



University of Nevada, Reno
Statewide • Worldwide

**UNR Economics Working Paper Series
Working Paper No. 06-010**

**A Reassessment of the Problems with Interest Targeting: What Have
We Learned from Japanese Monetary Policy?**

Thomas F. Cargill and Federico Guerrero

**Department of Economics /0030
University of Nevada, Reno
Reno, NV 89557-0207
(775) 784-6850 | Fax (775) 784-4728
email: tcargill@att.net; guerrero@unr.edu**

December, 2006

Abstract

Interest rate targeting is widely used by central banks to pursue price stability; however, the variation in inflation policy outcomes between central banks such as the Federal Reserve and the Bank of Japan despite a common policy instrument framework suggests interest-targeting has limitations. Despite the variation in policy outcomes, the role of targeting was enhanced with the advent of Taylor rules in the 1990s and interest rate targeting dominates central bank attitudes to the exclusion of any other policy instrument framework. The recent Japanese experience confronts us with the need to reassess the relative merits of interest targeting. This paper frames the discussion of the various problems of the interest-targeting framework within a model that encompasses a number of important previous results and stresses that interest rate targeting may leave the price level indeterminate in various plausible circumstances. In a low, or even zero interest rate environment, such as the one that characterized Japan, Taylor-type rules may offer no solution to the indeterminacy problem. The paper then discusses various aspects of the BoJ's decision to adhere to interest rate targeting despite its limitations.

JEL Classification: E52, E58, E31

Keywords: Interest-targeting, Monetary Policy, Deflation, Japan.

A Reassessment of the Problems with Interest Targeting: What Have We Learned from Japanese Monetary Policy?

Thomas F. Cargill and Federico Guerrero

Professor and Assistant Professor, respectively
Department of Economics / 030
College of Business Administration
University of Nevada
Reno, NV 89557. U.S.A.
tcargill@att.net
guerrero@unr.edu

June 6, 2006

Abstract: Interest rate targeting is widely used by central banks to pursue price stability; however, the variation in inflation policy outcomes between central banks such as the Federal Reserve and the Bank of Japan despite a common policy instrument framework suggests interest-targeting has limitations. Despite the variation in policy outcomes, the role of targeting was enhanced with the advent of Taylor rules in the 1990s and interest rate targeting dominates central bank attitudes to the exclusion of any other policy instrument framework. The recent Japanese experience confronts us with the need to reassess the relative merits of interest targeting. This paper frames the discussion of the various problems of the interest-targeting framework within a model that encompasses a number of important previous results and stresses that interest rate targeting may leave the price level indeterminate in various plausible circumstances. In a low, or even zero interest rate environment, such as the one that characterized Japan, Taylor-type rules may offer no solution to the indeterminacy problem. The paper then discusses various aspects of the BoJ's decision to adhere to interest rate targeting despite its limitations.

JEL classification: E52, E58, E31.

Keywords: Interest-targeting, Monetary Policy, Deflation, Japan.

1.0 Introduction

The long-run relationship between monetary growth and inflation is well established; however, the policy-instrument-final policy target framework utilized by central banks focuses on interest-rate targeting rather than the money-supply expenditure channel. Unstable money demand and supply functions, increased complexity and variety of financial portfolios as a result of innovation, the difficulty of obtaining timely and accurate measures of the money supply, and the difficulty of defining the money supply in the context of financial innovation have all been identified by central bankers to support focus on the interest rate expenditure channel of monetary policy. Recognizing the difficulty of linking short term interest rates to inflation, central banks have embraced Taylor-type rules that link the target for the interest rate to the output gap and differences between actual and target inflation.

This paper develops an encompassing analytical model to assess interest rate targeting that incorporates into one coherent analytical framework of optimizing, forward-looking agents the important monetary lessons offered by Fisher, Tinbergen, Sargent-Wallace, Taylor and others. The model is developed against the background provided by relevant monetary policy-making experiences from Japan and the U.S.

The limitations of the interest rate targeting framework are addressed from two perspectives. First, we focus the analysis in the context of positive price changes and non-zero interest rate bounds to show that interest rate targeting even constrained by Taylor-type rules may leave the price level (or the inflation rate) indeterminate. The lesson is not new (it was introduced in modern economics by Sargent and Wallace, 1975), but is worth recalling, given the experience of the Federal Reserve in the 1970s.

Second, the framework is extended to incorporate zero interest rate bound conditions. This is the environment of BoJ policy since the late 1990s to 2006. The framework presents the problem of indeterminacy from a different perspective: the potential for a deflationary trap to arise in a low interest rate environment (e.g., Eggertsson and Woodford, 2003). In so doing, the framework provides an explanation for the failure of the BoJ to stabilize the price level from 1995 to 2006.

Despite well-known pros and cons regarding interest rate targeting, the encompassing analytical framework presented here suggests that interest rate targeting may likely not lead to sustained price stability, suggesting that the debate between policy instruments should be reopened. While monetary aggregates possess well-known problems, they may pale in comparison to the problems brought about by interest rate targeting. The experience of the Bundesbank and, to a lesser degree, of the European Central Bank as well, suggests that there could be a role for money growth as an intermediate target in some cases. Each situation should be considered on its own merits; however, the downsides of the interest-targeting framework should not be minimized.

