IS THE BANK OF JAPAN A CLOSET MONETARIST?
MONETARY TARGETING IN JAPAN, 1978-1988

Takatoshi Ito

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ABSTRACT

This paper investigates whether the Bank of Japan has practiced a
monetarist rule since 1975. The Bank of Japan (BOJ) published a report in
1975, stating that it would pay close attention to money supply (M2), and in
1978 started announcing quarterly the "forecast" (targets) of monetary (M2)
growth rate. Since 1975, the monetary growth rate has gradually declined,
and inflation has subsided without causing a major fluctuation in output.
This seems to be a successful case of the monetarist experiment. Has the BOJ
practiced a monetarist rule, i.e., an announcement and maintenance of the M2
growth target?

This paper reveals that it has not. The BOJ "forecasts" were quite
accommodative in that an unexpected increase in actual money supply would
make "forecasts" to allow a further increase in money supply. In other
words, a "forecast" did not behave like a "target" under a strict monetarist
rule. Testing a monetarist rule with "forecasts" is shown to be more
powerful than testing with the actual process, under some weak assumptions.
One of the necessary assumptions is that "forecasts" are rational
expectations, and the rational expectations hypothesis is not rejected by the
data. Thus, the conclusion of this paper is negative to a question posed by
its title.

Takatoshi Ito
Institute of Economic Research
Hitotsubashi University
Kunitachi, Tokyo 186,
JAPAN

"Japan illustrates a policy that is less monetarist in rhetoric than the policies followed by the United States and Great Britain but far more monetarist in practice." (Milton Friedman (1985, p.27))

"[T]he Bank of Japan is now at its zenith as far as the autonomy of monetary policy is concerned. ... Japan's monetary management after the second oil crisis can be regarded as one of the most successful such experiences in any industrialized country. (Hamada and Hayashi (1985; p.83))

1. Introduction

While the rise and fall of monetarism prompted many debates and research papers in the United States, the Bank of Japan conducted a sound, but not loud, monetary policy. An important part of its policy is its emphasis on the money supply (M2+CD) as an "intermediate target." The Bank of Japan announced that money supply would be watched closely in 1975, and then the Bank of Japan started to announce a quarterly "forecast" [mitoshi] of money supply (M2) in the third quarter of 1978. Although it is called a "forecast," it could be regarded as a "target," if the Japanese central bank prefers to be modest and diplomatic in naming it. As the monetary growth rate declined gradually, the inflation rate came down slowly. Real income growth rate remained steady through the turbulent period of the second oil crisis. For this kind of performance, the Bank of Japan was hailed by monetarists. However, there is a sign of change recently. In response to a rising yen value, the money supply was allowed to soar in 1987. Although a surge in money supply would stir a concern among monetarists, no sign of inflation exists in Japan at the end of 1988.

In order to understand the Japanese monetary policy after 1975, it is crucial to determine how rigidly the money supply targeting was implemented, and to analyze how much "forecasts" of the Bank of Japan reflected its "targeting." However, aspects of the targeting by the Bank of

Japan has escaped a close scrutiny. In this paper, I will examine various questions concerning the money supply targeting by analyzing the Bank of Japan "forecasts." Were "forecasts" by the Bank of Japan disguised "targets"? Was the target steady? Did the Bank of Japan conduct the policy to keep the money supply within the specified range? If monetarism prevailed in Japan from 1975 to 1986, was it abandoned in 1987 when the actual money supply soared? These questions will be investigated in the following sections. In order to focus on money supply targeting, other interesting aspects regarding the Japanese monetary policy will not be discussed in the paper.\1

A main focus and contribution of this paper is an anlysis of the "forecasts" announced by the Bank of Japan. One might think that it is more important to examine whether an "actual" process, as opposed to "forecasts" process followed a monetarist rule. An attempt of a monetarist rule is one thing and an actual implementation is another. However, there are two reasons to prefer "forecasts" in the test of a monetarist rule. First, a "forecast," a target of money supply, contains less noises than an outcome. Actual money supply may deviate from a target due to unexpected demand (credit multiplier) shocks. Hence, econometric investigation using "forecasts" would have a better fit and serve a more powerful hypothesis testing (see Section 3). Second, monetarists always argue that it is important not only to practice but also announce it beforehand a stable monetary policy. Therefore, if a monetarist rule is intended and attempted, it should appear in the "forecasts." The "forecasts" by the Bank of Japan, which, contain a grain of "targets," provide us with a rare opportunity to test, in a pure form, a monetarist rule.

