1.2 Firms

The production side of the economy is modeled along the lines of Lucas (1978), Jovanovic (1982), and Hopenhayn (1992). Firms are heterogenous: each firm has monopoly power over the good it produces, and the firms have different productivity levels. Two assumptions regarding the structure of the production side in the economy are crucial for the results of the paper regarding the dynamics of TFP:

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[32] In the Blanchard's (1986) originial model the sum $W_{1,t} + W_{2,t}$ denotes the aggregate human wealth, that is, the present value of all labor income of currently alive households. In this model it repesents the same quantity minus the present value of the aggregate disutility from working of the currently alive households.

1. There is a sunk entry cost.

2. There is an operating cost: in addition to labor and capital used directly in production, firms must pay for a fixed amount of overhead labor (i.e. managers) and capital.

The entry cost. A part of the entry costs stems from satisfying different official regulatory requirements. As Djankov et al. (2002) report, in Japan *"the official cost of following* (entry) *procedures for a simple firm"* is 11% of per capita GDP.[33] Entry costs may also include expenses related to the acquisition of firm specific capital[34] and other start-up costs.

The operating cost. The operating cost typically refers to overhead labor, and expenses that are lumpy in nature, for example, renting a physical location. According to findings of Domowitz et al. (1998), in U.S. manufacturing plants, the overhead labor accounts for 31% of total labor. Ramey (1991) suggests that overhead labor is about 20%. Basu's (1996) preferred estimate of overhead inputs is 28%.

I also assume that firms learn their productivity only after the sunk entry cost is paid. This assumption reflects very high uncertainty faced by entering firms. This is routinely found in the data and documented, for example, by Klette and Kortum (2004) as a *stylized fact.*

Final Good Producers   The final consumption good in this economy is produced by perfectly competitive firms, owned by the households, according to the following production function:

$$Y_t = \left[\int_0^{\mu_t} [y_t(i)]^{\frac{1}{\lambda}} \, di \right]^{\lambda};$$

where μ_t is the number of intermediate goods produced in the economy, λ is a constant which is greater than one, and $y_t(i)$ is the quantity of the intermediate good i. Let $p_t(i)$ be the price of ith intermediate good in terms of the final good. Then, the maximization problem of the final good producer can be written as

$$\max \left[\int_0^{\mu_t} [y_t(i)]^{\frac{1}{\lambda}} \, di \right]^{\lambda} - \int_0^{\mu_t} p_t(i) y_t(i) di,$$

and the first order optimality condition implies that

$$p_t(i) = \left[\frac{y_t(i)}{Y_t} \right]^{-\frac{\lambda-1}{\lambda}}.$$

---

[33]22% of per capita GDP if the time cost is included.

[34]See Shapiro and Ramey (2001).

Intermediate Good Producers A firm in the intermediate goods sector lives two periods, is profit maximizing and owned by the households. All firms are ex ante identical. There is an entry cost κ. A firm must borrow from the bank in order to pay this cost. Once the entry cost is paid, a firm gains the ability to produce an intermediate good in the next period. Next, the firm draws a productivity parameter $A(j)$, where j is drawn from an i.i.d. uniform distribution over $[0,1]$. The firm has a monopoly power for the good it can produce. The production function for the good j is given by

$$[A(j)]^{1-\gamma}\left[k(j)^{\alpha}n(j)^{1-\alpha}\right]^{\gamma}$$

where $k(j)$ and $n(j)$ denote capital and labor respectively. The productivity parameter differs among the firms. A firm with a higher index has a higher productivity parameter:

$$A(j) > A(i), \text{ for } j > i, \text{ and } i,j \in [0,1].$$

The parameter γ determines the degree of diminishing returns to scale in capital and labor.[35]

In order to produce the firm must borrow to buy capital, as well as to cover the operating cost. The operating cost consists of wages paid to ϕ^{m} managers,[36] and ϕ^{δ} units of capital. The managers are paid in the beginning of the next period, before the production takes place.

Consider a decision of a firm born in time t with a draw j. If it decides to produce, its profits are

$$\pi_{t+1}^{P}(j) = \max_{k_{t+1}(j),n_{t+1}(j),L_t(j)} \left[\frac{y_{t+1}(j)}{Y_{t+1}}\right]^{-\frac{\lambda-1}{\lambda}} y_{t+1}(j) - R_{t+1}^{f}L_t(j) - w_{t+1}n_{t+1}(j) + (1-\delta)k_{t+1}(j),$$

s.t.

$$y_{t+1}(j) = [A(j)]^{1-\gamma}\left[k_{t+1}^{\alpha}(j)n_{t+1}^{1-\alpha}(j)\right]^{\gamma}$$
$$L_t(j) \geq k_{t+1}(j) + \phi^{\delta} + w_{t+1}^{m}\phi^{m}.$$

(4.2)

where R_{t+1}^{f} is the interest rate on loans that a firm faces, $L_t(j)$ is the amount of a firm's loan, w_{t+1} is the labor wage, and w_{t+1}^{m} is the managers' wage. The parameter δ denotes the depreciation rate of capital used in production. Capital which is used to operate, i.e. ϕ^{δ}, depreciates completely. The decision whether or not to produce depends on if $\pi_{t+1}^{P}(j)$ is positive or not. Therefore, the jth

---

[35] This is what Lucas (1978) calls managers' span of control.

[36] The managers in the model are identical to those in Lucas (1978): each firm requires a fixed number of them, and they do not affect the marginal product of labor.

firm's profits $\pi_{t+1}^F(j)$ are given by:

$$\pi_{t+1}^F(j) = \max\{\pi_{t+1}^P(j), 0\}.$$

Lastly, free entry implies that in equilibrium the firm's profits must be equal to the expected entry cost κ:[37]

$$\frac{1}{R_{t+1}^f} \int_0^1 \pi_{t+1}^F(j)dj = \kappa. \tag{4.3}$$

4.1.3 Deriving the Firms' Average Productivity

Below, I derive the equilibrium relationship between the firms' average productivity and the operating cost. First, I determine the lowest productivity level necessary for a firm to decide to produce. Note that the first order conditions for a firm j which decides to operate is given by

$$\begin{aligned}
\alpha \frac{\gamma}{\lambda} \frac{p_{t+1}(j)y_{t+1}(j)}{k_{t+1}(j)} &= R_{t+1}^f - (1-\delta); \\
(1-\alpha) \frac{\gamma}{\lambda} \frac{p_{t+1}(j)y_{t+1}(j)}{n_{t+1}(j)} &= w_{t+1}.
\end{aligned} \tag{4.4}$$

These two conditions imply that for any two operating firms i and j, the following relations hold:

$$\frac{p_{t+1}(j)y_{t+1}(j)}{p_{t+1}(i)y_{t+1}(i)} = \frac{k_{t+1}(j)}{k_{t+1}(i)} = \frac{n_{t+1}(j)}{n_{t+1}(i)} = \frac{a(j)}{a(i)}; \tag{4.5}$$

where $a(j) \equiv A(j)^{\frac{1-\gamma}{\lambda-\gamma}}$. That is, in equilibrium, the gross profits, capital, and labor ratios of any two goods are equal to their (scaled) productivity ratio. Denote the operating cost as $\phi_{t+1}^O \equiv (\phi^\delta + w_{t+1}^m \phi^m)$. Then, the first order conditions in (4.4) also imply that the profits from producing are equal to the firm's share of the gross profits $(1 - \frac{\gamma}{\lambda})$ minus the present value of the operating cost $R_{t+1}^f \phi_{t+1}^O$:

$$\pi_{t+1}^P(j) = (1 - \frac{\gamma}{\lambda})p_{t+1}(j)y_{t+1}(j) - R_{t+1}^f \phi_{t+1}^O.$$

Let J_{t+1} be the firm which is indifferent between producing or not,[38] i.e.

$$(1 - \frac{\gamma}{\lambda})p_{t+1}(J_{t+1})y_{t+1}(J_{t+1}) - R_{t+1}^f \phi_{t+1}^O = 0. \tag{4.6}$$

---

[37] I assume that the firms' shareholders have full liability. That is, if after incurring the cost κ and drawing j the firm decides not to produce, the bank is still paid in full. However, if all (or sufficiently many) firms are owned by one agent, i.i.d. nature of the productivity draws implies that there is no risk in owning these firms.

[38] Note that J_{t+1} may not exist, because it can be the case that it is optimal to produce at any level of productivity: $\pi_{t+1}^P(j) > 0$ for all j. I assume that this is not the case.