The remainder of the paper is composed of six sections. Section 2 presents a brief review of Federal Reserve and Bank of Japan policy outcomes since the early 1970s to show that while both central banks pursued an interest rate targeting framework, the policy outcomes were dramatically different. The indeterminacy of the price level or inflation rate in an interest rate target framework provides at least part of the explanation for different policy outcomes despite using much the same framework. In Section 3, we offer an encompassing monetary model to illustrate why interest rate targeting may be a dubious platform to achieve price stability. The results are invariant to how money is

introduced into the model. In Section 4 the results are shown to hold even in the context of Taylor-type rules; that is, interest rate targeting still may leave the price level indeterminate, in the presence of deflationary expectations. Section 5 extends the model to incorporate a zero bound on the interest rate in an effort to provide insight into Japanese monetary policy during the past decade and suggests that to the extent “policy error” explains Bank of Japan (BoJ) outcomes the errors are rooted in interest rate targeting and reminiscent of the policy errors made by the Federal Reserve (FR) in the 1930s (Cargill, 2001). Section 6 specifically discusses BoJ misconceptions that likely focused the BoJ on targeting the interest rate. A short concluding section ends the paper.

2.0: Federal Reserve and BoJ Policy Outcomes under Interest Rate Targeting

Interest rate targeting is no guarantee central banks can achieve price stability judged by a review of the monetary policy outcomes over the last several decades in Japan and the U.S. Cargill and Hutchison (1990) reviewed the policy outcomes of the FR and the BoJ and found that while both central banks used much the same interest rate targeting framework through the late 1980s, they generated significant policy outcome differences. Dotsey (1986) clearly showed that operating procedures of the FR and BoJ were similar and that differing macroeconomic policy outcomes had to be traced to other factors.

In the late 1960s and 1970s the FR permitted significant inflation while for much of the postwar period through the late 1980s the BoJ maintained price stability. This difference in policy outcomes was even more significant since the FR was regarded as one of the world’s more formally independent central banks while the BoJ was regarded

as one of the world's most formally dependent central banks. The relative policy outcomes of the FR and BoJ contradict the conventional wisdom that formally independent central banks generate better price stability outcomes. The two outcomes also suggest that interest-rate targeting is not sufficient to generate price stability because in the case of the FR it did not generate price stability while in the case of the BoJ it did generate price stability, up to the late 1980s.

The relative performance of the FR and the BoJ in the 1990s is likewise remarkable and further suggests interest rate targeting is not sufficient for price stability. The operating procedures of the two central banks changed little in the 1990s and yet, in that decade, it was the FR that achieved a better price stability record than the BoJ. Price stability in the late 1980s and 1990s in the U.S. has been a major macroeconomic feature of the U.S. economy while disinflation in the early 1990s and actual deflation after 1994 through 2006 have been major macroeconomic features of the Japanese economy.

The problem with interest rate targeting that offers an explanation for the different policy outcomes of the FR and the BoJ is rooted in the ambiguity between the interest rate and price stability. These issues have been discussed in many places and are not novel; however, this paper provides a reassessment of the main problems within a theoretical framework that highlights the limitations of interest rate targeting in general, and in particular shows that interest rate targeting becomes less reliable the closer the nominal interest rate approaches zero. The lower-bound problem is especially important in the context of Japan since the BoJ has targeted the call rate at zero since February 1998 with the exception of a brief period in late 2000. The implications of the lower bound are important for other central banks as well since the last two decades have witnessed a

significant reduction in the rate of inflation in most industrialized economies thus rendering a lower interest rate environment more common than previously.

3.0: The Peril of Interest Targeting in the Absence of a Low Interest Rate

Environment

There are two standard, policy-oriented approaches to introducing money into a macroeconomic framework: the MIU, or money-in-the-utility-function approach, and the CIA, or cash-in-advance model. Interest rate targeting in either approach renders the price level or the rate of change of the price level (depending on the assumption on price-level flexibility) indeterminate in the presence of forward-looking agents; that is, interest targeting leaves the central bank without a nominal anchor. In what follows, the MIU approach is utilized to develop the framework; however, given Feenstra's equivalence proposition (Feenstra, 1986), the same results hold in the case of the CIA approach. The results under the CIA model are shown in the Appendix.

3.1: Interest Targeting and Price Level Indeterminacy under Flexible Prices

Consider a closed economy where the households sector is composed by Sidrauski-type families who maximize a discounted sum of instantaneous utilities that depend on consumption and real money balances. The representative household is endowed with perfect foresight. As of $t = 0$ (the 'present' time), the functional describing the well-being of the representative household is given by:

$$(1) \quad \int_0^{\infty} [u(c_t) + v(m_t)] e^{-\rho t} dt$$

Where c stands for consumption per capita, $m \equiv \frac{M}{P}$ represents real money holdings per capita (or the ratio of the stock of money to the price level, since the size of population is assumed to be equal to one), $u(\cdot)$ and $v(\cdot)$ are the instantaneous utility functions, and the parameter ρ is the rate of time preference, or the subjective discount rate, which is initially assumed to be strictly positive.