Section 2 briefly reviews the monetarism debate in the United States and a history on intermediate targets of Japanese monetary policy. Section 3 explains in detail the econometric issues involved in this paper. Section 4, a core of this paper, analyzes the statistical properties of and some hypotheses regarding "forecasts" by the Bank of Japan. Section 5 contrasts the processes of actual and target money supply and then test the rationality of "forecasts." This section backs up the preceding section in order to respond to a potential criticism. Section 6 summarizes the findings of the paper.

2. Overview: U.S. vs Japan

2.A. United States: the Rise and Fall of Monetarism, 1979-1982

The U.S. had conducted monetary policies in more or less a Keynesian manner, with the interest rate targeting, throughout the 1960s and 1970s. After the sharp increase in the inflation rate in late 1970s, the Federal Reserve announced on October 6, 1979, a "new operating procedures" which sounded like an implementation of monetarism. Chairman, Paul Volker, announced a major change in monetary policy "to support the objective of containing growth in the monetary aggregates... by placing greater emphasis on the supply of bank reserves and less emphasis on confining short-term fluctuations in the Federal funds rates."

The target cone for M1 was announced and efforts were made to keep M1 within the range. However, the actual path of M1 broke out of the cone too frequently. The weekly money supply announcement was closely watched by the market in order to forecast the Fed reaction to the surprise in money supply. Many studies, such as Engel and Frankel (1984), Ito and Roley (1985) and Roley (1983), established evidences that the market believed

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that the Fed will tighten after an unexpected increase in money supply.

Inflation fell but only after the United States experienced the recession of 1981-82, the worst since the Second World War. The Fed permitted the money supply to increase beyond its target after the summer of 1982, and the policy implemented in October 1979 was formally abandoned in October 1982. After the monetary target was abandoned, money supply increased at a faster pace: M1 increased only at 6.5% in 1981, but it grew 8.8% in 1982 and 9.7% in 1983. Despite repeated warnings from monetarists, inflation did not materialize from a higher growth rate of money supply. At present, M1 target is no longer announced. Monetarism has been pronounced "dead" for some time (Dewald (1988) and B. Friedman (1988)).

Milton Friedman was skeptical about the prospect of practicing a monetarist policy in October 1979, and quickly disinherited the Fed from monetarism. As early as December 1980, Milton Friedman complained that the Federal Reserve had failed to keep its promise of October 6, 1979 (See M. Friedman (1980)). Monetarists claimed that, despite the monetarist rhetoric, the Fed failed to implement a monetarist policy. The Fed permitted M1 to fluctuate widely and even allowed it to swing outside the target range. Thus, monetarists and sympathetic observers argue that the experience from 1979 to 1982 was nothing like monetarists would advocate. (See McCallum (1984, 1985) and Milton Friedman (1984, 1985).)

Nonmonetarists concluded from the experiment that it is neither possible nor desirable to target the money supply. The monetary tightening in 1981 due to an unrealistic goal in M1 growth hurt the economy. Moreover, nonmonetarists argue that no inflation with a high monetary growth rate after 1982 is a solid evidence that monetarism is wrong. (See, for example, Benjamin Friedman (1984, 1988).)

2.B. Japan: Was the Bank of Japan a closet Monetarist?

Between 1956 and 1973, the Bank of Japan permitted monetary growth to fluctuate between fifteen and twenty-five percent per annum. The Bank curtailed monetary growth when the international balance of payment became a binding constraint, but otherwise relaxed monetary growth to finance economic growth. In 1972, the M2 growth rate reached 26.5 percent. When the oil embargo of October 1973 hit Japan, an inflation pressure was already there. A combination of domestic overstimulation, a mistake of the Bank of Japan, and quadrupling of oil prices caused the worst inflation since the 1950s. The WPI inflation soared to 31 percent in 1974.