Gross profits are increasing in productivity, and so are the net profits. Therefore, firms with indices higher than J_{t+1} will produce, and those with lower indices will not. This implies that the firm's expected profits are:

$$\pi_{t+1} = \int_{J_{t+1}}^{1} \left[(1 - \frac{\gamma}{\lambda}) p_{t+1}(j) y_{t+1}(j) - R_{t+1}^{f} \phi_{t+1}^{O} \right] dj. \tag{4.7}$$

Using equations (4.5) and (4.6), the zero profits condition (4.3) can be written as:

$$\kappa = \phi_{t+1}^{O} \int_{J_{t+1}}^{1} \left[\frac{a(j)}{a(J_{t+1})} - 1 \right] dj. \tag{4.8}$$

The expression above defines the cutoff J_{t+1} as an implicit function of the operating cost ϕ_{t+1}^{O}. It is straightforward to show that $J_{t+1}(\cdot)$ is an increasing function of the operating cost.[39] Therefore, the firms' average productivity $a_{t+1}^{AV} = \frac{\int_{J_{t+1}}^{1} a(j) dj}{\int_{J_{t+1}}^{1} dj}$ is an increasing function of the operating cost. In particular, when the operating cost declines, the firms' average productivity falls.

4.1.4 The relation between the entry, the number of producing firms, and the firms' average productivity

In equilibrium of this model there is an interesting connection between the number of firms which enter, that is, firms which pay the entry cost, and the number of firms which actually produce. Let ν_{t+1} denote the entry, and μ_{t+1} the number of producing firms. Then

$$\nu_{t+1} = \frac{\mu_{t+1}}{\int_{J_{t+1}}^{1} dj}.$$

Next, let me show that the cutoff J_{t+1} is an increasing function of μ_{t+1}. First, note that

$$w_{t+1}^{m} = \left[\frac{M_{t+1}}{\Psi_m} \right]^{\psi_0} = \left[\frac{\mu_{t+1} \phi^m}{\Psi_m} \right]^{\psi_0},$$

where the first equation uses the relation between wages and aggregate number of managers in (4.1), and the second one uses the market clearing condition for the managers. Therefore, the managers' wage w_{t+1}^{m} is an increasing function of the number of producing firms μ_{t+1}. Note, that J_{t+1} is an increasing function of w_{t+1}^{m}, and therefore, of μ_{t+1}. Finally, because $\int_{J_{t+1}}^{1} dj$, is decreasing in J_{t+1}, ν_{t+1} is an increasing function of μ_{t+1}.

---

[39] An increase in the cutoff J_{t+1} has two effects: profits of the jth firm, $\pi_{t+1}^{P}(j) = \phi_{t+1}^{O} \left[\frac{a(j)}{a(J_{t+1})} - 1 \right]$ decline, and also the number of producing firms declines. Therefore, the right hand side of (4.6) is decreasing in J_{t+1}, while it is clearly increasing in the fixed cost ϕ_{t+1}^{O}.

Therefore, in equilibrium, the entry ν_{t+1}, the number of producing firms μ_{t+1}, and the firms' average productivity a_{t+1}^{AV} move in the same direction.

4.1.5 Deriving aggregate output

Let K_{t+1} denote the economy's aggregate capital stock used in production. Then, the aggregate output in this economy is given by

$$
\begin{aligned}
Y_{t+1} &= \left[\nu_{t+1} \int_{J_{t+1}}^{1} [y_{t+1}(j)]^{\frac{1}{\lambda}} \, dj \right]^{\lambda} = \\
&= \left[\nu_{t+1} \int_{J_{t+1}}^{1} a(j) dj \right]^{(\lambda - \gamma)} \left[K_{t+1}^{\alpha} N_{t+1}^{1-\alpha} \right]^{\gamma};
\end{aligned}
$$

where the last equation comes from expression in (4.5). Note, that using the firm's FOC in (4.7) and expression in (4.5), the rental rate on capital and labor wage can be written as:

$$
\begin{aligned}
\alpha \frac{\gamma}{\lambda} \frac{Y_{t+1}}{K_{t+1}} &= R_{t+1}^{f} - (1 - \delta); \\
(1 - \alpha) \frac{\gamma}{\lambda} \frac{Y_{t+1}}{N_{t+1}} &= w_{t+1}^{n}.
\end{aligned}
\tag{4.9}
$$

4.1.6 The relation between R_t^f and R_t

The (pre-tax) return R_t^f on capital and the (net of tax) interest the households receive are related as follows:

$$
R_t = (1 - \tau_t^k)(R_t^f - 1) + 1,
$$

where τ_t^k is the capital income tax rate.

4.1.7 Banks

The banks are identical to the ones described in Section 3. Therefore, the amount of loans in this economy is given, as before, by

$$
L_t = D_t - B_t + G_t.
$$

4.1.8 Government

The government finances a stream of government purchases g_t, collects taxes, and provides deposit guarantees to the banks. The government's budget constraint is given by

$$G_t + g_t = \tau_t \left[\Psi_n w_t^{n \frac{1+\psi_0}{\psi_0}} + \Psi_m w_t^{m \frac{1+\psi_0}{\psi_0}} \right] + \tau_t^k (R_t^f - 1)(V_t - B_t).$$

where G_t is the transfer to the banks.

4.1.9 Resource Constraint, Market Clearing Conditions, and Equilibrium

The resource constraint is given by:

$$C_t + I_t + g_t = Y_t;$$

where I_t is the aggregate investment. The latter includes the aggregate investment into the capital used in production, and the fixed costs $\nu_{t+1}\kappa$ and $\mu_{t+1}\phi^\delta$. Also, since the managers' wages are borrowed in the current period, but paid in the next, the term $\left[M_{t+1}w_{t+1}^m - M_t w_t^m \right]$ must be included in the aggregate investment.

The market clearing conditions are:

$$
\begin{aligned}
V_{t+1} &= L_t + B_{t+1}; \\
L_t &= \nu_{t+1} \int_{J_{t+1}}^1 L_t(j)dj + \nu_{t+1}\kappa; \\
\nu_t \int_{J_t}^1 n_t(j)dj &= N_t; \\
\nu_t \int_{J_t}^1 \phi^m dj &= M_t; \\
\nu_{t+1} \int_{J_{t+1}}^1 k_{t+1}(j)dj &= K_{t+1}.
\end{aligned}
$$

Finally, equilibrium is defined as in Section 3.

4.2 The Experiments

The initial conditions and the bad loans shock. In all simulations it is assumed that initially the economy is in steady state. At date zero, unexpectedly, a fraction q of firms does not pay back the amount borrowed from banks. I consider a case in which the funds that have not been repaid to the banks, i.e., $B_0 = qR^{ss}L^{ss}$, are distributed to the households in a lump sum fashion.[40] To

---

[40] As Bareseghyan (2002) shows, if B_0 simply dissappears from the economy, the recession caused by the bad loans problem is deeper.

insure that the aggregation properties of the model are not altered, it is assumed that the share of B_0 distributed to each household is equal to its share of labor income in that period.

Parameter values.[41] The parameters in the model can be categorized as "neoclassical", "perpetual youth", "endogenous productivity", and others.

The "neoclassical" parameters are chosen based on findings of Hayashi and Prescott (2002). In particular, the share of capital is set to 0.362, the capital tax rate is set to 0.48. In steady state the depreciation rate of capital is 0.089%, and the interest rate is 5.0%. Government spending is equal to 15% of output.

The "perpetual youth" parameters θ_1, θ_2, a_1^n, a_2^n, a_1^m, and a_2^m are chosen as follows. The parameter p is chosen such that the resulting age distribution of the households comes closest to that in the data.[42] With this value of p the expected life time of the household is equal to 41.66 years. The parameters θ_1, θ_2, a_1^n, a_2^n, a_1^m, and a_2^m are chosen such that the resulting life-cycle pattern of labor income comes closest to that in the data.[43]

The "endogenous productivity" parameters γ, ϕ^δ, ϕ^m and function $a(j)$ are chosen as follows. The parameter γ is set to 0.85, which is the benchmark value of Atkeson and Kehoe (1995) and (2002).[44] In steady state, depreciation due to the fixed cost ϕ^δ is equal to 1.55% of the aggregate capital stock, and accounts approximately for 18% of total capital depreciation.[45] The parameter ϕ^m is chosen so that in the steady state the managers constitute 25% of the labor force.[46] The productivity function $a(j)$ in the experiments below is given by $a(j) = 0.25 + j^{36}$. This choice implies that the variance of the firms' productivity draws is quite high, consistent with findings of Eaton and Kortum (2002). The choice of this functional form is motivated by computational reasons because it does not directly affect the dynamics of the economy per se. The latter depends on the behavior of the function $a(j)$ around the cutoff J_{t+1}. In a neighborhood of the steady state cutoff J, there is a large mass of firms which have slightly lower than J, but essentially the same

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[41] The complete list of parameter values is provided in Appendix B.

[42] That is, p is chosen to minimize the distance between the population age distribution in the data, and the population age distribution in the model.

[43] See the previous footnote.

[44] Atkeson and Kehoe (2002) value of γ is the estimate for the U.S. manufacturing sector. To my knowledge, the estimate of γ for Japan's economy has not been constructed.

[45] The reason for this choice are dictated by the technical reasons, as described in the Appendix B.

[46] This is roughly the average value of the estimates of overhead inputs reported by Domowitz et al. (1998), Ramey (1991) and Basu (1996).

productivity (see Figure 4.1).