In order to ensure interior solutions and the existence of steady states, the following auxiliary assumptions are imposed:

$$\begin{aligned} u'(c), v'(m) &> 0 \quad \forall c, m > 0 \\ u''(c) &< 0 \quad \forall c > 0 \\ \lim_{c \rightarrow 0} u'(c) &= \infty; \quad \lim_{m \rightarrow 0} v'(m) = \infty; \quad \lim_{m \rightarrow \infty} v'(m) \leq 0 \end{aligned}$$

The maximization is made subject to the following constraints:

$$\begin{aligned} (2) \quad \frac{da}{dt} &= y_t + r_t a_t + g_t - (c_t + i_t m_t) \\ (3) \quad \lim_{t \rightarrow \infty} \lambda_t a_t e^{-\rho t} &= 0 \\ (4) \quad a_t &= m_t + b_t \\ (5) \quad m_t, c_t, b_t &> 0 \quad \forall t \quad \text{and } a_0 \text{ is given} \end{aligned}$$

Equation (2) is the evolution equation and acts as an intra-period budget constraint. In equation (2), y_t stands for the economy's aggregate output (exogenously given since there is no production sector), b_t stands for the per capita stock of one-period-maturity government bonds (paying a real rate of interest of r_t every period t), π_t is the instantaneous rate of change in the price level (so that the term $\pi_t m_t$ represents the inflation tax/subsidy on real cash balances) and g_t denotes lump-sum government

transfers/taxes per capita (assumed to be exogenously given to the representative agent at every time t). Last, but not least, i_t stands for the nominal interest rate. In the present context of perfect foresight, Fisher's parity condition (FP) holds, so that: (FP) : $i_t = r_t + \pi_t$, or in the case where output is constant ($y_t = y \forall t$):

$$(FP) \quad i_t = \rho + \pi_t.$$

Equation (3) is the transversality condition that guarantees the fulfillment of the lifetime budget constraint of the representative agent to ensure that the real value of the individual's assets does not explode as time passes. It is also sometimes referred to as the non-Ponzi game or non-bubbles condition. In equation (3), λ represents the shadow value of the representative agent's lifetime wealth.

Equation (4) is the definition of the representative agent's wealth, and equation (5) describes the initial condition for the stock of government bonds per person and the relevant non-negativity constraints.

The linearity of the evolution equation permits a straightforward base to integrate it forward (using the transversality condition to rule out the term involving asset bubbles).

Then, the following Lagrangean can be set up:

$$(6) \quad L = \int_0^{\infty} [u(c_t) + v(m_t)] e^{-\rho t} dt + \lambda \left[a_0 + \int_0^{\infty} (y_t - c_t - i_t m_t) e^{-\int_0^t r(s) ds} dt \right]$$

The following first order conditions are implied:

$$(7) \quad u'(c_t) = \lambda e^{\int_0^t [\rho - r(s)] ds}$$

$$(8) \quad v'(m_t) = \lambda e^{\int_0^t [\rho - r(s)] ds} i_t$$

Inserting equation (7) in equation (8):

$$(9) \quad v'(m_t) = u'(c_t) i_t$$

In steady state, first order condition (9) simplifies to:

$$(10) \quad v'(m) = u'(c) i$$

Equation (10) is a money demand function in implicit form for any given c . An increase in the nominal rate of interest increases the right hand side of (10) so that to maintain the equality, the left hand side would increase; that is, the marginal utility of money would increase. Assuming the utility function v is strictly increasingly concave, the increase in i would lead to a reduction in money demand or increase in the marginal utility of money.

Equation (10) can now be used to show that interest rate targeting is no guarantee that central banks can achieve price stability. Rearranging terms in equation (10), inserting the definition of real money balances, making use of the fact that in equilibrium $c_t = y_t \forall t$ (a macroeconomic condition that has to hold true in the present closed economy where there is no government spending), and assuming that output is constant (i.e., $y_t = y \forall t$), generates the following:

$$(11) \quad i = \frac{v'(\frac{M}{P})}{u'(y)}$$

Setting the denominator to unity and imposing interest targeting, $i = \bar{i}$, yields:

$$(12) \quad \bar{i} = v'(\frac{M}{P})$$

Equation (12) indicates that for any given interest rate target there are infinite pair of values of M and P that satisfy equation (12). In other words, given that the money supply adjusts to satisfy the interest rate target, the price level is left indeterminate.

We are now in a position to state the following proposition.

Proposition 1: Along any perfect foresight path, interest targeting leads to a fundamental price level indeterminacy, if prices are flexible (not predetermined). This result is obtained for the MIU method of introducing money into the model but, as illustrated in the Appendix, the result is also obtained using the CIA approach.

This proposition is merely an illustration of the “Tinbergen principle” (Tinbergen, 1952) that states that full commitment to a single point value for an individual target variable leaves all other target variables fundamentally indeterminate in the presence of a single instrument variable. The possibility of price level indeterminacy in rational expectation models was first presented by Sargent and Wallace (1975) in the context of an ad-hoc, non- optimizing model of flexible prices and is rephrased here in more modern terms.

3.2: Interest Targeting and Rate of Price Change Indeterminacy Assuming

Predetermined Prices

Taking the time derivative of the first order conditions for consumption in equation (7) and setting $i_t = \bar{i} \forall t$, generates the following well-known Euler equation:

$$(13) \quad \dot{c} = -\frac{u'(c_t)c_t}{u''(c_t)}[\bar{i} - \rho - \pi]$$

In the standard case when utility from consumption has a constant marginal elasticity of

intertemporal substitution: $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$; $\sigma \equiv -\frac{u''(c)}{u'(c)c} > 0$ (where $\sigma > 0$ guarantees the

concavity of the utility function), the Euler equation for consumption is as follows:

$$(14) \quad \dot{c} = \frac{1}{\sigma} [\bar{i} - \rho - \pi]$$

To introduce predetermined prices we employ Calvo's (1983) inflation variability equation based on a standard model of staggered prices --or the so-called "New-Keynesian Phillips curve". The following expression for the rate of change of prices is obtained, which can easily be proven to be consistent with the standard utility maximizing behavior postulated in the above derivation (see Calvo, 1983):

$$(15) \quad \dot{\pi} = -\psi [y - y^{FULL}]; \psi > 0$$

where y^{FULL} is full employment output.