In order to curb the high inflation rate and to prevent its resurgence, the Bank of Japan decided to put more emphasis on money supply in Japan. The Bank of Japan (1975) analyzed the causal relationship between monetary aggregates and income and derived a conclution that M2 had always led the price level (WPI). In its manifesto, the Bank of Japan (1975) announced that it would watch the the money supply growth more closely:

> "In order to achieve price stability and to strive for the appropriate development of the economy, it will be necessary to pay sufficient attention in the future to the movements of M2 in the management of monetary policy. ... Since the relationship between M2 and ultimate policy objectives may change depending on regimes of the economy, it is an inappropriate policy management to announce and to machanically stick to the target of M2 growth rate.
>
> In actual management of policy, the growth rate of the money supply should be kept stable in cases when it is judged that no particularly large economic problems loom, ... Money-focused monetary policy in no way implies decreased importance for interest rate policy." (Bank of Japan (1975; pp. 10-11) and Bank of Japan (1987; p.328 for translation of part of the above quote))

Since 1975, the Bank of Japan has declared M2 as an intermediate target, and gradually decreased its growth rate. Fluctuations in the money

supply have also been curbed as evident in Figure 1. The figure shows that money supply growth rate was gradually declined, and so was the nominal GNP growth rate, but importantly keeping the real GNP growth rate steady. Put simply, the gradual decrease in the money supply growth rate reduced inflation without reducing economic growth. This is what a monetarist would preach. [2] Is the Bank of Japan a closet monetarist? Milton Friedman, a founding father of monetarism, thinks so. As shown in his quote in the beginning of this paper, Friedman praises the Bank of Japan for "practicing" monetarism without vocalizing it.

Insert Figure 1 about here

If the Bank of Japan practiced monetarism, the Bank abandoned the principle, without announcing it, in 1987, when the M2+CD growth rate jumped to 10.4 percent from 8.7 percent in 1986. However, a care must be taken in the comparison of the monetary policies by the Fed in 1979-1982, and by the Bank of Japan in 1975-1986, since there are some technical differences in monetary targeting of the two central banks. First, the Bank of Japan has targeted the M2+CD, while the Fed targeted M1. The Bank of Japan thinks that M1 is more volatile in nature, and it is difficult to target M1 or its relation to income and inflation is weaker. Second, the Federal Reserve announced the actual statistics weekly, while the Japanese monetary announcement comes only monthly. Announcements of weekly volatile movements might cause jitterly reactions from the market. Third, it is cosmetic, but the Bank of Japan announces its statistics in terms of annual increases instead of the week-to-week changes. [3] Last, but most important, the Bank of Japan may not have treated its M2+CD "forecast" in a way that the Federal Reserve treated M1 as a "target."

3. Econometric Issues

In this subsection, econometric specifications of various tests performed in the next two sections are formalized and explained. First, the money supply growth, $M(t)$, is the linear function of economic conditions known at period t, consisting of a vector of public information, $PU(t-1)$, and that of private information of the Bank of Japan, $PR(t-1)$, and economic conditions developed in period t $PU(t)$ and the Bank of Japan contemporaneous (within period t) decisions $PR(t-1)$:

$$(3.1) \qquad M(t) = k + b*PU(t-1) + c*PR(t-1) + d*PU(t) + f*PR(t) + u(t)$$

where $u(t)$ is the disturbance term representing the unexpected errors in controling money supply within period t, so that $u(t)$ has a zero mean and is uncorrelated with any of the right-hand-side variable variables. The past public information vector, $PU(t-1)$, includes, for example, the past money supply growth rates, $M(t-1)$, $M(t-2)$, ..., GNP growth rates, inflation rates and other publicly available variables on economic conditions. The private information $PR(t-1)$ includes (i) financial market information that the Bank of Japan collects but does not release to the public at the time of "forecast" annoucements, and (ii) any monetary policy instruments that the Bank of Japan has decided, but unknown to the public, to exercize in the next three months. Changes in economic conditions in period t are divided into the expected (at period t-1) part that is included in $b*PU(t-1)$ and the unexpected part, $PU(t)$. Similarly, policy actions, affecting the money supply, taken by the Bank of Japan in period t consists of the expected part included in $c*PR(t-1)$ and the unexpected part, $PR(t)$. By definition, $E[PU^u(t) \mid PR(t-1), PU(t-1)] = 0$ and $E[PR^u(t) \mid PR(t-1), PU(t-1)] = 0$. Given that the Bank knows the true parameters, the expected money growth rate by