I conservatively set λ to 1.20, which implies a mark up of 20 percent. In Japan, according to the findings of Martins et al. (1996), the (average) mark up is 40 percent.

4.3 Results: Estimating the effect of the bad loans problem on the economy

In this model, the effect of bad loans on the economy is the smallest when the households expect taxes to be raised as soon as possible. In Japan's case this means that the bailout starts in 2003, that is, 13 periods after the bad loans' shock.

As previously discussed, the estimates of the amount of bad loans vary significantly: from 24% of GDP to 63% of GDP. I consider three cases: A) the actual amount of bad loans is 24% of the GDP; B) the actual amount of bad loans is 37% of the GDP; and C) the actual amount of bad loans is 43% of the GDP.[47] I assume that the households expect the labor income tax to be raised respectively by 25%, 40% and 45%. The tax increase is expected to last as long as it is necessary to payoff the full amount of the outstanding bad loans.[48]

Table 4.1 presents the effects of the bad loans on the economy for these three cases. The average yearly decline in output is 0.22%-0.39%. Table 4.1 also reports what happens to capital, aggregate labor, and the Solow residual.

Table 4.2 presents the effects of the bad loans problem in the model economy for the cases A), B), and C) when the parameter p is set to 0.1.[49] Higher p implies that the households care less about the future tax increase, therefore, they save less than in the benchmark case, which causes a larger fall in loanable funds. Consequently, the investment decline is sharper and the recession

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[47] B) is the lower bound plus one third of the difference between the upper and the lower bounds, and C) is the lower bound plus one half of the difference between the upper and the lower bounds. It it important to emphasize that only recently a very large amount of bad loans has been written off (See Section 2). Including these loans in the analysis would make the effect of the bad loans on the economic activity larger.

[48] Of course, if the labor income tax would be increased more, the effect of the bad loans would be even smaller. However, a 25% increase in labor income tax seems already unrealistically high. The 40% and 45% used for cases B) and C) are necessary to insure that the increase in tax revenue is sufficient to offset the rise in the amount of bad loans due to interest compounding.

[49] The parameter p in the model is the difference between the discount rate for the human wealth and the interest rate. Hayashi's (1982) estimates suggest that the discount rate for human wealth is higher than the interest rate, and in particular that the implied value of p is 0.1. See Hayashi (1982) and Blanchard (1985) for more details.

is deeper. Overall, with this value of p, the bad loans problem causes 0.40-0.71% average yearly decline in output.

Under the assumption that the bad loans problem has been the only reason for the slowdown of Japan's economy, the model developed here can be used to estimate the impact of the bad loans problem on Japan's economy. The estimation strategy is as follows. First, derive the crowding effect on capital in the data by computing the average decline in investment-output ratio. Next, simulate the model with different bailout policies and different amounts of bad loans, and single out cases in which the resulting crowding out effect on capital comes closest to the one observed in Japan. The average yearly decline in output, which occurs in these cases, is the estimate of the impact of the bad loans problem on Japan's economy.

When the fall in the investment-output ratio generated by the model replicates the one in the data, the implied average yearly decline in output is 0.92%. It is important to emphasize that the steady state investment-output ratio is set to the average investment-output ratio over the period of 1981-1990. If it was set to the 1990 level, the fall in output would have been more dramatic. Figure 4.1 presents the dynamics of the model economy for one such case – the bailout starts 13 periods after the shock, the government finances the bailout by reducing the government spending by 30%, and the amount of bad loans is 50% of the GDP. As the figure shows, the model's performance is also satisfactory in two other dimensions: the fall in aggregate labor is about three quarters of that in the data, and the fall in the Solow residual is about one third of the Hayashi and Prescott (2002) benchmark.[50] More recent evidence on the behavior of TFP provided by Jorgenson and Motohashi (2003) strongly suggests that the decline in TFP was not nearly as dramatic as it was originally thought. If the benchmark estimate of the slowdown is based on the findings of Jorgenson and Motohashi (2003), then the decline in TFP in the model slightly overstates the actual decline of TFP.

Overall, the results of this exercise suggest that the bad loans problem is possibly the main cause of Japan's slowdown in the 1990s.

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[50] In this experiment, 1% fall in output is accompanied by .34% fall in the Solow residual. In Japan during the 1990s, as measured by Hayashi and Prescott (2002), a 1% fall in (the growth rate of) output was accompanied by roughly a 1% fall in (the growth rate of) the Solow residual.

4.4 Relation to the Empirical Facts and the Existing Literature

Return on Capital

A shortcoming of the model is that the after-tax return on capital (i.e. the interest rate) does not fall, as it does in the data. This is because near the steady state, the output-capital ratio cannot decline when capital falls.[51] However, even if the output-capital ratio does not decline in the model, there is essentially no rise in the rate of return on capital – it rises less than two hundredth of a basis point per year. This is interesting, because in standard models a crowding out effect on capital is typically accompanied by a noticeable rise in the rate of return on capital. It is important to note that there are at least two forces which are not considered in this paper that could make the return on capital fall.

First, Barseghyan (2005) shows that the bad loans can not only crowd out capital but can also induce a decline in the price of existing capital goods.[52] This decline leads to capital losses which can be large enough to offset increases in the marginal product of capital stemming from the fall in the stock of capital. Therefore, the rate of return on capital falls.

Second, as Hayashi and Prescott (2002) argue, the changes in the Labor Standards Law in 1988 generated a substantial decline in aggregate labor supply. Incorporating this decline into the analysis would generate a temporary decline in the rate of return on capital.

Total Factor Productivity and Investment

As I mentioned in the introduction, the decline in TFP is often considered a major cause for Japan's slowdown. Commonly, it is argued that the (relative) number of low productivity enterprises increased, forcing TFP down, which, in turn, contributed to the decline in aggregate output. The model constructed here reproduces this pattern exactly. The intuition behind this result goes back to Hopenhayn (1992): as the capital stock declines expected profits from entry decline, which lowers the number of entering firms. At the same time, because the operating cost falls,[53] lower productivity firms become profitable enough to break even, and, therefore, choose to

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[51]That would imply that the steady state is not stable.

[52]Note that in Japan during the 1990s the price of capital, as measured by Nikkei 225 Index, had declined.

[53]The decline in the operating cost is caused by the decline in manager's wage. It can be shown that in a more general setting with endogenous price of capital the decline in the operating cost will be almost entirely driven by a decline in the price of capital. As Figure 1.1. shows, there was a significant decline in the price of capital in Japan during the 1990s.

operate (see Figure 4.3). The overall effect of the fall in the capital stock is less firms[54], lower average productivity, and a fall in TFP.[55]

The endogenous decline in TFP is a result of a decline in the capital stock, i.e. investment. It should be stressed that Hayashi and Prescott (2002) cast doubts on the importance of the decline in investment in generating Japan's slowdown by emphasizing that the decline in investment of the non-financial corporate sector was weaker than the decline in total gross domestic investment (see Figure 4.4). They use this observation to support their view that an exogenous decline in TFP was the driving force behind Japan's slowdown. However, in the standard growth models an exogenous decline in TFP leads to a decline in the investment-output ratio. To see this recall that on a balanced growth path the investment-output ratio is given by:

$$\frac{I}{Y} = \frac{I}{K}\frac{K}{Y} = (\delta + g)\frac{1}{s_k}\left[1/\beta - (1 - \delta)\right],$$

where g is the growth rate of the economy's output and capital, and s_k is the share of capital. Consider, for example, an exogenous change in TFP which lowers the growth rate of economy from 2.5% (3.0%) to 1.0%. With $\delta = 0.089$, this implies that the investment-output ratio declines by 13% (17%), which is very close to the decline in the investment-output ratio generated by the bad loans problem in my model.[56] Therefore, declines in TFP and the investment-output ratio occur simultaneously regardless of what is the driving mechanism behind the slowdown.

The Bad Loans versus Government Debt, and the Current Account Surplus

In the paper, I treated bad loans as government debt and abstracted from open economy considerations. An important question could be whether, with unrestricted flows of foreign capital, the delay in the government bailout would have an impact on economic activity similar to the one described above. In Japan's case, the answer is yes. As detailed below, existing Japanese banks did not have the ability to generate large increases in lending to firms, and there was no entry into Japan's banking sector. Therefore, the bad loans differ from typical government debt because the shortage of loanable funds generated by the bad loans cannot be offset by borrowing from abroad.

In order to keep the exposition clear, I assumed that there was no positive capital adequacy requirement, and that the deposit insurance covered all deposits. However, in Japan, there is a

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[54] As Figure 1.1 shows, in Japan during the 1990s the number of establishments had declined.

[55] Appendix A describes the link between TFP and the Solow residual in this model.

[56] Recall that the latter matches the decline in Japan's (growth domestic) investment-output ratio during the 1990s.

positive capital adequacy requirement in line with Basel agreements, and the deposit insurance is asymmetric; that is, it covers only domestic depositors. These two facts are the key for explaining why the banks chose not to increase the amount of deposits, even with an access to the world capital markets.