Equations (14) and (15) form a system of differential equations. Taking the partial derivatives of the system with respect to c and π , it is straightforward to calculate that the determinant of the system as $|D| = -\frac{\psi}{\sigma} < 0$, which is a sufficient condition for the system to display saddle-path stability.

The economic relevance of the result rests on the fact that under saddle path stability, if the system converges to the steady state it does so regardless of the initial values of c and π . In other words, the *rate of change* of the price level is fundamentally indeterminate. Moreover, if the predetermined price level is initially set at a level inconsistent with full employment, the system converges to its long-run equilibrium starting from a situation of excess capacity. This is consistent with fully optimizing

forward looking firms that set prices to try to maximize their expected profits as explained in Calvo (1983), and is now well-known in academic circles.

Thus in the case when prices are predetermined, interest targeting implies that the *rate of change* of the price level undetermined. This suggests the following:

Proposition 2: When prices are predetermined, interest targeting implies leaving the *rate of change* of the price level indeterminate. This result is obtained for the MIU method of introducing money into the model but as illustrated in the appendix the result is also obtained using the CIA approach.

4.0: Generalizing the Price Level Indeterminacy Result in the Context of Taylor

Rules

The price level indeterminacy in the context of interest rate targeting when prices are flexible may also occur in the less stringent case when the central bank accommodates the money supply to ensure the interest rate stays within a certain range, aided by a Taylor-like rule (Taylor, 1993).

Consider the following feedback rule:

$$(16) \quad \mu \equiv \frac{dM}{dt} \equiv \frac{\dot{M}}{M} = \eta(i_t - i^*); \eta > 0$$

Where i denotes the targeted interest rate and i^* denotes the equilibrium interest rate in the interbank market.

The target rate i is determined by the central bank according to a Taylor-type rule:

$$(17) \quad i = \pi + r^* + \mathcal{G}(\pi - \pi^*) + \Phi \tilde{y} ; \mathcal{G}, \Phi \geq 0$$

Where r^* is the real, long-term equilibrium interest rate, π^* is the target inflation rate, and \tilde{y} is the output gap. Taking logs and time derivatives to the definition of real money balances we obtain the following:

$$(18) \quad \frac{\dot{m}}{m} = \mu - \pi$$

Inserting (16) into (18) and solving for i_t generates:

$$(19) \quad i_t = \left(\frac{\dot{m}}{m} + \pi \right) \frac{1}{\eta} + i^*$$

Making use of Fisher's parity condition and solving for π generates:

$$(20) \quad \pi = \frac{1}{1-\eta} [(\rho - i^*)\eta - \frac{\dot{m}}{m}]$$

This equation combined with the first order condition (10) for the MIU model shows that price level indeterminacy arises for a wide range of parameter values.

To illustrate this point insert (20) into (10), set $u'(y) = I$, and obtain:

$$(21) \quad \frac{\dot{m}}{m} = -(1-\eta)v'(m_t) + K$$

Where $K \equiv -\rho + 2\eta\rho - \eta\bar{i}$ is a constant term. Local uniqueness (LU) of the perfect foresight path involving positive real money balances requires that the slope of the locus representing the differential equation given by (21) be positively sloped at the steady state point with positive real money balances. Formally:

$$(LU): \quad \frac{d\dot{m}}{dm} = K - (1-\eta)v'(m) - (1-\eta)v''(m) > 0 \text{ when } K = (1-\eta)v'(m) \text{ (the}$$

situation when $\dot{m} = 0$ and $m > 0$). In a steady state where $m > 0$, the first term in the

right hand side of (LU) vanishes. Hence, if $v(m)$ is (strictly) concave (so that $v''(m) < 0$), (LU) implies that there will be a unique perfect foresight path if and only if: $\eta < 1$. In other words, for $\eta \geq 1$ there will be price level indeterminacy once again.

We are now in a position to state a third proposition.

Proposition 3: Perfect foresight equilibrium paths involving price level indeterminacy may arise in the case of flexible prices, even if the central bank is not targeting the interest rate at every point in time when the central bank tries to keep the interest rate within a target range. If the feedback rule is highly accommodative the price level will be indeterminate. This result is obtained for the MIU method of introducing money into the model but, as illustrated in the Appendix, the result is also obtained using the CIA approach.

It remains to be shown what parameter restrictions the previous result imposes on the parameter values involved in a typical Taylor rule like the one given by equation (17) above. Collecting terms involving the actual rate of inflation on the right hand side of (17), and adding and subtracting the target rate of inflation to the right hand side of (17) yields:

$$(22) \quad i = (1 + \mathcal{G})(\pi - \pi^*) + r^* + \pi^* + \Phi \tilde{y}$$

Setting $(1 + \mathcal{G}) = \frac{1}{\eta}$, and solving for η yields: $\eta = \frac{1}{1 + \mathcal{G}}$. Therefore, for $\eta < 1$ to hold, \mathcal{G}

must be strictly positive, and hence, the inflation coefficient $(1 + \mathcal{G})$ must be greater than unity. This result is usually called the ‘Taylor principle’ in the specialized literature (Kuttner and Posner, 2004, for instance): in order for price stability to be preserved, the inflation coefficient in the Taylor rule has to be greater than unity. This result is not just

an intellectual curiosity. Judd and Rudebusch (1998) estimate the inflation coefficient for different Federal Reserve chairmen and present an illustrative example of price level indeterminacy in the US experience under Chairman Arthur Burns.