the Bank of Japan, $E[M(t)|BoJ]$ (linear projection on $PU(t-1)$ and $PR(t-1)$) is

(3.2) $E[M(t)|BoJ] = E[M(t)|PU(t-1),PR(t-1)] = k + b*PU(t-1) + c*PR(t-1)$.

However, the econometrician who is not informed of $PR(t-1)$ would calculate the expectation of the money supply growth using public information only:

(3.3) $E[M(t)|ec] = k + b*PU(t-1)$.

Assuming that $PR(t-1)$ and $PU(t-1)$ are orthogonal, unbiased estimate of k and b can be obtained easily. The forecast (target) money supply growth rate, announced by the Bank of Japan for period t is denoted by $TG(t)$:

(3.4) $TG(t) = \bar{k} + \bar{b}*PU(t-1) + \bar{c}*PR(t-1) + w(t)$

where $\bar{k}$ is a constant, the error term $w(t)$ represents rounding errors (in deciding "forecasts") and other "trembling-hand" disturbances in setting targets, which has mean zero and is uncorrelated with any information which is available at period $t-1$. Since $TG(t)$ is announced, the last equation can be easily estimated by the econometrician, if a private information set $PR(t-1)$ is either empty or is uncorrelated with $PU(t-1)$:

(3.5) $TG(t) = \bar{k} + \bar{b}*PU(t-1) + v(t)$

where the disturbance term $v(t)$ includes errors due to the private information of the Bank of Japan and $u(t)$: $v(t) = \bar{c}*PR(t-1) + w(t)$.

Coefficients, $\bar{k}$, $\bar{b}$, and $\bar{c}$ do not necessarily coincide with the coefficients of the actual money supply, k, b, and c unless the Bank of Japan announce the "forecasts," which is the best forecast based on their information available at that time, i.e., $TG(t) = E[M(t)|BoJ]$, ("forecasts" being "rational expectations"). This is examined and tested in Section 5:

(3.6: RE) $\bar{k} = k$, $\bar{b} = b$, $\bar{c} = c$.

When rational expectations conditions are satisfied, a monetarist rule is better tested with information TG(t), intention, on the left hand side rather than M(t).   This can be easily understood by comparing the two regression equations that the econometrician will use:

(3.7)   TG(t) = k + b*PU(t-1) + v(t)

            where v(t) = c*PR(t-1) + u(t),

(3.8)   M(t) = k + b*PU(t-1) + z(t)

            where z(t) = c*PR(t-1) + d*PU(t) + f*PR(t) + u(t).

In order to estimate and interpret k and b, the first equation is more efficient because its error term has less noises.   This justifies the procedure taken in Section 4, that is, I use "forecasts" announced by the Bank of Japan rather than the actual money supply data in the test of monetarist rule.

One may wonder what determines the relative accuracy of the Bank of Japan announced "forecasts" against the econometrician's forecasts.   The forecasts error of the "forecasts" announced by the Bank of Japan is FER(t,BOJ) $\cong$ M(t) - TG(t). Hence, if the announcement is not the best forecast of the Bank of Japan,

(3.9)   FER(t| BOJ) = (3.1) - (3.4)

  = (k-$\bar{k}$) + (b-$\bar{b}$)*PU(t-1) + (c-$\bar{c}$)*PR(t-1) + d*PU(t) + f*PR(t) + u(t)-w(t).

If the announced "forecasts" are rational expectations of the Bank of Japan, i.e., (3.6) is the case, then the forecast errors can be reduced

(3.10)   FER(t| BoJ, RE) = d*PU(t) + f*PR(t) + u(t)-w(t).

