Monetary Implications of the Hayashi-Prescott Hypothesis for Japan*

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Abstract

Hayashi and Prescott (2002) speculate that the anemic performance of the Japanese economy since the early 1990s can be understood in terms of how any 'well-functioning' private sector might react to an exogenous 'productivity shock.' In particular, they downplay the role of monetary and financial factors in shaping Japan's 'lost decade.'

But many view the monetary and financial developments in Japan as direct evidence of a 'malfunctioning' financial sector. These developments include: a steady decline in bank lending and the money multiplier; unexpected declines in inflation (and even the price-level); nominal interest rates that are close to zero; and massive infusions of liquidity by the Bank of Japan that seem to have no effect at all (a 'liquidity trap').

The primary purpose of my paper is to show that the Hayashi and Prescott hypothesis is not inconsistent with these monetary and financial developments. To the extent that this is true, monetary and fiscal policies, or reforms directed exclusively at the banking sector, are unlikely to re-establish productivity growth. What is likely needed are economy-wide reforms that enhance the willingness and ability of individuals to adopt potentially disruptive technological advancements and work practices.

Keywords: Productivity Slowdown, Money Multiplier, Monetary Policy, Liquidity Trap.

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1 Introduction

In a highly provocative paper, Hayashi and Prescott (2002) speculate that the anemic performance of the Japanese economy since the early 1990s can be understood in terms of how any 'well-functioning' private sector might react to a shock that lowers the growth rate of total factor productivity. Their hypothesis stands in direct contrast to popular explanations that are based in terms of an extended credit crunch that emerged in the in the aftermath of a bursting asset 'bubble.' They are led to explore the implications of their hypothesis on the basis of evidence which suggests that despite the ongoing difficulties in the Japanese banking sector, desired capital expenditure is for the most part fully financed.[1] To the extent that this is true, Japan's sluggish investment activity is likely to be better understood in terms of low levels of *desired* capital expenditure and not in terms of credit constraints that prohibit firms from financing projects with positive net present values.

To investigate the empirical plausibility of their hypothesis, Hayashi and Prescott develop a quantitative dynamic general equilibrium model of the Japanese economy and examine the properties of the predicted growth path of the model economy in response to an exogenous productivity slowdown.[2] While their model economy features no financial market 'friction,' the authors find that several real variables in their model economy respond in a manner that is consistent with observation.

Because Hayashi and Prescott's model abstracts from monetary phenomena, it cannot speak to what many regard to be strong evidence linking Japan's ongoing slump to monetary and financial phenomena. For example, the steady contraction in bank lending and the money multiplier (the creation of broad money) is often interpreted as the cause of deflationary pressure, which itself is thought to adversely affect private sector expenditure. This deflationary pressure in turn has driven the nominal interest rate to zero, leaving Japan in a 'liquidity trap.' Massive infusions of liquidity by the Bank of Japan (BoJ) seem to have had no effect at all, as banks have simply 'hoarded' their cash in the form of reserves instead of lending it out. It is this type of behavior that has led many to interpret the banking sector as the root of Japan's problems.

The purpose of my paper is to show that the Hayashi and Prescott hypothesis is not inconsistent with the behavior just described. As a consequence, the evidence that is commonly used to explain Japan's problems as emanating from the banking sector is not sufficient to justify such an interpretation. In order to demonstrate this point rigorously, I develop a monetary version of the neoclassical model that is simple

[1] In addition to the evidence presented in Hayashi and Prescott (2002), one can refer to Motonishi and Yoshikawa (1999).

[2] The authors also argue that an exogenous decline in the workweek and an exogenous increase in government's share of output had roles to play in Japan's recent economic history. I abstract from these considerations in order to focus on productivity and monetary policy.

enough to be studied analytically (I do not examine the quantitative properties of the model).

My findings can be summarized as follows. A productivity slowdown in the early 1990s combined with tightening monetary policy (which I argue was the case in Japan at this time) is consistent with a contraction in capital expenditure, a decline in the nominal (and real) interest rate, declining inflation, and a steady decline in the money multiplier. It is shown that these shocks may very well drive the nominal interest rate to zero, which I assume happened sometime in late 1995. In the event of a zero nominal interest rate, the model predicts that sales of government securities by the BoJ can have no effect on anything real or even on the price level; the economy at this stage appears to be in a 'liquidity trap.' Continued shocks to productivity reduce the return to investment and increase the attractiveness of nominally-denominated government securities (money and bonds at this stage are viewed as perfect substitutes), which has the effect of exerting further downward pressure on the price-level. Aggressive monetization of existing government securities on the part of the central bank is powerless to stem this deflationary pressure. I argue that these properties of the model lend further support for Hayashi and Prescott's hypothesis.

I conclude with some thoughts on the potential role for fiscal policy. Some economists, notably Krugman (1999) and Eggertsson (2002), have advocated the use of fiscal policy as a means of 'stimulating' the economy when it finds itself in a 'liquidity trap' scenario. The model that I present below is consistent with this idea. In particular, by increasing the rate of expansion of nominal government debt, the fiscal authority can drive down the expected real rate of return on government securities (by increasing the expected inflation rate), thereby inducing asset substitution from government securities into capital investment. However, whether such a policy is likely to have a quantitatively important effect and whether such a policy would even be desirable in terms of economic welfare are still questions open to debate. At the end of the day, what Japan needs are policies that are designed to promote productivity growth. It is unlikely that monetary or fiscal policies are well-equipped to deal with this need.