5.0: Interest Targeting in a Low Interest Rate Environment: The Influence of the Zero Bound

The indeterminacy of the price level or rate of inflation creates new practical problems when short term interest rates approach zero as has been the case in Japan for almost a decade. We show this in three steps. First, the relationship between a ZIRP (zero interest rate policy) and conditions for a deflationary trap; second, the conditions that generate a decline in the real rate of interest are provided, and third, the implications of a ZIRP on a monetary policy strategy that determines the target value for the interest rate based on a Taylor-like rule are discussed.

5.1: The ZIRP and the Deflationary Trap

The conditions for a deflationary trap can be illustrated by assuming $y_t = y \forall t$ and considering Fisher's parity condition (FP):

$$(FP) \quad i = r^* + \pi$$

Where r^* denotes the long-run, equilibrium (natural) real rate of interest and π is the rate of change in the price level. Assume that: (a) $\pi < 0$, so that there is deflation, and, given perfect foresight, also expected deflation, and: (b) that the natural real rate of interest falls to very low levels, such that the zero bound becomes a binding constraint. In that case, deflationary expectations will be validated and the economy will stay in a

deflationary trap: monetary policy is committed to the achievement of the zero nominal interest rate, and the fact that the zero bound constraint is binding only reinforces deflationary expectations. This result has been discussed elsewhere; for example, see Krugman (1998) and Eggertsson and Woodford (2003). The issue, however, is to explain how the real interest rate could fall to very low levels in the first place.

5.2: Accounting for the Decline in the Real Interest Rate

Differentiating equation (7) with respect to time yields:

$$(23) \quad u''(c_t) \frac{dc}{dt} = (\rho - r_t) \lambda e^{\int_0^t [\rho - r(s)] ds} = (\rho - r_t) u'(c_t)$$

Where the last equality in (23) makes use of equation (7).

Defining $\frac{dc}{dt} \equiv \dot{c}$, $\rho \equiv r^*$, and invoking the macroeconomic equilibrium condition

$c_t = y_t \forall t$, we can analyze the conditions under which the real interest rate slips below its long-run, natural level by solving the Euler equation above (equation 23) for $(r_t - r^*)$

to get:

$$(24) \quad (r_t - r^*) = -\frac{u''(y_t)}{u'(y_t)} \dot{y}$$

Therefore, given the strict increasing concavity of $u(\cdot)$, the real interest rate slips below its long-run level when the economy experiences a recession (i.e., when $\dot{y} < 0$).

This, of course, is Irving Fisher's classical theory of the real interest rate: during recessions the real interest rate falls below its long-run level, so targeting a zero nominal

interest rate during those times is particularly risky, and even more so in the face of deflationary expectations, as discussed in the previous section.

5.3: Taylor Rules May Not Determine the Price Level in the Presence of Deflation and the Zero Bound

To show the inefficacy of a Taylor-rule approach to interest targeting in a deflationary environment where the zero bound is binding, it is useful to return to equation (17), $i = \pi + r^* + \mathcal{G}(\pi - \pi^*) + \Phi\tilde{y}$; $\mathcal{G}, \Phi \geq 0$. Assume the equilibrium real interest rate r^* has declined to zero, the output gap is negative ($\tilde{y} < 0$), and that the economy is experiencing deflation ($\pi < 0$). In addition, assume that the target inflation rate equals zero ($\pi^* = 0$), as seemed to have been the case in Japan under Hayami's tenure (see Ito, 2004, and the discussion below). These assumptions combined with equation (17) reveal that the target value for the short-term interest rate should be negative. This problem has indeed been recognized by Taylor himself, who argued that money supply rules were preferable to interest rate rules in a deflationary environment (Taylor 1997). Yamaguchi (2002, p. 76) states that the BoJ was indeed following operational procedures that were fully consistent with a Taylor-like rule.

This result suggests that BoJ policy, especially under former Governor Hayami lacked a logical foundation. Hayami (2000, p. 4) provides a textbook example of targeting the interest at zero in the context of deflation, and its embedded, if mistaken, belief that this produces an accommodative stance for monetary policy:

“It is a mistake to think that the Bank is concerned only with inflationary risks. This can be understood from the conduct of monetary policy in the recent period. In February 1999, the Bank embarked on *drastic monetary easing, namely the zero interest rate*

policy. And in April, it made clear its firm intent to maintain this policy until deflationary concerns are dispelled”. (Italics added)

At the same time, BoJ staff economists were fully aware of the problems they were confronting and of the range of policy options available (See Baba et al., 2005, or Iwamoto, 2005, for example). Be it as it may, the policy framework of the BoJ seemed to have left the price level with no positively relevant lower bound, thus providing a feedback algorithm to pre-existing deflationary expectations.

6.0: Why Did the BoJ Pursue Interest Rate Targeting in a Zero Interest Rate Environment?

If the perils of interest targeting in the presence of a falling price level and a binding zero bound on the short-term nominal interest rate are transparent as the above model suggests, why did the BoJ use the interest targeting framework starting February 1998 to target the call rate at zero in an already low interest rate environment, declining prices, and deflationary expectations? Moreover, why did the BoJ reject advice offered by non-BoJ observers at different points in time to adopt some sort of inflation or price level targeting as reflected in the papers presented at the July 2000 monetary conference sponsored by the BoJ (Bank of Japan, 2001)? Three policy errors can be identified that wedded the BoJ to targeting interest rates.