First, consider a typical bank with a large amount of non-performing loans, which faces a possibility of being shut down. If such a bank decides to increase the amount of deposits it collects, it must make a positive capital injection. However, if the bank is shut down, this capital injection becomes a pure loss to the bank's shareholders because it will be used to pay off the bank's depositors. Therefore, in some cases, such capital injection will not be profitable.[57] In fact, during the 1990s only a handful of Japanese banks chose to recapitalize on their own, while the majority chose not to do so, implying that the banking sector did not have the ability to generate large increases in the amount of deposits, and, therefore, loans.

Second, the asymmetric nature of the deposit insurance may prevent the banks from borrowing abroad. Indeed, from the perspective of the foreign financial institutions, lending to banks which might be shut down is not secure:[58] if the bank is shut down the foreigners would not be repaid. Barseghyan (2002) studied the implications of the asymmetric deposit insurance, and showed that delaying the bailout does lead to a decline in the loanable funds, and, therefore, in investment and output. Interestingly, in that model the decline in output is accompanied by a current account surplus, as it has been in Japan's case.

A final issue to address is why there was no entry into Japan's banking sector, which could have boosted lending to firms. The main reason is that there would have been no profits from such entry. Indeed, the return on capital and the lending rates have not risen. These phenomena are consistent with the crowding out effect on capital generated by the bad loans problem. Moreover, expected profits from entry depend on the competition from existing banks. Therefore, uncertain government bailout policies, which generated an uncertainty about the number of insolvent banks that will continue their operations, effectively acted as a barrier to entry into banking sector. Other reasons for the lack of entry were the deteriorating conditions of Japan's banking sector, and, in particular, the strong exit pressures, as described by Hoshi and Kashyap (2002).[59]

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[57] For a formal exposition of this result see Barseghyan and Jaimovich (2003).

[58] In case of Japan, this is indicated by Japan's premium, as described in Section 2.

[59] The opinion that entry into the Japanese financial sector would not be beneficial prior to the recovery of domestic

The Bad Loans Problem and Lending to 'Zombie' Firms

As a concluding remark, this paper does not reject the possibility that other forces may have been contributing to Japan's slowdown. Most importantly, I abstracted from the bank-firm relationships. A closer study of this relation by Caballero et al. (2004) reveals an additional channel through which the bad loans can cause a fall in economic activity. In particular, Caballero et al (2004) argue that because "*most large Japanese banks would be out of business if regulators forced them to recognize all their loan losses immediately*" they "*keep many zombie* (i.e. low productivity) *firms alive by ever-greening their loans – rolling over loans that they know will not be collected.*" This contributes to the congestion of industries that have many zombie firms and, therefore, discourages entry of new firms. It is noteworthy that in order for 'loan ever-greening' to occur it must be the case that the insolvent banks continue to receive deposits and enjoy government guarantees and the entry to the banking sector is unprofitable. Otherwise, new banks will enter, deposits will shift to them, insolvent banks will fail and zombie firms will disappear. Therefore, conditions that lead to crowding out of capital are identical to those which allow zombie firms to survive.

5 Conclusions

This paper argued that the delay in the government bailout of the financial sector forces banks to take resources of the economy away from investment financing. Consequently, the economy falls into a prolonged recession, which is characterized by declines in output, investment, labor, and TFP. These features are consistent with Japan's experience over the last decade.

The mechanism through which the delay in the government bailout causes a decline in economic activity is very much different from the ones commonly proposed in the literature. In particular, the results of the paper do not rely on inability of firms to finance profitable investment projects. In the model economy developed here, the firms operate in a perfectly competitive environment, and their financing is not constrained.

To assess the quantitative effect of the delay in the government bailout I calibrated my model using Japanese data. I constructed a conservative estimate of the impact of the delay in the government bailout by assuming that the bailout will start in 2003, and will be financed by lump

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banks has been expressed, for example, by *Analytica Japan*. See "Entry into Japanese Financial Services", (1998).

sum taxes. Under these assumptions, the estimated decline in output due to the delay of the bailout ranges between 0.22 and 0.71 percent per year. When the magnitude of the bad loans problem and the expectations about the bailout were set such that the resulting decline in the investment-output ratio coincides with the decline in the investment-output ratio observed in the data, the impact of the delayed bailout is a 0.92% yearly decline in output. Absent such a decline, the growth rate of Japan's per capita GDP would have exceeded 2%, a rough benchmark for a satisfactory economic performance. Based on this, I argued that the delay in the resolution of the bad loans problem could be the main reason for Japan's slowdown.

Appendix

A TFP and the Solow residual

In the model, $\left[a_t^{\mathrm{AV}}\right]^{(\lambda-\gamma)}$ can be interpreted as TFP. The Solow residual is given by

$$
\begin{aligned}
s_t &= \frac{Y_t}{K_t^{s_k}\left[N_t + M_t\right]^{1-s_k}} \\
&= \frac{\left[\mu_t a_t^{\mathrm{AV}}\right]^{(\lambda-\gamma)}\left[K_t^{\alpha} N_t^{1-\alpha}\right]^{\gamma}}{K_t^{s_k}\left[N_t + M_t\right]^{1-s_k}};
\end{aligned}
$$

where the s_k is the share of capital defined as

$$
s_k = s_k \frac{R^f \nu \kappa}{Y} + \frac{R^f \mu \phi^{\delta}}{Y} + \frac{\left[R^f - (1-\delta)\right] K}{Y}.
$$

That is, the share of capital is equal to the share paid to the capital K directly used in the production, plus the share paid to the capital $\mu\phi^{\delta}$ which is a part of the fixed operating cost. In addition, $R^f \nu \kappa$, the part of the income which is not generated by neither capital or labor, is split between the two in proportion to their share of income.

Around the steady state, it can be written as

$$
\hat{s}_t = (\lambda - \gamma)\hat{a}_t^{\mathrm{AV}} + b_K \hat{K}_t + b_{\mu}\hat{\mu}_t + b_N \hat{N}_t;
$$

where $\widehat{\ }$ denotes the deviation from the steady state, and

$$
\begin{aligned}
b_{\mu} &= (\lambda - \gamma) - (1 - s_k)\frac{M}{N + N} - s_k\frac{\mu\phi^{\delta}}{K + \mu\phi^{\delta}} \\
b_N &= (1 - \alpha)\gamma - (1 - s_k)\frac{(1 - \alpha)\gamma}{\lambda - \gamma - s_k + (1 - \alpha)\gamma} \\
b_k &= \alpha\gamma - s_k\frac{K}{K + \mu\phi^{\delta}}
\end{aligned}
$$

For the parameter values used in the paper b_N, and b_k are quantitatively small, and so is $\hat{\mu}_t$. Therefore,

$$
\hat{s}_t \approx (\lambda - \gamma)\hat{a}_t^{\mathrm{AV}}.
$$

B   Parameter Values

Parameter	Value
γ	0.85
α	0.38
δ	7.45%
$\frac{\mu\phi^\delta}{K+\mu\phi^\delta}$ *	1.55%
R	1.05
p	0.024
θ_1	0.0803
θ_2	0.0800
ψ_0	0.62
Ψ_n	2097.8
Ψ_m	691.09
$\frac{R^f\nu\kappa}{Y}$	9%
$\frac{M}{M+N}$ **	25%
$\frac{I}{Y}$ **	24%
$\frac{g}{Y}$ **	15%

* In the model, the total depreciation of capital is equal to $\delta K + \phi^\delta \mu$. This quantity in the steady state is equal to .89. Note that in this model $\nu_t \kappa$ is not counted as capital. This is in line with Atkeson and Kehoe (2002) findings for the U.S. manufacturing sector that "...nearly 9% of the output ... is not accounted for by payments to either of these (capital or labor) factors." They "...interpret this unaccounted-for output as payments to various forms of unmeasured capital or monopoly rents." Also, for a given choice of $\frac{M}{M+N}$, the parameter ϕ^δ is set to absorb the remaining part of the firms' gross profits.

** refers to the steady state values.

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Figure 1.1 Key Economic Indicators for Japan.