2 The Model

The model is similar to the one developed in Champ and Freeman (1990). Time is discrete and the horizon is infinite; i.e., $t = 1, 2, ..., \infty$. In each period, N new individuals arrive and N old individuals leave the economy. Individuals remain in the economy for two periods only so that the total population at any given time is given by $2N$. This is just the standard 'overlapping generations' structure that was introduced by Samuelson (1958).

Individuals that arrive in period $t \geq 1$ have preferences defined over time-dated consumption, $c_t(i)$, where $i = 1, 2$ denotes 'current' and 'future' consumption, respectively. Preferences are represented by:

$$U_t = u(c_t(1)) + \beta c_t(2), \tag{1}$$

where $u(.)$ is strictly increasing, concave and where $\beta > 0$. In period $t = 1$, there are N individuals who arrived in period 0. These individuals are called the 'initial old' and (from the perspective of $t = 1$) care only for $c_0(2)$.

In their first period, individuals have an endowment of output $y > 0$. They also have access to a storage technology that takes k_t units of current output and returns $zf(k_t)$ units of future output, where f is increasing, strictly concave and where $z > 0$ indexes the expected productivity of capital investment. For simplicity, assume that capital depreciates completely after being used in production.

In addition to private capital, there are two other assets available, both of which are issued by the government. The first asset is a 'monetary' instrument, which here takes the form of a nonredeemable zero-interest paper note with no fixed maturity date. The second asset is a marketable, interest-bearing nominal bond, also with no fixed maturity date. These bonds earn (net) interest $R_t \geq 0$ payable at the end of each period in government money. Following Champ and Freeman (1990), I make the assumption that government debt is not fully indexed to surprise changes in the price-level.

Let p_t denote the price-level at date t and let q_t and b_t denote the real holdings of government money and bonds per young individual at date t. As well, let τ_t denote a lump-sum tax (measured in units of future output) that is levied on individuals when they are old. The period budget constraints facing a young person are given by:

$$\begin{aligned} c_t(1) &= y - q_t - b_t - k_t; \\ c_t(2) &= \frac{p_t}{p_{t+1}} q_t + (1 + R_t) \frac{p_t}{p_{t+1}} b_t + zf(k_t) - \tau_t. \end{aligned} \tag{2}$$

Notice that as long as the nominal interest rate is strictly positive ($R_t > 0$), money will be dominated in rate of return by bonds and will therefore not be valued. In reality, governments impose legal restrictions that render their paper valuable in spite of being dominated by other assets.[3] Here, we model this legal restriction by the following requirement:

$$q_t \geq \sigma, \tag{3}$$

where $\sigma > 0$ is a policy parameter. This constraint will bind whenever the nominal interest rate is strictly positive and becomes slack when the nominal interest rate equals zero.[4]

[3] For example, governments typically prohibit private banks from issuing small-denomination paper notes, thereby compelling individuals to acquire government money in order to finance at least a part of their desired transactions.

[4] Here, as elsewhere in the literature, I am assuming that the nominal interest rate is bounded

2.1 Individual Decision-Making

Letting λ_t denote the Lagrange multiplier associated with the constraint (3), the conditions characterizing a young person's desired asset-holdings are given by:

$$\begin{aligned} u'(y - q_t - b_t - k_t) &= \frac{p_t}{p_{t+1}}\beta + \lambda_t; \\ u'(y - q_t - b_t - k_t) &= (1 + R_t)\frac{p_t}{p_{t+1}}\beta; \\ u'(y - q_t - b_t - k_t) &= zf'(k_t)\beta. \end{aligned}$$

If $R_t > 0$, then $q_t = \sigma$ with b_t and k_t determined by:

$$\begin{aligned} u'(y - \sigma - b_t - k_t) &= (1 + R_t)\frac{p_t}{p_{t+1}}\beta; \\ zf'(k_t) &= (1 + R_t)\frac{p_t}{p_{t+1}}. \end{aligned} \tag{4}$$

If $R_t = 0$, then $q_t > \sigma$ is indeterminate at the individual level. That is, when the nominal interest rate is equal to zero, individuals view the two government assets as perfect substitutes so that only the sum $m_t = q_t + b_t$ is determined. The conditions characterizing optimal behavior in this case are given by:

$$\begin{aligned} u'(y - m_t - k_t) &= \frac{p_t}{p_{t+1}}\beta; \\ zf'(k_t) &= \frac{p_t}{p_{t+1}}. \end{aligned} \tag{5}$$

2.2 Government

Let M_t denote the stock of government money and let B_t denote the stock of interest-bearing government debt at date t. Define $D_t = M_t + B_t$ as the total nominal value of government debt outstanding at date t. I assume that the government finances an endogenous level of purchases $p_t N g_t$ entirely out of new debt; i.e.,[5]

$$p_t N g_t = D_t - D_{t-1}. \tag{6}$$

As of date t, the government has an outstanding stock of nominal debt equal to D_{t-1}, which is held entirely by the old. Assume that the carrying cost of this debt is financed entirely by a lump-sum tax on the old; i.e.,

$$R_{t-1} B_{t-1} = p_t N \tau_{t-1}. \tag{7}$$

below by zero. The implicit assumption here is that individuals are free to store cash from one period to the next (so it would not make sense to deposit cash in a bank that pays negative interest).

[5] Here, I am implicitly assuming that the stock of money does not shrink over time and that government purchases of goods and services do not affect the marginal utility of private consumption expenditures.