Monetary Policy and Short Term Nominal Interest Rates: Friedman and Schwartz (1963) showed for the U.S. during the 1930s that in the presence of deflation and low interest rates or a binding zero bound the stance of monetary policy cannot be judged on the short term nominal interest rate. The above analysis formalized the

problem, but the basic issue is straightforward. If prices are falling at a 4 percent annual rate then a zero nominal rate puts the real cost of borrowing at a positive 4 percent. The prospect of a 4 percent real interest rate might be justified if the economy is growing but it is too high in an environment where the prospects for growth are either weak or non-existent as in Japan in the 1990s. Therefore, the stance of monetary policy can be contractionary, even if the nominal interest rate is low, or even zero, as in the case of the ZIRP in Japan, a point that seemed to be missed by Japanese monetary authorities, as the previous quotation from former Governor Hayami showed.

This point provides perspective on Yamaguchi's observation (2002: 76) that the BoJ followed a path fully consistent with a policy rule, such as a Taylor rule, but was unable to effectively combat the deflationary and contractionary pressures affecting the economy. There should have been no confusion. Interest rate targeting in a low or zero bound interest rate environment simply will not generate price stability.

Inflation Targeting is Inflation: Once the zero bound on nominal interest rates becomes binding inflation targeting offers a path to ending the deflationary cycle without generating an all-out inflation (Krugman, 1998 and Eggertson and Woodford, 2003). This is also implied in the above analysis. The BoJ, however, has resisted inflation targeting and while there are legitimate concerns about inflation targeting, some of the BoJ's views are difficult to understand. Hayami, for example, refers to inflation targeting as "inflation policy" or "reflation policy" and further argues that inflation targeting was inflation policy "in disguise" and that "inflation is no cure for Japan's current problems" (see the discussion in Ito, 2004).

Implicit in Hayami's statements is the idea that the optimal rate of inflation is zero. Hayami is certainly not the only central banker to have adopted this view (see Hoskins, 1991 for a defense of zero inflation as the optimal monetary policy, and Aiyagari, 1990, 1991, for forceful rebuttals), but Hayami ignored a vast body of literature developed in the 1990s and more fundamentally for a central banker, ignored the crucial developments in the practice of central banking that followed New Zealand's successful adoption of an inflation targeting framework in 1990. A small, positive, inflation rate is considered to be optimal in practice by most central bankers on two main grounds: first, as a buffer against deflation and second, to account for the well-known upward bias of the CPI, the most prevalent indicator of inflation used to target inflation.

As noted by Ito (2004), Hayami's view of zero inflation as the optimal rate of inflation is likely a reflection of the literature of the 1980s. Indeed, the experiences that Hayami cited in his speech correspond to the "inflationary 1970s". According to Ito (2004, p. 23): "it was unfortunate that in the early stages of deflation in Japan, the argument for inflation targeting was dismissed on the grounds of a quite dated evidence".

Interest Rate Targeting Consistent with BoJ Perceived Balance Sheet

Constraints: Conventional open market operations lose their effectiveness as the yield of the asset purchased approaches zero and the asset such as a short term government bond is a perfect substitute for currency. In this case no significant increase in liquidity can be achieved by means of an open market purchase. As argued by Meltzer (1999) however, the validity of the standard text-book-type liquidity trap depends crucially on the existence of a very narrow set of assets and all that is needed to avoid a liquidity trap is for the central bank to purchase assets that are not perfect substitutes of money that have

a positive yield such as long-term government bonds, or even foreign exchange (Meltzer, 2000). Bernanke (2002 and 2003) discusses some of these unconventional monetary policy strategies.¹

In this case however, the central bank is guaranteed to make a capital loss on its portfolio of long-term government bonds as the economy expands and interest rates increase. Nevertheless, as stressed by both Meltzer (2000) and Ito (2004), accepting that the government (or any of its agents) must absorb many of the financial system's losses is a key step in ending the deflation-stagnation cycle. Cargill (2005) further emphasizes that government should not consider the central bank as a "sink or swim" institution irrespective of even a high level of formal independence from the government.

Coordination between the BoJ and MoF is required to ensure that some artificial measure of central bank capital does not become a constraint on price stability.

The BoJ's focus on interest rate targeting and rejection of aggressive large scale purchases of long-term government debt is partly accounted for by the BoJ's concern over capital adequacy.

7.0 Concluding Comments

Japan's recent experience with interest targeting in the form of the Zero Interest Rate Policy and its failure to eliminate deflation suggests the need to reassess the merits and drawbacks of interest targeting, both as an instrument policy and as a final policy-target framework.

¹ It should be noted that the Federal Reserve managed longer-term yields at various times during the 1950s (operation twist), so the strategy is not entirely unfamiliar in the 20th century history of central banks.

This paper framed the discussion of the problems with interest-targeting within a model that encompasses previous important results against the background of monetary policy-making experiences in Japan and the U.S. The theoretical problems are serious and the different policy outcomes over the past two decades of the BoJ and the FR, both using much the same operating framework, have generated differing policy outcomes. While the interest targeting approach is widely accepted by central bankers the results of this paper and the experiences of the FR and the BoJ, especially the BoJ in the 1990s, suggest the discussion should be reopened. While monetary aggregates possess well-known problems as intermediate targets, they may pale in comparison to the problems brought about by interest rate targeting. The experience of the Bundesbank and, to a lesser degree, of the European Central Bank suggests an expanded role for money growth as an intermediate target in some cases. In a renewed discussion, the downside of interest targeting should not be minimized in light of recent experience.