Growth rate of GDP per capita (% per year, 1980-2000)
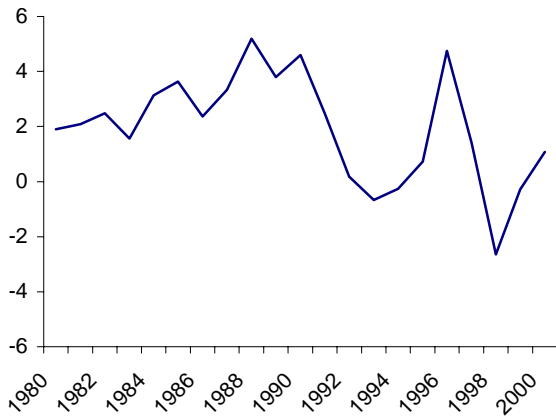
Investment/ Output ratio (1980-2000)
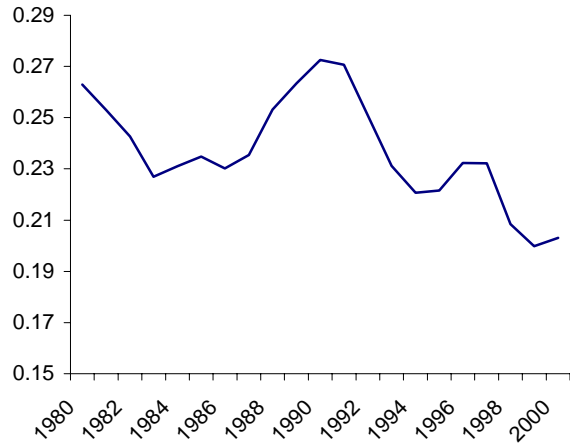
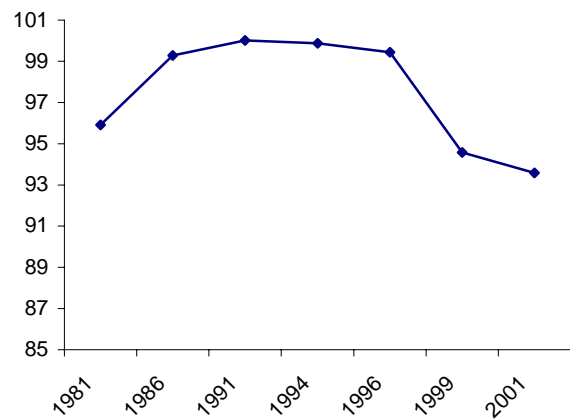**Aggregate Labor (Hours, 1980-2000, 1990=100)**
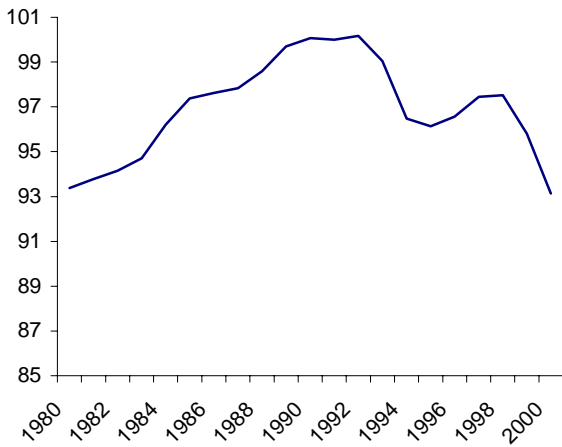
TFP growth rate (% per year,1980-2000)
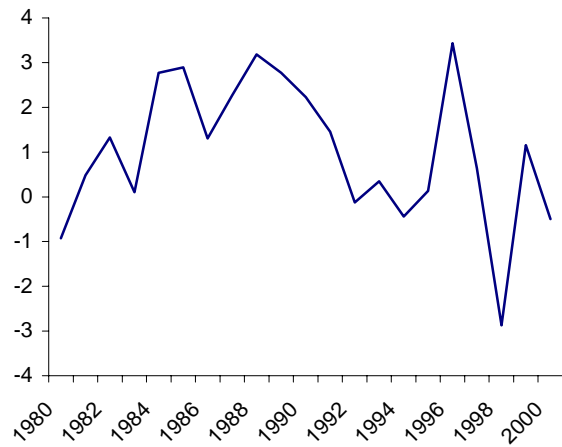
**Nikkei 225 (Monthly Averages, 1980-2000)**
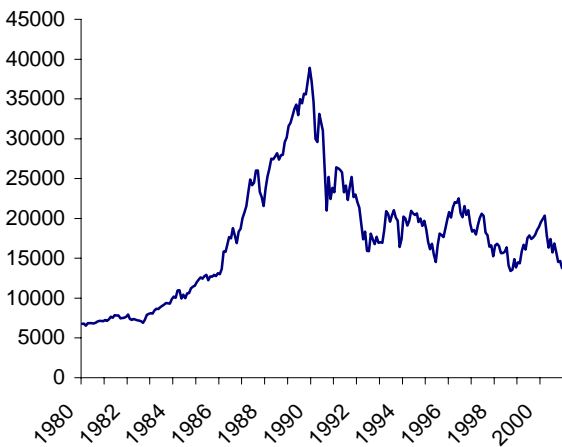
Number of Establishments (, 1981-2001, 1991=100)

Notes. 1) GDP numbers are from the National Accounts, 93SNA. 2) Nikkei 225 Index is publicly available from the Bank of Japan. 3) The establishment data is from Japan's Statistical Yearbook. 4) The rest of the data is publicly available from F. Hayashi's web site. 5) TFP is the Solow Residual of Hayashi and Prescott (2002).

**Figure 1.2 Collapse of Bank Loans to Nonfinancial Corporate Sector
(from Hayashi and Prescott (2002))**
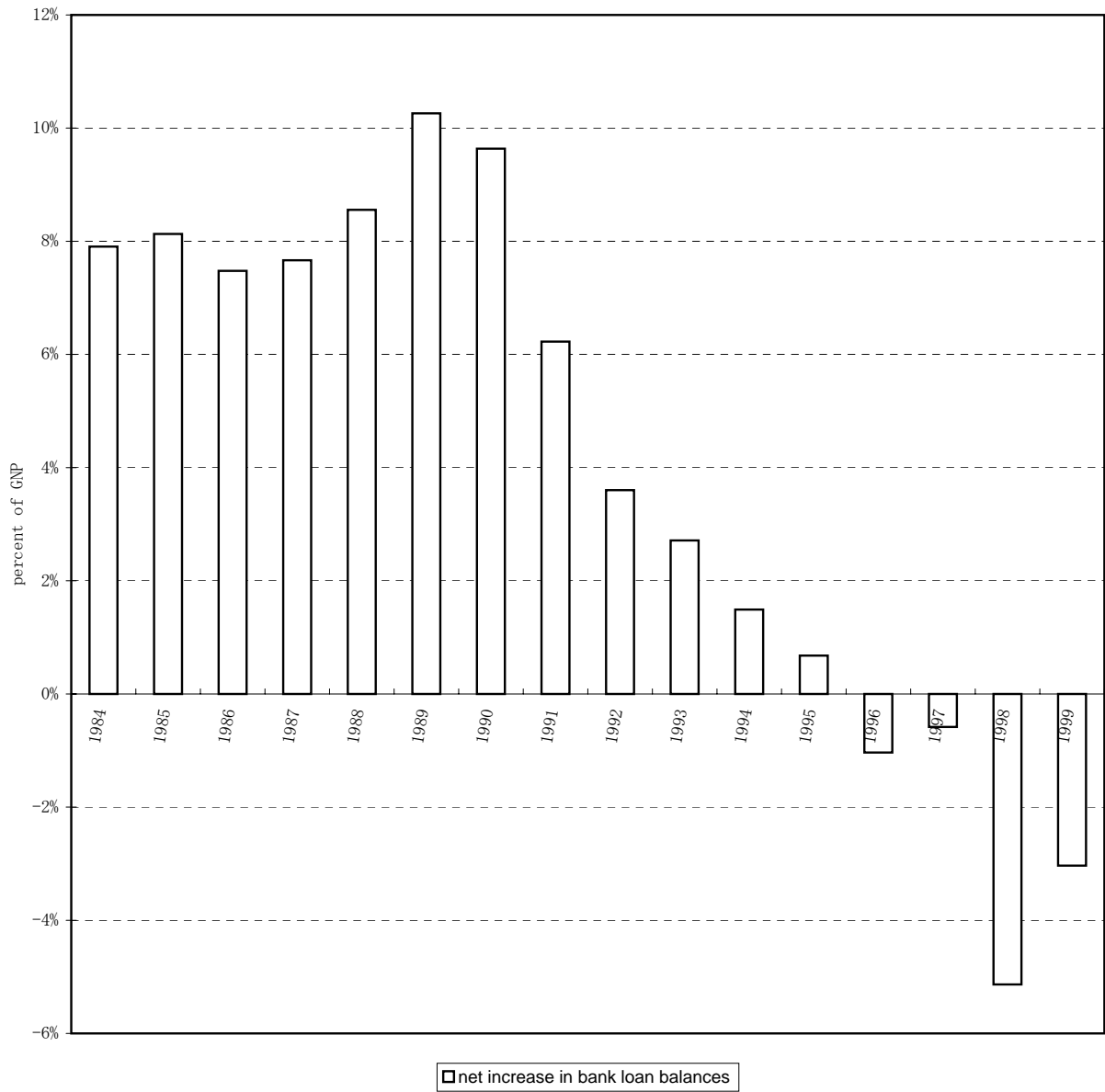
Table 2.1   Relative Weights of Industries, By Sector and Size of Capital

share of	all industry					manufacturing					non-manufacturing				
	A	B	C	D	**C+D**	A	B	C	D	**C+D**	A	B	C	D	**C+D**
capital stock	1.00	0.69	0.09	0.22	**0.31**	0.41	0.34	0.03	0.05	**0.07**	0.59	0.35	0.06	0.18	**0.24**
operating profits	1.00	0.49	0.12	0.38	**0.51**	0.36	0.22	0.04	0.10	**0.15**	0.64	0.27	0.08	0.28	**0.36**
current profits	1.00	0.49	0.12	0.39	**0.51**	0.42	0.26	0.05	0.10	**0.15**	0.58	0.22	0.07	0.29	**0.36**
sales	1.00	0.40	0.16	0.44	**0.60**	0.30	0.17	0.04	0.09	**0.13**	0.70	0.24	0.12	0.35	**0.46**
Industry's contribution to GDP	1.00					0.26 0.11 see note1				**0.15**	0.74				

Size of capital: A is all sizes, B is 1 billion yen or over, C is 100 million yen to 1 billion yen, D is 10 to 100 million yen
Figures are averages for 1990-2002(II quarter).
Note 1: break down of manufacturing sector on this line is on two groups:
with employees above 300, and the rest. The former is in column B.