Suppose that the econometrician is able to estimates the (3.1) and obtained the $\hat{k}$ and $\hat{b}$, then forecast error FER(t| ec) = M(t)-E[M(t)|ec]:

(3.11) FER(t| ec) = (3.1)-(3.3)

$$= (k-\hat{k}) - (b-\hat{b})*PU(t-1) + c*PR(t-1) + d*PU(t) + f*PR(t) + u(t).$$

In Section 4, the target function (3.5) is estimated and interpreted. This is a test of monetarist rule at the level of intention. It is not necessary for the test to be valid that the target process is consistent with a true process. A monetarist rule is interpreted and tested at the level of "forecasts." As described above, testing using TG(t) is more powerful than using M(t) under the rational expectations assumption.

Section 5 is devoted to an examination of various assumptions on which the above test is constructed. Section 5.A estimates equations (3.7) and (3.8) and obtained a better fit for equation (3.7), confirming the above theoretical prediction about why using TG(t) is better than M(t). In Section 5.B, the rationality of the Bank of Japan "forecasts" is directly tested. If rational expectations (3.6) are true, the forecast errors M(t)-TG(t) is unbiased and uncorrelated with any variable contained in information set PU(t-1) and PR(t-1). Usual tests are performed to confirm this hypothesis. Therefore, this enhances the validity of procedure followed in Section 4. In Section 5.C, the importance of the private information PR(t-1) is will be examined, given an assumption that the econometrician knows a correct variables of information set PU(t-1). The forecast errors, FER(t|BOJ) and FER(t| ec) are compared. In the test, TG(t) is shown to be more precise than E[M(t)|PU(t-1)] in terms of the mean absolute (forecast) error. In other words, the announced "forecasts" TG(t) is better forecasting variable than one constructed by the econometrician.

4. "Forecasts" by the Bank of Japan

4.A. Official Description

Targeting and control of money supply by the Bank of Japan seems to be at the heart of its conduct of the monetary policy that has received such praises from monetarists and others. First of all, let us review how the Bank of Japan itself described the forecasts.

In its publication, the Bank of Japan explains why it adopted "money-focused monetary policy" and how it is exactly implemented (Suzuki (1987; pp. 328-311). The following is a summary of the official explanation concerning its "forecast" announcement.

> On the basis of these ideas, a change in monetary management occurred in Japan, beginning in July 1978. Since that time, the Bank of Japan has made it a rule to annuonce, at the beginning of every quarter, an estimated value for the growth rate of the average outstanding balance, of the money supply relative to the same period in the previous year. This estimated value is called a forecast [mitoshi] and applies to the current quarter. Originally, the definition of the money supply used was M2, but the definition was changed to M2+CDs when the latter began to be issued [in May 1979]. (Suzuki (1987), p. 328)

> [T]he annual rate of increase is the focus of attention. ... Monetary policy in Japan focuses on M2+CDs but does not determine 'targets' in the strict sense of the word. Only 'forecasts' [mitoshi] are announced. However, the policy actions of the Bank of Japan itself are included in the determination of these forecasts, and in this sense the forecasts represent increases in the money supply that the Bank of Japan is willion to permit. (ibid, p.331)

The above descriptions tantalize the reader, who insists on knowing whether "mitoshi" is a "forecast" or a "target." One way to resolve this issue is to examine characteristics of "forecasts" and to determine whether "forecasts" deserve to be monetarist "targets."

4.B. Track Record

(i) Official Four-quarter Basis

The announced "forecasts" and ex post actual growth rates of M2+CD are

summarized in Table 1. Figure 2 plots the actual rate (solid line) against
the mean of the forecasts. The difference between the mean of forecast and
actual growth rates are shown in the "shock" column of Table 1 and the
vertical difference of the two lines of Figure 2. Table 1, the "large shock
column" also show that the actual path strayed outside the forecast range
only eight times in ten years. Notable deviations, three straight quarters
of under-forecasting, occurred in 1987.