References

- Aiyagari, S. R., 1990. Deflating the case for Zero Inflation. *Federal Reserve Bank of Minneapolis Quarterly Review*, Vol. 14, No. 3, Summer 1990, pp. 2-11.
- Aiyagari, S. R., 1991. Response to a Defense of Zero Inflation. *Federal Reserve Bank of Minneapolis Quarterly Review*, Vol. 15, No. 2, Spring 1991, pp. 21-24.
- Baba, N., Nishioka, S., Oda, N., Shirakawa, M., Ueda, K. & Ugai, H., 2005. Japan's Deflation, Problems in the Financial System, and Monetary Policy. *Monetary and Economic Studies*. Bank of Japan. February.
- Bernanke, B., 2002. Making sure 'It' doesn't happen here. Speech before the National Economists Club. Washington D.C., November 21.
- Bernanke, B., 2003. Some Thoughts on Monetary Policy in Japan. Speech Before the Japan society of monetary Economics, Tokyo, Japan, May 31.
- Calvo, G., 1983. Staggered contracts in a utility-maximizing framework. *Journal of Monetary Economics* 12(3): 383-98.
- Cargill, T. F., 2001, Monetary Policy, Deflation, and Economic History: Lessons for the Bank of Japan, *Monetary and Economic Studies*, Bank of Japan, Vol. 19 February, 113–34.
- Cargill, T. F., 2005. Is the Bank of Japan's Financial Structure an Obstacle to Policy? *IMF Staff Papers*, Vol. 52, Number 2, 311-324.
- Cargill, Thomas F. and Michael M. Hutchison, 1990. Monetary policy and political economy: the Federal Reserve and the Bank of Japan, in Thomas Mayer (editor), *The Political Economy of American Monetary Policy*, Cambridge University Press.

- Cargill, T. F., Hutchinson, M. M., and Ito, T., 2000. Financial Policy and Central Banking in Japan”, Cambridge: MIT Press.
- Dotsey, Michael, 1986. Japanese Monetary Policy: A Comparative Analysis, *Monetary and Economic Studies*, Bank of Japan, Vol. 4.
- Eggertsson, G. and Woodford, M., 2003. The Zero Bound on Interest Rates and Optimal Monetary Policy. *Brookings Papers on Economic Activity* 1: 139-211.
- Feenstra, R. C, 1986. Functional Equivalence Between Liquidity Costs and the Utility of Money, *Journal of Monetary Economics*, March, 271-291.
- Friedman, M. and Schwartz, A., 1963. A Monetary history of the US 1867-1960. National Bureau of Economic Research. Princeton University Press.
- Hayami, M., 2000. Price Stability and Monetary Policy. Speech delivered to the Research Institute of Japan in Tokyo, March 21. Available at:
<http://www.boj.or.jp/en/press/00/ko0003b.htm>
- Hoskins, W. L., 1991. Defending Zero Inflation: All for Naught. *Reserve Bank of Minneapolis Quarterly Review*, Vol. 15, No. 2, Spring 1991, 16-20.
- Ito, T., 2004. Inflation Targeting and Japan: Why has the Bank of Japan not adopted Inflation Targeting? National Bureau of Economic Research Working Paper #10818. Cambridge, MA. September.
- Iwamoto, Y., 2005. Monetary and Fiscal Policy to Escape from a Deflationary Trap. *Monetary and Economic Studies* (February). Bank of Japan.
- Judd, J. P., and G. D. Rudebusch, 1998. Taylor’s Rule and the Fed: 1970-1997. FRBSF Economic Review 3: 3-16.

- Krugman, P., 1998. It's baaack: Japan's slump and the return of the liquidity trap. *Brookings Papers on Economic Activity* 2: 137-187.
- Kuttner, K. N., and Posen, A. S., 2004. The difficulty of discerning what's too tight: Taylor rules and Japanese monetary policy. *The North American Journal of Economics and Finance* 15: 53-74.
- Meltzer, A., 1999. Liquidity claptrap. *International Economy* 13 (6): 18-23.
- Meltzer, A., 2000. Monetary Policy in the New Global Economy: The Case of Japan. *Cato Journal*, Vol. 20, No. 1 (Spring/Summer 2000).
- Oda, N. and Okina, K., 2001. Further Monetary Easing Policies Under the Non-Negativity Constraints of Nominal Interest Rates: A Summary of the Discussion Based on Japan's Experience. In *Monetary and Economic Studies*, special edition, Tokyo, Bank of Japan Institute for Monetary and Economic Studies, February, pp. 323-59.
- Sargent, T. and Wallace, N., 1975. Rational Expectations, the optimal monetary instrument and the optimal money supply rule. *Journal of Political Economy* 83 (April): 241-54.
- Taylor, J. B., 1993. Discretion versus policy rules in practice. *Carnegie-Rochester Conferences Series on Public Policy* 39: 195-214.
- Taylor, J. B., 1997. Policy rules as a means for monetary policy. In I. Kuroda (Ed.), *Towards more effective monetary policy*. New York: St. Martin's Press.
- Tinbergen, J., 1952. *On the Theory of Economic Policy*. North Holland, Amsterdam.
- Yamaguchi, Y., 2002. Monetary Policy in a Changing Economic Environment. *Federal Reserve Bank of Kansas City Economic Review*: 69-78, Fourth Quarter.