I also make the simplifying assumption that the coupon payment on bonds are indexed by the fiscal authority to surprise changes in the price-level. However, the principal value of the debt D_{t-1} is not indexed.

Assume that it is the government's policy to grow the total stock of nominal debt at a constant rate; i.e., $D_t = (1+\mu)D_{t-1}$. For a given D_t, we can think of the monetary authority as determining the division of total debt between its interest-bearing and noninterest-bearing form. Assume that the monetary authority chooses as a policy to maintain a constant money-to-debt ratio θ; i.e.,

$$\begin{aligned} M_t &= \theta D_t; \\ B_t &= (1-\theta) D_t. \end{aligned} \tag{8}$$

2.3 Equilibrium: Positive Interest Rate

The restrictions that characterize the equilibrium allocation and prices will depend on whether or not the legal constraint (3) binds or not. Here, I will consider each case in turn.

When $\lambda > 0$, the demand for real money balances is fixed at $q = \sigma$, and the money and bond market clearing conditions are given by:

$$\begin{aligned} M_t &= p_t N \sigma; \\ B_t &= p_t N b. \end{aligned} \tag{9}$$

The money market clearing condition implies that $p_t = M_t/(N\sigma)$, so that the expected (and equilibrium) inflation rate is equal to:

$$\frac{p_{t+1}}{p_t} = (1+\mu). \tag{10}$$

Combining equations (8) and (9), one can derive the expression:

$$b = \sigma \left(\frac{1-\theta}{\theta} \right).$$

This expression makes explicit how monetary policy on its own (θ) can influence the *real* supply of bonds in the economy. Combining this expression together with (10) and the system of equations in (4) yields a full characterization of the equilibrium capital stock and nominal interest rate:

$$\begin{aligned} u'(y - \theta^{-1}\sigma - k) &= z f'(k) \beta; \\ (1+R) &= (1+\mu) z f'(k). \end{aligned} \tag{11}$$

The remaining endogenous variables can be found easily by making the appropriate substitutions:

$$\begin{aligned} c(2) &= \frac{\sigma}{(1+\mu)\theta} + zf(k); \\ \tau &= \left[zf'(k) - (\frac{1}{1+\mu})\right]\left(\frac{1-\theta}{\theta}\right)\sigma; \\ g &= \left(\frac{\mu}{1+\mu}\right)\left(\frac{\sigma}{\theta}\right). \end{aligned} \tag{12}$$

An expression for the money multiplier can be derived as follows. Assume, for simplicity, that all private sector capital expenditure is intermediated by banks in this economy. Then the nominal value of the banking sector's loan portfolio is given by $p_t N k$ or, using the money market clearing condition (9), $M_t k/\sigma$. Consequently, the total supply of money in this economy is given by:

$$M2_t = \left(1 + \frac{k}{\sigma}\right) M_t, \tag{13}$$

where the bracketed term represents the money multiplier $M2/M$.

2.4 Equilibrium: Zero Interest Rate

When $\lambda = 0$, money and bonds are literally perfect substitutes (in the model) so that there are no separate market clearing restrictions for these two assets. Instead, the following must hold:

$$\begin{aligned} M_t + B_t &= p_t N(q+b); \\ &\Rightarrow D_t = p_t m. \end{aligned} \tag{14}$$

This expression also implies that the expected (and equilibrium) inflation rate is equal to the rate at which total nominal debt is expected to grow. Consequently, from (5), we have the following characterization of the equilibrium capital stock and real quantity of government securities:

$$\begin{aligned} u'(y-m-k) &= zf'(k)\beta; \\ zf'(k) &= (\frac{1}{1+\mu}). \end{aligned} \tag{15}$$

The remaining endogenous variables are given by:

$$\begin{aligned} c(2) &= \left(\frac{1}{1+\mu}\right) m + zf(k); \\ \tau &= 0; \\ g &= \left(\frac{\mu}{1+\mu}\right) m; \end{aligned}$$

with the money multiplier now given by:

$$\frac{M2_t}{M_t} = \left(1 + \frac{k}{\theta m}\right). \tag{16}$$

3 Monetary and Fiscal Shocks

In this section, I examine how the model economy reacts to unanticipated monetary and fiscal shocks. The monetary shock is an unanticipated 'loosening' of monetary policy in the sense of a permanent increase in the parameter θ, which corresponds to a permanent jump up in the stock of money (and a corresponding permanent jump down in the supply of bonds), brought about by an open-market purchase of bonds by the monetary authority.

The fiscal shock is an unanticipated 'loosening' of fiscal policy in the sense of a permanent jump up in the supply of government debt D_t (beyond the level expected according to the parameter μ). Since I am assuming that all changes in the level of debt are used to finance government purchases, this experiment also corresponds to a *transitory* change in g_t. The qualitative results that I report below would continue to hold if I assumed a constant g together with a transitory tax/transfer on the initial old. In both of these experiments, the fiscal authority is expected to continue growing the total quantity of nominal debt at the constant rate $(1 + \mu)$ and each shock is interpreted by the model agents as a one-time event. The economic effects of theses policies depend very much on whether the nominal interest is initially positive or equal to zero. Again, I will consider each case in turn.

In what follows, I will let the 'starred' variables denote the new values for variables following the implementation of a policy change at some arbitrary date t. I will also refer those agents who are old at the time of the shock as the 'initial old' (in order to distinguish them from future generations of old individuals).