Insert Table 1 and Figures 2 about here

A few caveats are in order. First, in the original announcement, the
range of "forecasts" are not officially specified in numbers. Instead, only
descriptive verbal expressions of the range (e.g. "about" 10 percent) are
announced. The expression is interpreted numerically, using common sense of
the language, (e.g. "about" = +/- 0.5 percentage point), and the ceiling,
mean, and the floor of the forecasts are recorded. This interpretation is
explained in Note 2 of Table 1. Second, since the announcement is
deliberately vague as expalined above, some rounding errors in announcement
are inevitable. For example, even if the Bank of Japan predicts $E(M(t)|BoJ)$
the growth rate to be "10.18% +/- 0.48%," the Bank announces uses the
language, $TG(t)$, "about 10%." The same announcement $TG(t)$ may result from
$E(M(t)|BoJ)$ = "9.89% +/- 0.46%." This is one of the sources of an error
term $w(t)$ in equation (3.4).

Third, in the official announcement, forecasts and actual (realized)
rates are described in terms of growth rates (in percent) over the last four
quarters. Denoting the announced (mean) forecast of growth rate by TG, the
level of M2 by M2, and the Bank of Japan "forecast" of M2 for this quarter
by EM, the definition is shown as,

(4.1) $TG(t) = 100*[EM2(t)-M2(t-4)]/M2(t-4)$.

Although a potential seasonality problem is avoided in this definition, an actual money growth in three out of four quarters covered in this forecast formula is already known. When three-quarters of a "forecast" has already happened, it is no wonder that the forecasting record, Table 1 and Figure 2, appears to be very good.

(ii) *Quarter-to-Quarter Basis*

As noted above, when a quarterly forecast over the 12-month growth rate forecast is announced, the last three quarters are known. Therefore, there is a possibility that the announced forecasts mask a subtle change (or no change) of "forecasts" in the quarter-to-quarter basis. This will be explained in detail in next subsection.

The actual growth rate for the last quarter is announced at the same time the "forecast" for this quarter is announced, and it is trivial to calculate a quarter-to-quarter forecasts. Denoting the quarter-to-quarter growth rate by QTG, the relationship is summarized as

(4.2) $QTG = 400*[EM2(t)-M2(t-1)]/M2(t-1)$

The rate of change is multiplied by 400 in order to annualize the growth rate. This conversion is applied separately to the high, mean, and low of forecasted statistics. The actual monetary growth, inflation, and GNP growth rates are also converted to the quarter-to-quarter basis and denoted, respectively, by QM, QINFL and QGNP:

$QM = 400*[M2(t)-M2(t-1)]/M2(t-1)$.

$QINFL = 400*(CPI(t)-CPI(t-1))/CPI(t-1)$.

$QGNP = 400*(GNP(t)-GNP(t-1))/GNP(t-1)$.

Table 2 and Figure 3 shows the track record in the quarter-to-quarter basis, correspond to Table 1 and Figure 2, respectively.

Now compare Table 1 (announced, four-quarter growth rate) with Table 2 (implied, quarter-to-quarter growth rate) for the period 86:4 - 88:1. The announced "forecasts" increase gradually from 8.5% to 12.0 %. However, the implied quarter-to-quarter forecasts decreased from 8.30% (86:4) to 6.69% (87:2) and then jumped to 10.30% (87:3). Since there was a large jump in actual rates in 86:3 and 87:1, even a small rise in four-quarter growth rate in 87:2 implies a <u>decline</u> of the growth rate in the quarter-to-quarter growth rate.[4] Similarly, from 88:2 to 88:3, the quarter-to-quarter (mean) growth rate does not change, while the four-quarter (mean) growth rate registers a 1.5 point drop.

Since the quarter-to-quarter basis contains more net information, most analyses in the following uses this definition. Regressions using the four-quarter basis are also done, but does not present any different stories, so they are not reported in the paper.