Table 2.2   Bank Dependence By Sector and Size of Capital

	all industry				manufacturing				non-manufacturing			
	A	B	C	D	A	B	C	D	A	B	C	D
long term bank borrowing/ total liabilities	0.26	0.21	0.25	0.31	0.20	0.12	0.21	0.34	0.28	0.25	0.27	0.30
	0.25	*0.18*	*0.21*	*0.34*	*0.19*	*0.12*	*0.19*	*0.32*	*0.28*	*0.22*	*0.22*	*0.34*
total bank borrowing/ total liabilities	0.45	0.38	0.48	0.51	0.37	0.28	0.41	0.52	0.48	0.44	0.50	0.50
	0.42	*0.34*	*0.43*	*0.50*	*0.34*	*0.26*	*0.39*	*0.49*	*0.44*	*0.37*	*0.44*	*0.50*
long term bank borrowing/ long term liabilities	0.60	0.45	0.68	0.74	0.51	0.31	0.63	0.82	0.63	0.51	0.69	0.72
	0.55	*0.39*	*0.58*	*0.72*	*0.47*	*0.30*	*0.56*	*0.75*	*0.58*	*0.43*	*0.59*	*0.71*

Size of capital: A is all sizes, B is 1 billion yen or over, C is 100 million yen to 1 billion yen, D is 10 to 100 million yen.
Main figures are averages for 1990-2002(II quarter), small italics are levels as of August 2002.

Manufacturing:	Non-manufacturing:
Food	Construction
Publishing and printing	Wholesales and retails
Chemicals	Real estate
Metal products	Transport and communications
General machinery	Electricity
Electrical machinery	Services
Transportation equipment	

Source: White Paper on Small and Medium Enterprises.
Ministry of Economy, Trade, and Industry.
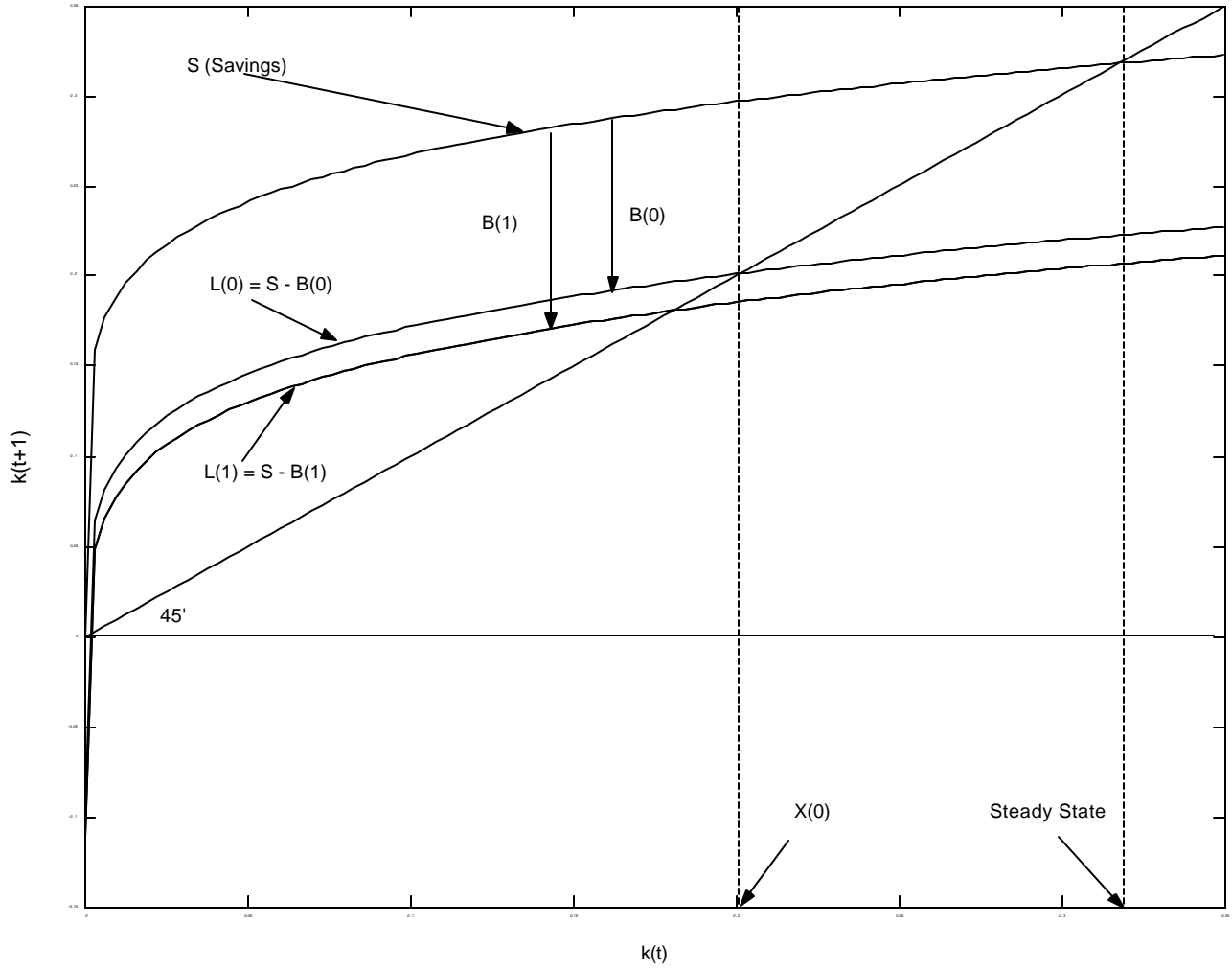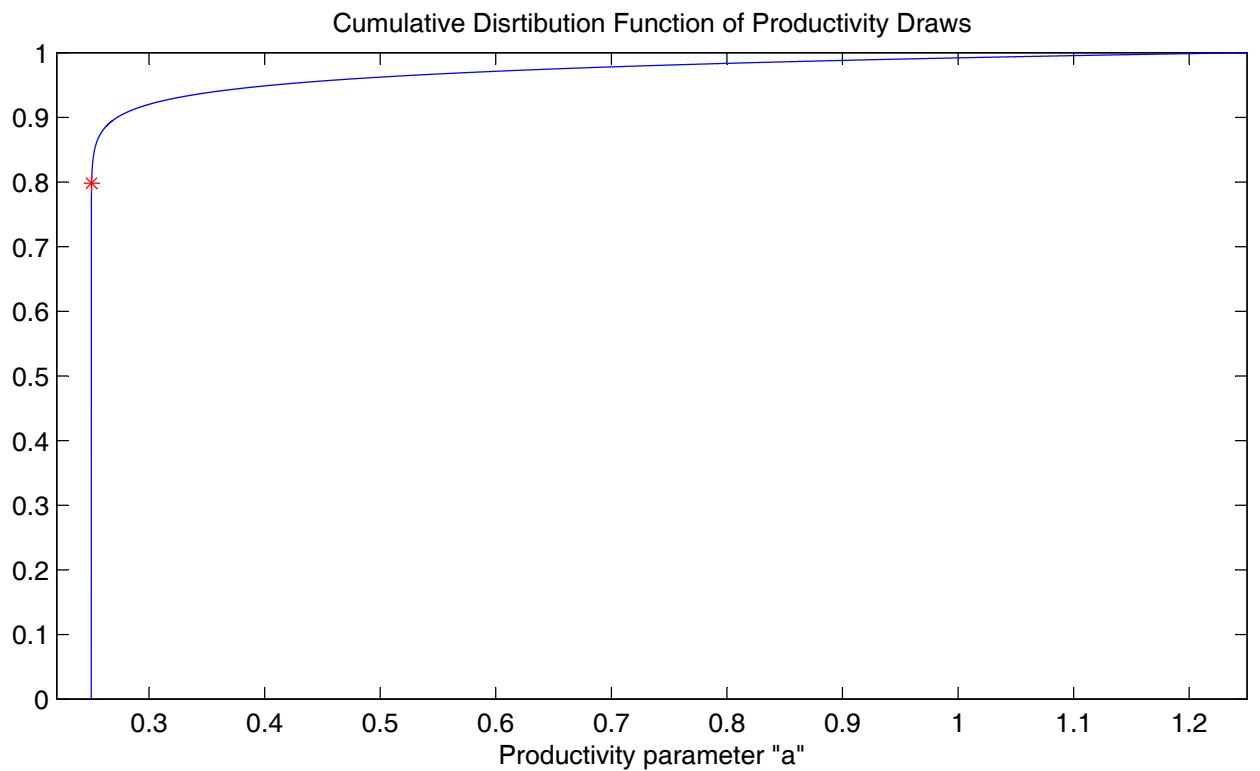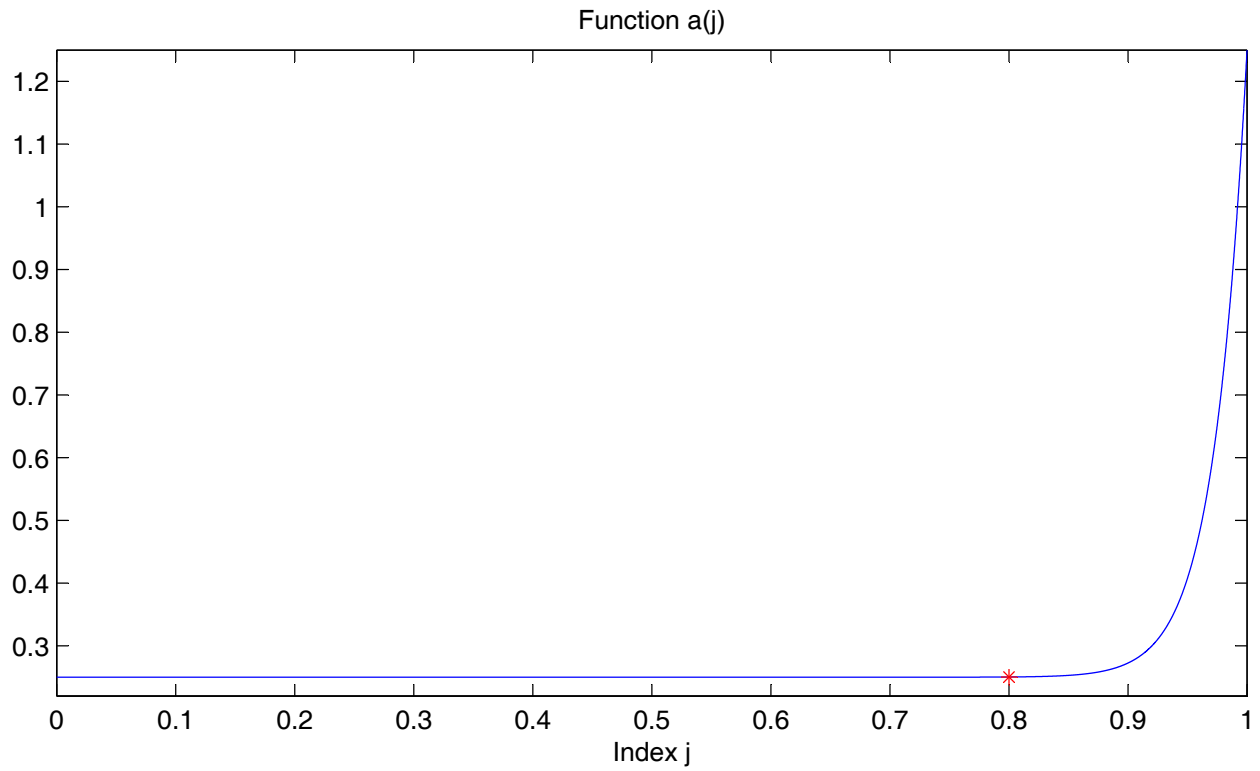
FIGURE 3.1 DELAYD BAILOUT.