3.1 A Positive Nominal Interest Rate

When the nominal interest rate is positive, the first equation in (4) characterizes the equilibrium level of investment. A simple comparative static exercise tells us that a surprise open-market purchase of bonds by the monetary authority results in an expansion in real capital spending:

$$\frac{dk}{d\theta} = \frac{\sigma\theta^{-2}u''(c(1))}{u''(c(1)) + zf''(k)\beta} > 0.$$

Since $M_t^* > M_t$, we see from the money market clearing condition (9) that the policy shock leads to a jump in the price-level; i.e., $p_t^* > p_t$. Since the stock of money is permanently higher, so are all future price-levels, thus leaving the expected rate of inflation unchanged; i.e., $p_{t+1}/p_t = p^*_{t+1}/p^*_t = (1+\mu)$. Nevertheless, the nominal interest falls (permanently), since the higher capital stock causes the real rate of interest to decline; i.e., $(1+R^*) = (1+\mu)zf'(k^*)$. An alternative way to interpret this shock is to think of the central bank as cutting the interest rate (via an open market operation). The lower interest rate then stimulates capital spending and subsequently leads to a higher level of future output.

Let me delve a little deeper into the economic mechanism at work here. Remember that at the beginning of date t, the old are in possession of $D_{t-1} = M_{t-1} + B_{t-1}$ yen worth of government securities. The interest-bearing component of this portfolio entitles the old to a coupon payment equal to $R_{t-1}B_{t-1}$ yen. From the government's budget constraint (7), we see that:

$$\tau^*_{t-1} = \frac{R_{t-1}B_{t-1}}{Np^*_t},$$

so that $\tau^*_{t-1} < \tau$. In other words, because the coupon payment on bonds is indexed, the real tax burden of the old at date t falls accordingly. Consequently, the old have an after-tax amount of nominal securities worth D_{t-1} (which is invariant to the open market operation, since this policy simply alters the composition of their portfolio and not its yen value). Because this component of the government debt is not indexed, the surprise increase in the price-level reduces the purchasing power of these securities. The 'initial' old therefore end up consuming:

$$\begin{aligned} c^*_{t-1}(2) &= \frac{D_{t-1}}{Np^*_t} + zf(k_{t-1}) + \left[\frac{R_{t-1}B_{t-1}}{Np^*_t} - \tau^*_{t-1}\right]; \\ &= \frac{p_{t-1}}{p^*_t}\left(\frac{\sigma}{\theta^*}\right) + zf(k_{t-1}), \end{aligned} \tag{17}$$

where $c^*_{t-1}(2) < c(2)$.

Finally, since D_t remains unchanged, the amount of new debt issued by the fiscal authority also remains unchanged at μD_{t-1}. From the government's budget constraint (6), we see that the increase in the price-level reduces the purchasing power of this new debt, so that real government spending must fall:

$$g^*_t = \frac{\mu D_{t-1}}{Np^*_t} < g.$$

So we see that the surprise increase in the price-level reduces the purchasing power of the initial old and the government. But since real output within the period of the shock is fixed at $N[y + zf(k_{t-1})]$, this must imply that the young are the net beneficiaries of the policy shock (the initial young are able to purchase the existing stock of government securities for less output). This positive wealth effect manifests itself as an increase in life-time consumption spending for the initial young (with future consumption rising in part owing to the higher level of capital expenditure during the period). After one period of adjustment, the economy reverts to its new steady state characterized by the system of equations in (11) and (12); i.e., note that this shock has a *permanent* affect on all real variables.

Let me now consider the effects of a surprise increase in D_t. Notice that D_t appears nowhere in the system (4); this shock leaves real capital spending unchanged. However, from the money market clearing condition $p_t^* = \theta D_t^*/(N\sigma)$, we see that there is a surprise increase in the price-level; i.e., $p_t^* > p_t$. This surprise increase in the price-level reduces the purchasing power of the government securities brought into the period by the initial old; their consumption falls in a manner similar to equation (17). In effect, the government is using the extra debt $(D_t^* - D_t)$ to purchase additional output from the initial old.[6] Since the composition of this extra debt between money and bonds remains constant, the young are unaffected by this fiscal policy (they simply acquire a greater nominal quantity of debt at a proportionately higher price-level). Unlike the previous shock, we see from equations (11) and (12) that in the long-run, this fiscal policy shock is neutral.

3.2 A Zero Nominal Interest Rate

When the nominal interest rate is equal to zero, the equilibrium is characterized by the system in (15). Notice that the monetary policy parameter θ appears nowhere in this system. In other words, when the nominal interest rate is zero, the BoJ is (at least, in this model) unable to influence anything real by way of debt swaps (like an open market operation). As long as the nominal interest rate remains zero, the central bank finds itself in what looks very much to be a 'liquidity trap.' Furthermore, from (14), we see that monetary policy cannot even affect the price-level. The reason for this latter result is that the increase in money supply is met yen for yen by an increase in the demand for money. In other words, the liquidity trap does not arise (as some have suggested) because of a sticky price-level; the price-level appears to be endogenously 'sticky' under such circumstances.

As in the case with a positive interest rate, the effect of a fiscal shock has no effect on capital spending and temporarily reduces private sector consumption spending as resources are diverted toward government purchases. However, unlike monetary policy, it appears that fiscal policy has the power to influence the price-level (since $p_t = D_t/m$).

[6] Note that if the purchasing power from this extra debt issue was instead distributed to the initial young agents, then this policy would result in a transitory boom in capital spending.