Appendix

The following shows that the results of the paper can be developed in the context of the CIA model. The presentation follows that of the paper.

3.1A: The Peril of Interest Targeting in the Absence of a Low Interest Rate

Environment: The case of an interest-inelastic money demand, the CIA model:

Consider an economy where money enters the system to finance the purchase of consumption goods. Formally:

$$(1A) \quad m_t = \alpha c_t ; \alpha > 0$$

So that the evolution equation (equation (2) above) is now:

$$(2A) \quad \frac{da}{dt} + r_t a_t + y + g_t = (1 + \alpha i_t) c_t$$

Where the right hand side of equation (2A) is “full consumption” (i.e., inclusive of the consumption of money that is needed to buy goods).

To solve the maximization problem we can set up the following Lagrangean:

$$(3A) \quad L = \int_0^{\infty} u(c_t) e^{-\rho t} dt + \lambda [a_0 + \int_0^{\infty} [(\rho a_t + y + g_t) - (1 + \alpha i_t) c_t] e^{-\rho t} dt]$$

Where for convenience we assumed that $y_t = y \quad \forall t$ (and consequently $r_t = \rho \quad \forall t$).

The first order condition with respect to consumption gives:

$$(4A) \quad u'(c_t) = \lambda (1 + \alpha i_t) \quad \forall t$$

Making use of equation (1A), the definition of real money balances, and pegging the nominal interest rate yields:

$$(5A) \quad u' \left(\frac{M}{P} \frac{1}{\alpha} \right) = \lambda (1 + \alpha \bar{i})$$

Since the right hand side of equation (5A) is constant, so is the left hand side and we obtain that perfect foresight equilibria require a unique, constant, value for real money balances. There are infinite combinations of the stock of money and the price level that will satisfy this requirement and, given that the stock of money is being used to guarantee a certain value for the nominal interest rate, the price level is left indeterminate.

3.2A: Interest Targeting and Rate of Price Change Indeterminacy Assuming Predetermined Prices: Taking the time derivative of the first order conditions for consumption in 4A and setting $i_t = \bar{i} \forall t$, produces the following well-known Euler equation:

$$(6A) \quad \dot{c} = -\frac{u'(c_t)c_t}{u''(c_t)}[\bar{i} - \rho - \pi]$$

In the standard case when utility from consumption has a constant marginal elasticity of intertemporal substitution: $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$; $\sigma \equiv -\frac{u''(c)}{u'(c)c} > 0$ (where $\sigma > 0$ guarantees the concavity of the utility function), the Euler equation for consumption is simply:

$$(7A) \quad \dot{c} = \frac{1}{\sigma}[\bar{i} - \rho - \pi]$$

We now append Calvo's well known inflation variability equation stemming from the most popular model of staggered prices (Calvo 1983), also known as the "New-Keynesian Phillips curve", to get (See Calvo, 1983 for a proof that the equation is consistent with the standard utility maximizing behavior postulated above):

$$(8A) \quad \dot{\pi} = -\psi[y - y^{FULL}]; \psi > 0$$

Where y^{FULL} is full employment output.

Equations (7A) and (8A) form a system of differential equations. Taking the partial derivatives of the system with respect to c and π , it is easy to calculate that the determinant of the system is given by $|D| = -\frac{\psi}{\sigma} < 0$, which is a sufficient condition for the system to display saddle-path stability. The economic relevance of the result rests on the fact that under saddle path stability, if the system converges to the steady state it does so regardless of the initial values of c and π . In other words, the rate of change of the price level is fundamentally indeterminate. Moreover, it is perfectly possible (and plausible) that the system converges to its long-run equilibrium starting from a situation of excess capacity. All that is needed is that the predetermined price level be set initially at a level that is not consistent with full employment, a possibility that is perfectly consistent with fully optimizing forward looking firms that set prices to try to maximize their expected profits (again, see Calvo, 1983 for the details).

4.0A: Generalizing the Price Level Indeterminacy Result in the Context of

Taylor Rules: Substituting equation (20) into first order condition (5A), gives:

$$(9A) \quad \frac{\dot{m}}{m} = \frac{1-\eta}{\lambda\alpha} \lambda \left[1 + \alpha\rho + \alpha \frac{1-\eta}{\eta} (\rho - i^*) \right] - \frac{1-\eta}{\lambda\alpha} u' \left(\frac{m}{\alpha} \right)$$

Again, local uniqueness of perfect foresight paths involving positive real money balances require that the locus representing differential equation (9A) be positively sloped at the steady state involving positive real money balances. In this case, the requirement is that:

$$(LU) \quad \frac{d \dot{m}}{dm} = \frac{1-\eta}{\lambda\alpha} \lambda \left[1 + \alpha\rho + \alpha \frac{\eta}{1-\eta} (\rho - i^*) \right] - \frac{1-\eta}{\lambda\alpha} u' \left(\frac{m}{\alpha} \right) - \frac{(1-\eta)}{\lambda\alpha} u'' \left(\frac{m}{\alpha} \right) \frac{1}{\alpha} > 0$$

The term in square brackets on the right hand side of the expression above vanishes for a steady state with positive real money balances. Hence, given the assumed

strict concavity of $u(c)$ ($u''(c) < 0$), (LU) will be satisfied if and only if $\eta < 1$. Put differently, there is a wide range of parameters for which there will be price level indeterminacy (i.e., when $\eta \geq 1$).