k(t+1)

S (Savings)

B(1)   B(0)

L(0) = S - B(0)

L(1) = S - B(1)

45'

X(0)   Steady State

k(t)

FIGURE 4.1 FUNCTION a(j) and CUMULATIVE DISTRIBUTION of PRODUCTIVITY DRAWS

Function a(j)

Index j

Cumulative Disrtibution Function of Productivity Draws

Productivity parameter "a"

Note: * indicates the point which corresponds to the steady state value of J.

Table 4.1 The Effect of the Bad Loans: lump sum taxes.

B_{T-1}[3]	Tax Increase[4]	Bailout[1] Starts	Ends	Average Decline[2] in Output	Capital	Solow Residual	Labor
24	25	13	40	0.22	0.23	0.07	0.11
37	40	13	37	0.33	0.34	0.11	0.16
43	45	13	40	0.39	0.40	0.13	0.19

Table 4.2 The Effect of the Bad Loans when $p = 0.10$: lump sum taxes.

B_{T-1}[3]	Tax Increase[4]	Bailout[1] Starts	Ends	Average Decline[2] in Output	Capital	Solow Residual	Labor
24	25	13	44	0.40	0.41	0.13	0.20
37	40	13	40	0.59	0.60	0.19	0.29
43	45	13	45	0.71	0.73	0.24	0.35

Support table for Figure 4.1.

B_{T-1}[3]	Decrease In Gov.t Spending[5]	Bailout[1] Starts	Ends	Average Decline[2] in Output	Capital	Solow Residual	Labor
50	30	13	31	0.92	0.93	0.31	0.45

Notes
1. Periods after shock.
2. Average yearly decline, in percent.
3. Percent of GDP.
4. Percent increase in the labor income tax.
5. Percent of steady state.

FIGURE 4.2 DELAYED BAILOUT
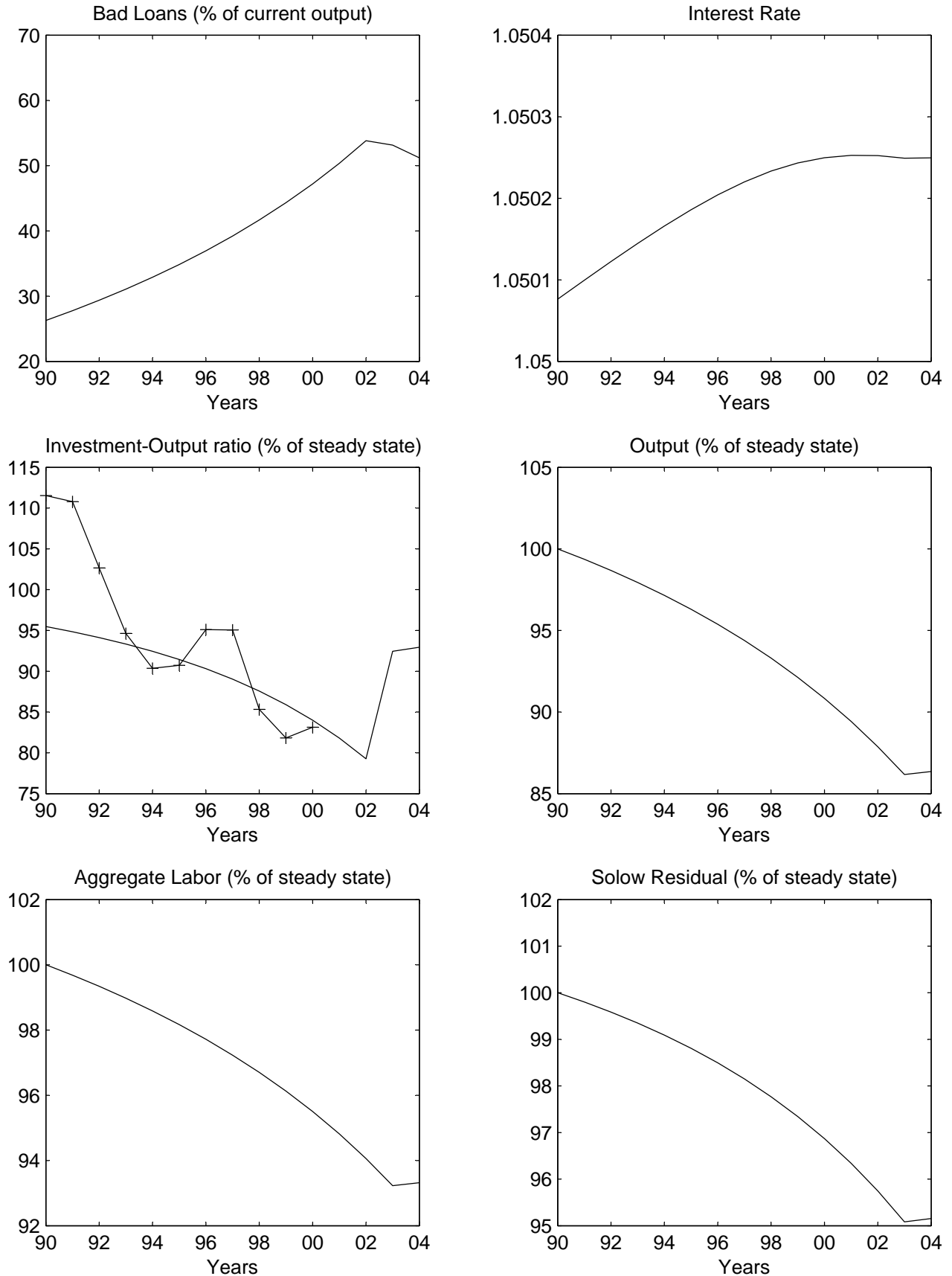
Notes. 1) "+" denotes the investment-output ratio in the data. For this figure