4 Technology Shocks

Let us consider the effect of a decrease in the productivity of capital investment, beginning with the case in which the nominal interest rate is positive. From (11), we see that:

$$\frac{dk}{dz} = \frac{-f'(k)\beta}{u''(c(1)) + zf''(k)\beta} > 0.$$

In other words, the effect of a downward revision in the forecast of productivity leads to lower capital spending. The reduced level of capital spending here occurs even though firms are not credit constrained. The logical possibility of this circumstance makes it difficult to disentangle what role bank finance plays in contributing to sluggish investment spending during a cyclical downturn. From (13) we see that the effect of an adverse productivity shock is to cause a decline in the money multiplier as banks respond (optimally) to the dearth in attractive investment opportunities by contracting the size of their loan portfolios.

Since the equilibrium price-level in this case is given by $p_t = M_t/(N\sigma)$, there is no price-level effect associated with such a disturbance. This result is somewhat sensitive to the way in which I have modelled the legal restriction in (3); in general, one might expect that such a shock would also influence the demand for real money balances and hence the price-level. A straightforward extension of the model here along the lines of Champ and Freeman (2001, Chp. 9) would suggest that the price-level would *fall* in response to such a shock. In that model, a decline in the interest rate makes holding government fiat more attractive (relative to interest-bearing private money instruments), thereby increasing the demand for real money balances q and hence increasing the value of fiat money.

Since the nominal interest rate is given by $R = (1+\mu)zf'(k) - 1$, it follows that:

$$\frac{dR}{dz} = (1+\mu)f'(k)\left[1 - \frac{zf''(k)\beta}{u''(c(1)) + zf''(k)\beta}\right] > 0.$$

In other words, the adverse productivity shock releases market forces that put downward pressure on the interest rate. For a given monetary policy parameter θ, the central bank must respond to such a shock by cutting the interest rate. Note, however, that it would be a mistake to interpret such interest rate cuts as a 'loosening' of monetary policy, since the central bank is simply accommodating market pressures. In fact note that if the central bank did not drop the interest rate in response to this shock, it would in fact be 'tightening' monetary policy (since it would have to lower θ in order to maintain the interest rate peg).

The model developed here suggests that a sequence of 'bad' productivity shocks could drive the interest rate down to its lower bound of zero (at least, to the extent that the central bank is inclined to accommodate the downward pressure on market interest rates). If the economy reached this point, what would be the effect of another downward revision in the productivity of capital investment? From (15), we can derive the long-term implications of this shock on capital spending:

$$\frac{dk}{dz} = \frac{-f'(k)}{zf''(k)} = -\frac{dm}{dz} > 0. \tag{18}$$

In other words, a further decline in productivity leads to a further contraction in capital spending (and bank lending) and an increase in the real demand for government securities (both money and bonds–which at this stage, are viewed as perfect substitutes). According to (16), both of these forces serve to put downward pressure on the money multiplier. According to (14), the effect of this shock is disinflationary in nature (i.e., the price-level falls permanently below its original time-path every time the economy is afflicted in this manner). In other words, poor prospects in the private sector lead individuals to 'dump' their stocks and 'flee' to government money (and money substitutes). This increase in the demand for money is what leads to deflation. Finally, to the extent that the productivity shock is unanticipated, there will be surprise changes in the price-level that (in the short-run), lead to wealth transfers between the government sector and the old at date t.

5 An Interpretation of Recent Events in Japan

There is the question of how to properly represent the Hayashi–Prescott 'productivity slowdown' within the context of the simple model developed above. I think that the essence of such a shock might be reasonably captured by considering a sequence of negative shocks to the return on capital investment as indexed by the parameter z.[7]

In my interpretation of economic events, I am going to take as given (leave unexplained) the time path of business sector forecasts concerning the productivity of capital investment in Japan. The late 1980s were characterized by increasing optimism (upward revisions in the forecast of z), while the 1990s were characterized by increasing pessimism (downward revisions in the forecast of z). The indirect evidence for this sequence of expectations is apparent in the behavior of the Nikkei index over the 1990s.[8] I am also going to take as given the time path of the monetary policy parameter θ, which declined systematically throughout the 1990s (see Figure 3). In the model, these changes are interpreted as purely unanticipated *tightenings* in BoJ monetary policy. From Figure 2, we see that the 1990s were also characterized by rapidly rising levels of government debt starting some time around 1993. In the analysis below, I am going to interpret this rising debt as a sequence of unanticipated

[7]The time-series for Japanese TFP can be downloaded at: http://ideas.repec.org/p/red/append/hayashi02.html.

[8]While not the focus of the analysis here, Zeira (1999) demonstrates how a sudden switch in the 'growth regime' can lead to a stock market crash.

changes in D_t; i.e., I am going to assume that the long-run growth rate in debt μ has remained constant throughout this period. The assumption here is that individuals in Japan believe that the high levels of government debt are ultimately going to be discharged via higher taxes instead of monetization.[9] Finally, I am going to take 1996 as the year in which the nominal interest rate fell to zero; I will call the years prior to this event the 'early 1990s' and years following this event the 'late 1990s.'

5.1 The Early 1990s

Japan began the 1990s with real GDP growth at close to 6% per annum, consumer price inflation at around 3%, and nominal interest rates on short-term government securities at around 7%. From this initial condition, imagine that the economy is suddenly hit by a sequence of adverse productivity shocks. Our model predicts that these shocks should lead to reduced levels of desired capital expenditure. The reduction in investment demand should put downward pressure on interest rates (for a given monetary policy parameter θ), as well as a reduction in M2 and the money multiplier as banks (optimally) contract their loan portfolios. As an empirical matter, note that the money multiplier in Japan has been falling dramatically (see Figure 1). According to Hayashi and Prescott, the contraction in bank lending is simply a symptom and not the cause of some deeper economic disturbance.