4.C. A <u>Monetarist</u> <u>Rule</u> <u>vs.</u> <u>Accomodation</u>

Let us investigate how a new "forecast" is formed when the most recent "forecast error" is revealed. Reactions of the monetary authority to forecast errors reveal how monetary policy is conducted. A monetarist rule will prescribe a compensating decrease in the next quarter to a positive forecast error, in order to keep a k% growth rate in the target period, say a year. Accomodative approaches will allow higher money supply once it has happened. In order to understand econometric implications of different

hypotheses, consider the following example.

Suppose that the level of monetary supply, after detrending the k%, was targeted to be constant for the last four quarters. The actual path was right on the target from t-4 to t-2. But it was just revealed that money supply jumped by 1 % from t-2 to t-1. (See Figure 4.) In the beginning of period t, that is when an official "forecast" is announced, how does the Bank of Japan target the money supply for that quarter?

Insert   Figure 4   about here

There are three scenarios: <u>Case 1 (Complete Accomodation)</u>. If the trend is considered to be set and accommodated, the quarter-to-quarter growth rate will be "forecasted" as 1% again from t-1 to t; <u>Case 2 (Bygones are bygones, but no further accommodation)</u>. If the jump was judged to be caused by a one-time idiosyncratic shock, the monetary authority may want to keep the money supply constant after rebasing; and <u>Case 3 (Rigid Monetarism)</u>. If a rigid monetarism is pursued, then the positive jump should be compensated by a following negative jump to keep the long-run trend target is kept.

In addition to these three hypotheses, another interesting hypothesis is that the money supply target is independent of economic conditions. According to a rigid monetarism, money supply should be independent from economic growth or inflation. Hence, target adjustments should also be independent from either of them. If money supply management follows fine-tuning as advocated by Keynesians, the money supply target will react to conditions of inflation and growth.

The following two specifications are investigated.

$$(4.5) \quad QTG(t)-QTG(t-1) = a+b*[QM(t-1)-QTG(t)]+c*QINFL(t-1)+d*QGNP(t-1)+e(t)$$

$$(4.6) \quad QTG(t)-QTG(t-1) = a + \sum_j b_j*(QM(t-j)-QTG(t-j+1))$$

$$+ \sum_j c_j*(QINFL(t-j)-QGNP(t-j)) + \sum_j d_j*(QINFL(t-j)-QGNP(t-j) + e(t).$$

where $j = 1,2,3,4$. The (4.5) specification uses information of money growth rate and others from t-2 to t-1. In the (4.6) specification, quaterly growth rates from t-5 to t-4, from t-4 to t-3, from t-3 to t-2, and from t-2 to t-1 are separately taken into account.[5]

Results of specification (4.5) and (4.6) are shown in Tables 3 (with one lag) and Table 4 (with four lags), respectively. Table 3 shows that b is estimated to be between 0 and 1. The hypothesis that the estimated b is equal to zero is rejected at the 5% level in most specifications. The estimated b being larger than 0 implies that a recent "surprise" increase in actual money supply would make the next "forecast" to increase beyond what has already happened (bygones). Table 4 shows that even if four lags are allowed, the sum of coefficients on the past forecast errors are between zero and one. Again, a hypothesis that the estimated b is equal to zero is rejected at the 5% level in all specifications. Without information of inflation or GNP growth rate, the sum of point estimates of b_j, $j=1,2,3,4$, is .71. This implies that if an increase in money supply above its target by one percent will make the long-run target to increase by about 70 percent in addition to adjusting the base of target to a realized level of money supply. This is a strong evidence for an accommodative policy in the money supply management.

Therefore, evidences are against a hypothesis that the Bank of Japan practiced a strict monetarist rule. The estimated b implies that any increase in the level of money supply is treated as bygones, and moreover a

further increase will be accommodated. It is also shown that b is less than 1, so that a jump in money supply partially but not totally makes the trend of increase. (In terminology of Figure 4, the finding implies that the reality is somewhere between case 1 and case 2.)