100 = average investment-output ratio in 1981-1990.
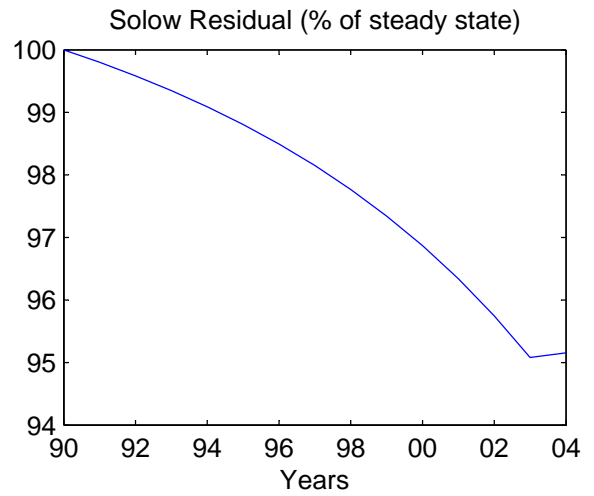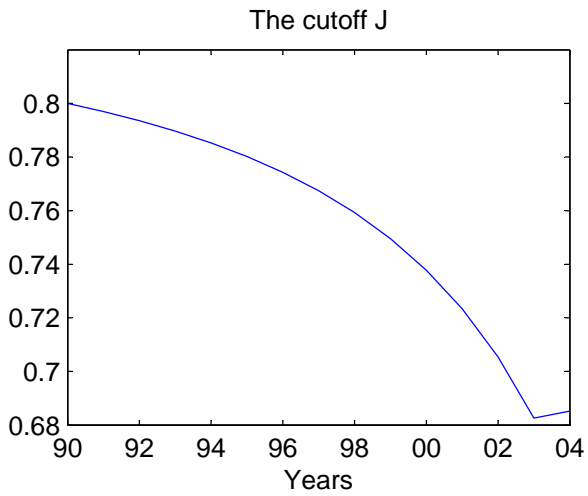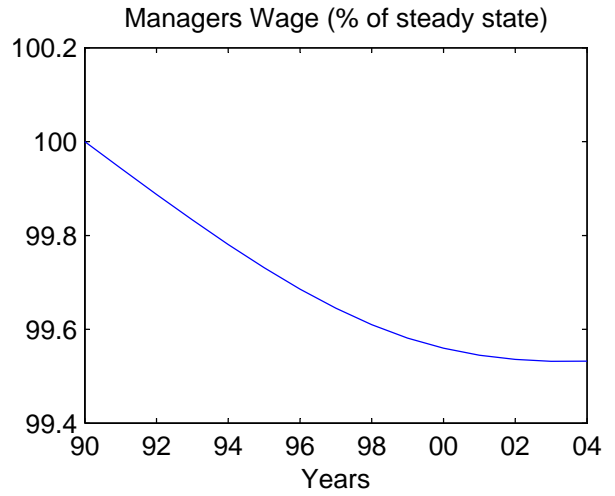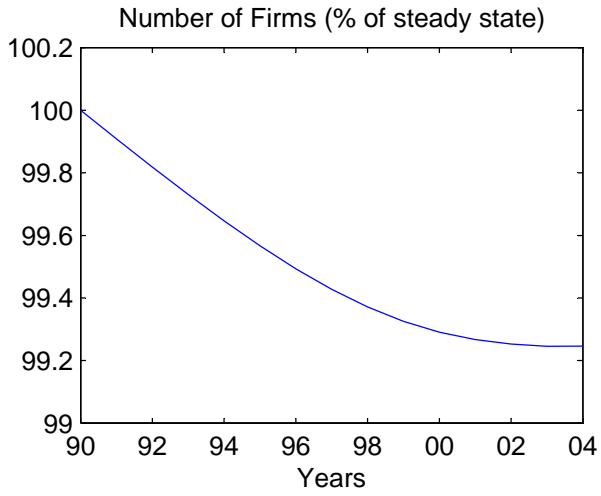
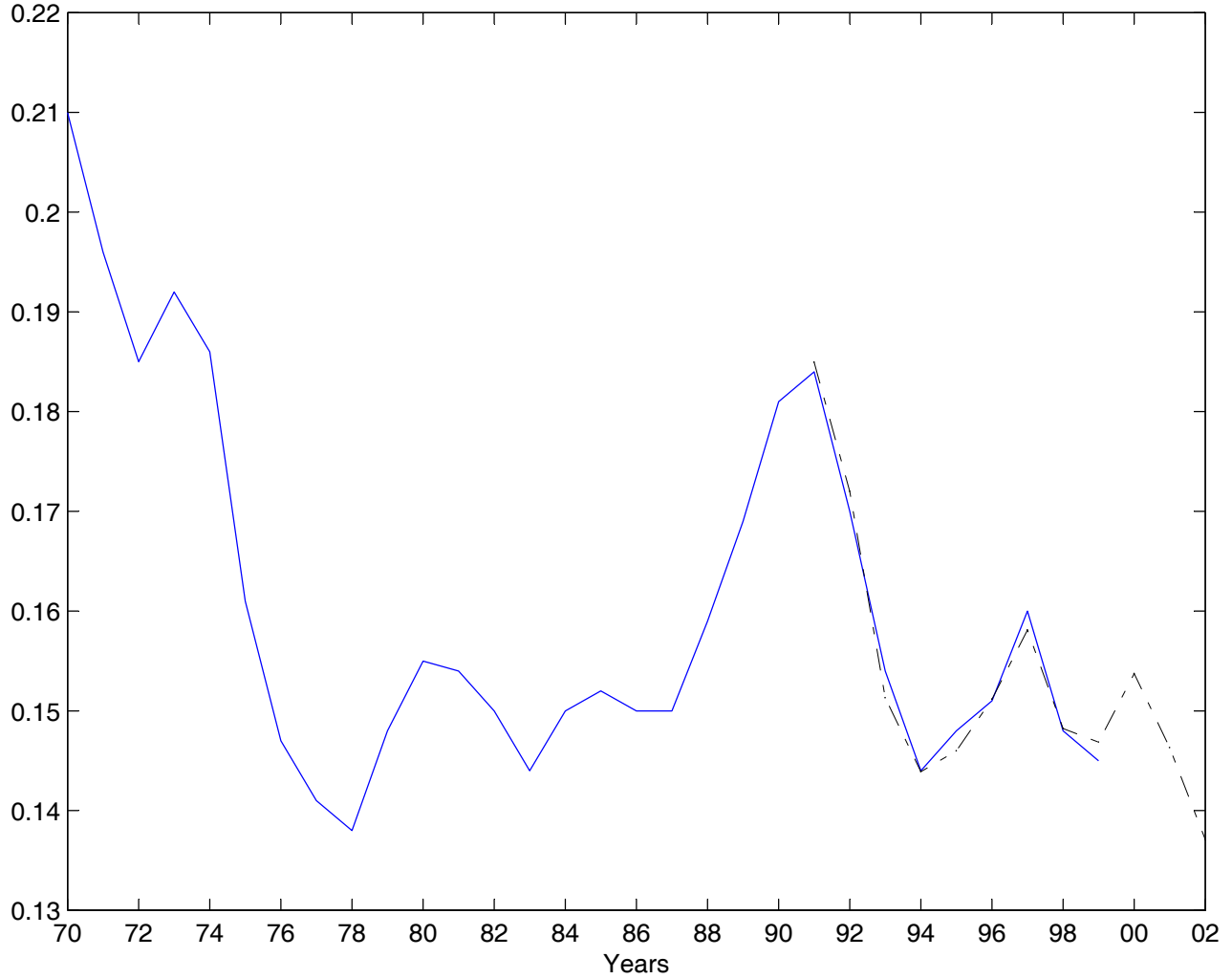FIGURE 4.3 DELAYED BAILOUT (cont.d)

FIGURE 4.4 INVESTMENT- GNP RATIO: NON-FINANCIAL CORPORATE SECTOR.

Notes: Solid line - Hayashi and Prescott (2002); dashed line - data from CFA accounts. Sources: Web-site of F. Hayashi, National Accounts for 2002 (93SNA), and Capital Finance Accounts, by Institutional Sectors.