At this time, the BoJ responded to the contraction in economic activity by cutting its official discount rate from over 5% in 1991 to less than 2% in late 1993, apparently in an attempt to stimulate economic activity.[10] Of course, our model is consistent with the idea of a central bank stimulating economic activity through an interest rate cut, but only to the extent that the cut in interest rates is brought about by increasing θ. According to Figure 3, it appears that the BoJ was in fact decreasing θ (i.e., *tightening* monetary policy) throughout the 1990s.[11] In other words, while the BoJ was cutting interest rates, it was not cutting them as much as a purely accommodative policy would have dictated. Thus, according to the model, this policy response on the part of the BoJ is what led to the downward pressure on prices over this period. This downward pressure on prices should have been offset somewhat by the surprise increases in D_t, but note that the stock of debt did not really start to take off until near the end of this episode.

[9] I will leave it up to the reader to judge the plausibility of this assumption. It may be worthwhile to note, however, that fully half of the government debt in Japan is indexed (Eggertson, 2002).

[10] A detailed account of economic events over this period can be found in Okina, Shirakawa and Shiratsuka (2001).

[11] Evidence of monetary policy tightening can also be seen in the sharp drop in the growth rate of base money in the early 1990s; see Figure 1.

5.2 The Late 1990s

By 1996, the short-term nominal interest rate in Japan was very close to zero, where it remained for the rest of the decade. According to the model developed above, Japan is (and remains) in a 'liquidity trap.' When monetary policy is restricted to implement policy by way of open market operations (as opposed to, say, simply injecting cash transfers into the economy), then the theory (as summarized by equations (15) shows why an expansionary monetary policy can have no effect. The additional quantity of cash injected into the economy (in exchange for zero interest bonds) is simply absorbed by the private sector (and treated as zero-interest government bonds).

From Figure 1, we see a significantly higher rate of base money growth in the latter part of the decade. In light of the BoJ's continued tightening of monetary policy (in the sense of a declining θ), it appears evident that this expansion in the money stock might be better interpreted as primarily a fiscal phenomenon (i.e., surprise increases in D_t). This interpretation receives further support from Figure 2, which shows a sharp increase in the debt GDP ratio in the late 1990's. According to our theory, these surprise increases in the total stock of nominal debt should be contributing to upward pressure of the price-level.[12] On the other hand, from equations (18) and (14), we see that our theory also predicts continued downward pressure on prices being exerted by persistent downward revisions in the expected return to capital investment. Which of these two forces dominates is an empirical matter, but in light of Japan's very low rate of inflation, our theory would seem to suggest that the two forces are largely cancelling each other out.

One can also observe from Figure 1 that the rapid expansion in stock of base money has been met with an equally rapid contraction in bank lending; i.e., while the growth in broad money (M2+CD) has remained low and stable, the money multiplier has been declining steadily throughout the decade. It appears as if agents (in particular private banks) are simply 'hoarding' government cash instead of using the cash to finance new capital projects. Some observers have argued that this behavior is evidence of a malfunctioning banking sector. In particular, it has been argued that the current poor state of the banking sector prohibits it from using the available cash to finance risky but worthwhile (positive NPV) capital projects.[13] Of course, the alternative hypothesis proposed here is that the decline in bank lending simply reflects a dearth of positive NPV capital projects and that banks are prudently holding on to their cash (after all, a zero interest rate is a much better return than a negative interest rate). Motonishi and Yoshikawa (1999) report evidence which suggests that this latter interpretation is entirely plausible. While there is some evidence of a 'credit crunch' influencing the investment activity of smaller firms since 1997, even

[12] Remember that I am assuming that long-run growth rate of the total debt (μ) has remained unchanged.

[13] See, for example, Mori, Shiratsuka, and Taguchi (2001, pg. 84).

these firms report that the most important elements in determining their investment decisions pertain to 'real' factors such as poor profit opportunities.

Finally, a short remark on events since the 1990s. In April of 2001, the BoJ implemented a policy of 'quantitative easing,' which in the context of our model can be thought of as a rapid increase in θ (see Figure 3). From Figure 1, we see that this policy has resulting in base money growth rates approaching 50% per annum. According to the theory developed above, such a policy is destined to have absolutely no effect on anything real or even on the price level. The only effect such a policy is predicted to have is a large decline in the money multiplier; see equation (16). In light of Japan's ongoing deflationary experience since 2001 and the continued declines in the money multiplier, the theory appears to be holding up well against the evidence.

6 Inflation Targets and Fiscal Policy

According to some economists, notably Krugman (1999) and Eggertsson (2002), one problem with Japan is that the real rate of interest on government securities is 'too high' so that resources that might be used to finance private capital expenditure are instead diverted into government securities (including money). In order to drive down the real return on money, the government needs to convince people that their money holdings are going to depreciate in value. The best way to do this is to implement an expenditure program that is financed with new money (or, to take the existing expenditure program and finance it with nonindexed nominal government debt instead of taxes).[14] In other words, the Ministry of Finance (with cooperation from the BoJ) must implement a policy that leads individuals in the economy to expect inflation.[15]

Our model tells us that when the interest rate is positive, the BoJ has on its own a capacity for generating a sustained inflation. From the money market clearing condition (9), we see that the price-level is given by:

$$p_t = \frac{\theta_t D_t}{N\sigma},$$

so that any given inflation target $\Pi = p_{t+1}/p_t$ can be achieved by choosing an appropriate sequence for θ_t; i.e.,

$$\theta_{t+1} = (1+\mu)^{-1}\Pi\theta_t.$$

[14]Again, I refer to Eggertson (2002), who reports that a large fraction of government debt in Japan is in fact indexed to the price-level.

[15]In contrast, Goodfriend (2001) provides arguments for why fiscal policy is likely to be ineffective at best and counterproductive at worst.

However, when the nominal interest rate is equal to zero, the equation that determines the price-level is given by:

$$p_t = \frac{D_t}{Nm},$$

which implies that the BoJ has no capacity for influencing inflation (and hence, expectations of inflation). In this case, inflation expectations are determined solely by the rate at which the total nominal debt is *expected* to grow. Since the *actual* rate of nominal debt growth μ is under the control of the fiscal authority, it appears that the MoF should in principle be able to influence expectations of inflation even in a liquidity trap scenario.[16]

When the nominal interest rate is equal to zero, the model's equilibrium is characterized by the system of equations (15). According to theory, if the MoF announces a higher μ and if individuals view the policy change credibly, then actual and expected inflation will rise accordingly.[17] As the higher expected inflation reduces the real return on government securities, individuals divert their savings to capital investment, which results in a permanent expansion in the level of real GDP (this is essentially a Tobin effect). Consequently, the analysis here supports Krugman's (1999) claim that fiscal policy can be used to stimulate the economy even in circumstances that leave the monetary authority powerless. However, it should also be pointed out that stimulating the economy in this manner is not necessarily the 'correct' policy. In the context of this model, the policy that maximizes the welfare of the representative young generation would have the government's debt remain constant over time.

From Figure 2, it appears that the government of Japan has been rapidly increasing its debt since about 1993. In light of this fact and the theory developed above, one cannot help but be surprised that inflationary pressures are still nowhere to be seen. There are at least two possible explanations for this apparent puzzle. The first is that Japan's expansionary fiscal policy has indeed exerted inflationary pressure, but that this has been offset by the deflationary pressure generated by the continued bearish outlook for productivity growth. Second, it is possible that expectations of inflation remain suppressed because individuals believe that the fiscal authority plans to pay off its accumulated debt by way of taxes instead of new money.

[16] Of course, private sector expectations may be slow to catch up to any given change in MoF policy; see Andolfatto and Gomme (2003) for a discussion related to this issue.

[17] It follows that according to our model, individuals have not viewed the high rates of government debt creation as permanent; i.e., they expect this debt to fall (taxes to rise) at some point in the future. To the extent that this is not true, our model must be viewed as being inconsistent with the evidence.

7 Conclusions

The analysis above provides some further support for the Hayashi–Prescott hypothesis that Japan's woes since the bursting of the asset 'bubble' in the early 1990s are rooted in the increasingly bearish prospects for domestic productivity growth brought on for reasons that are still not very well understood. It was shown above how a sequence of adverse 'productivity shocks' should theoretically lead to behavior that is broadly consistent with what actually happened in Japan. In particular, declining capital expenditure, declining interest rates, declining broad money aggregates and 'deflationary pressure' are outcomes that are consistent with an exogenous productivity slowdown. Monetary policy can theoretically mitigate these pressures, but not eliminate them. In the event that market pressures lead interest rates to fall to zero, monetary policy then becomes powerless to affect anything real or nominal. At this stage, an appropriately designed fiscal policy can potentially generate an inflation and lead to an expansion in capital expenditure via a Tobin effect. However, whether such a policy would have a quantitatively important effect or whether it would be desirable to pursue in the first place are issues that remain open to question. There is a legitimate fear that such a policy may simply transform Japan from a low growth–low inflation economy to a low growth–high inflation economy.

While the Hayashi–Prescott hypothesis downplays the role of Japan's distressed banking sector as an explanation for the cause of Japan's decade-long slump, it does not suggest that policymakers should therefore ignore that sector of the economy. By many accounts, the banking sector (and financial sector in general) is in dire need of regulatory reform. Undoubtedly, the weak balance sheet position of many banks has played some role in inhibiting productivity growth.[18] But then, the same can likely be said of many firms in the nonbank sector. Financial distress is not a phenomenon specific to banks during periods of economic recession. To the extent that regulatory reforms might facilitate the process of corporate restructuring, they should likely be targeted at the entire business community and not just the banking sector.

In any case, as far as the BoJ is concerned, the analysis above suggests that the ultimate source of the productivity slowdown is not likely relevant in terms of current policy choices. Since the BoJ is largely restricted to implement its monetary policy by way of debt swaps in government securities, altering the ratio of zero–interest government securities (government money and debt) is unlikely to have any real or nominal repercussions at all; Japan appears to be in 'liquidity trap.' From this, it follows that the recent policy of 'quantitative easing' unlikely to have its desired effect. In the current environment, the BoJ should simply focus on the important role it plays in ensuring that the payments system functions as smoothly as possible.

If Hayashi and Prescott are correct in their hypothesis, then the role of fiscal policy

[18] Smith (2002) describes some environments in which intermediation plays a crucial role in an economy's growth prospects.

also appears to be quite limited. The problem with Japan is in its lagging productivity growth. While the fiscal authority may have to power to generate an inflation, the link between higher inflation and higher productivity growth seems tenuous at best.[19] Simple monetary or fiscal policy measures are not likely to fix whatever is prohibiting the Japanese economy from performing close to its potential.[20] Productivity growth is ultimately determined by an economy's capacity to absorb technological innovation. While a malfunctioning financial sector can potentially inhibit the process of economic development, the available evidence suggests that Japan's distressed banking sector is unlikely to be at the root of a decade-long period of economic stagnation. The theory developed above provides some support for this assertion. Alternative hypotheses are needed to explain Japan's productivity slowdown.

[19] Although, Bullard and Keating (1995) provide some evidence suggesting that, at least for low initial rates of inflation, modest increases in the rate of inflation are associated with higher real rates of growth.

[20] Shirakawa (2000) makes this point rather forcefully.

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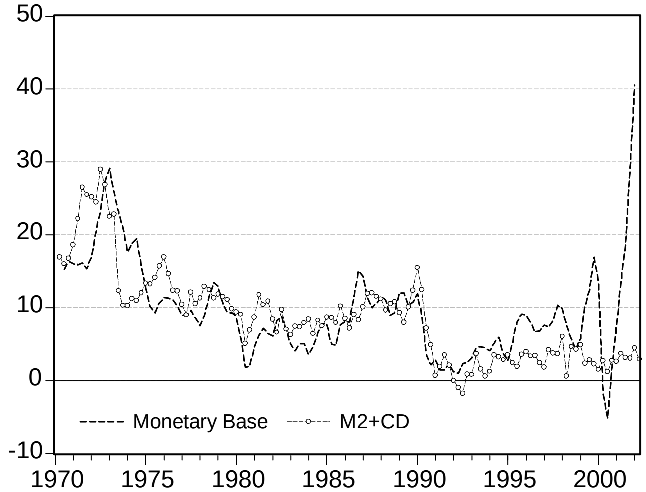
FIGURE 1
Money Growth and the Money Multiplier
in Japan



Money Multiplier
(M2+CD Divided by Monetary Base)

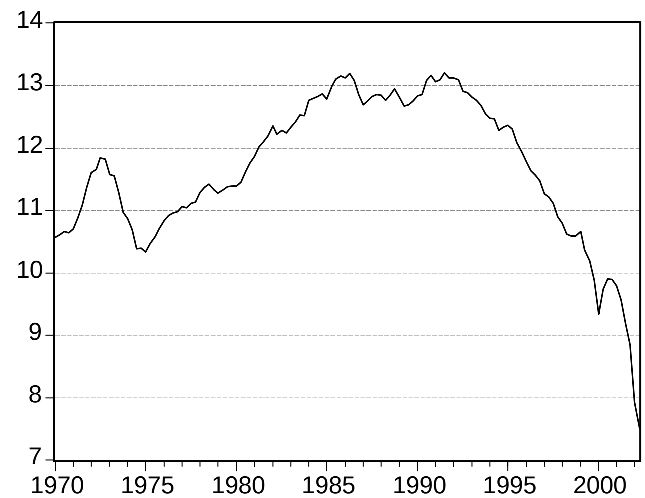
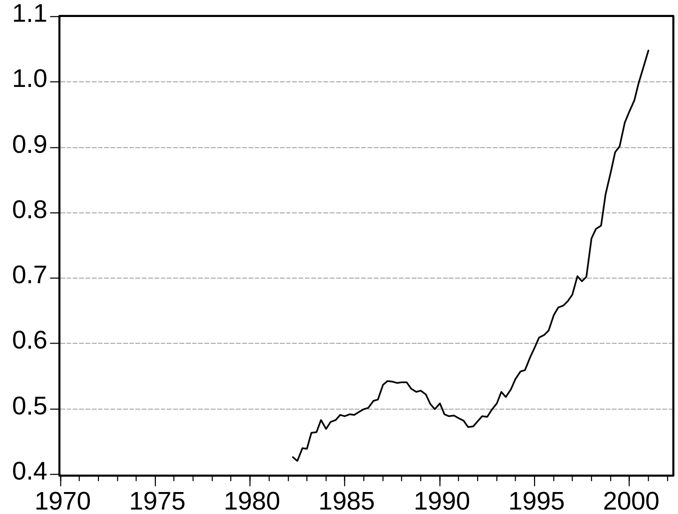


FIGURE 2

Debt-GDP Ratio



Growth in Japanese Government Debt
(Percent per Annum)

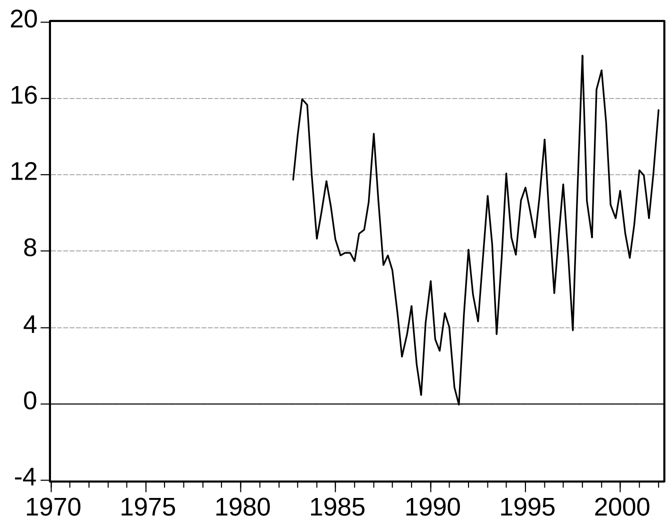


FIGURE 3
Ratio of Monetary Base to Total Government Debt
in Japan