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      Insert Tables 3 and 4 about here
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Insignificant estimates of c and d in Table 3 suggest that recent inflation or real GNP growth rate does not add any information to the recent "forecast errors." The last finding is a piece of evidence that goes against a hypothesis that the Bank of Japan practiced the quarter-to-quarter fine-tuning responding to inflation and GNP growth rate. The size of accomodation, b, is quite robust in to different specifications with respect to inflation and GNP growth. In Table 4, the magnitude of accommodation, that is the sum of b_j's, does not change much, even if inflation and economic growth rates in the past four quarters are also taken into account. The sum of coefficients on inflation is .24. That is, "forecasts" of money supply would increase if inflation becomes higher. This is hardly anti-inflationary. However, the coefficients of inflation are collectively insignificant at the 5% level, and significant only at the 10% level. Table 4 also shows that the GNP growth rates are insignificant, though a sum of coefficients is negative, in determination of targets. When lagged inflation and growth rates are collectively evaluated, it is not significant at the 5% level (as shown in the last row of Table 4).

In sum, we learn that the Japanese monetary policy was conducted in such a manner that was far from the monetarist k% rule. When an actual money supply deviated from a target, there was no effort, expressed in

forming the next target, to correct the deviation. A jump was not only treated as a bygone, but also prompt a further jump in the same direction in the future target. Neither inflation nor GNP growth rate did not affect the change in money supply target.

In the United States from 1979 to 1982, the market correctly believed that the Fed was conducting the strict monetary targeting, in that any unexpected increase in the money supply (out of the "cone") would be pulled back by a compensating decrease in money supply in the near future. In other words, the market rationally expected that the estimate-of b in the quarter-to-quarter regressions above to be significantly negative. Thus, as many studies showed, the interest rate and the exchange rate responded to the unexpected change in money supply within hours of money announcements during the monetarist regime in the United States. However, in Japan, an unexpected change in money supply announcements have not caused any response in the exchange rate movements. (See Ito and Roley (1985) and references therein.) The Japanese market was rational, in knowing that the Bank of Japan would not try to compensate a surprise by a revease movement of money supply in the near future.

5. Rationality of "forecasts"

In the preceding section, it was shown that "forecasts" did not behave like an announcement of k% rule. If the Bank of Japan's "forecasts" were not a monetarist targets, what were they? Is there any chance that an actual path of money supply has followed a monetarist rule despite an accomodative targeting rhetoric? This section will examine how forecasts were determined and whether they were "rational," in that the forecast reaction function was a correct conditional expectation of the true money supply process.

5.A Determinants of "forecasts" and actual money supply

In this subsection, the actual and "forecast" money supply growth rates are regressed on the same information set, in order to investigate whether they respond similarly to past information. This is also an indirect test whether the Bank of Japan forecast is biased in any significant manner.

Table 5 shows the estimated processes of actual money supply and "forecast" money supply, in terms of the growth rate (panel 1) and the level (panel 2). These tables show how similarly the "forecast" (target) and the actual process responded to past information. The Chow test is performed to check whether there are structual differences between the two processes.

Insert Table 5 about here

Results can be interpreted as follows. First, the "forecast" equation has a higher $\bar{R}^2$ than that a "actual" equation, supporting that an actual process contains more noises than a "target" process (as discussed in Section 3). Second, the actual process responded negatively to inflation, while the "forecast" process did not (in growth rates) or did so but in a smaller coefficient. Third, coefficients other than inflation are similar in magnitude. Fourth, both the actual and "forecast" processes show the long-run effect (sum of the coefficients) of the lagged money supply is close (.703 vs. .827 in growth rates and 0.986 vs. 0.961 in levels). The Chow test shows that there is no statistically significant difference between the two processes (both in growth rates and in levels). These results imply that there are no significant deviations in the two processes, so that the Bank of Japan did put their hands where their mouth was.

5.B   Rationality Test

A direct test of hypothesis that the Bank of Japan forecasts is a best conditional expectation given the information at the time of forecasting can be formulated as the usual test of "rational expectations." If rational expectations in the above sense holds, the "forecasts" are an unbiased predictor of ex post realized values (unbiasedness test). Moreover, rational expectations imply that forecast errors are not correlated with any information which is available at the time of prediction (orthogonality test). Each test is performed both in terms of growth rates and in terms of levels and results are shown in Table 6.

Insert Table 6

When the growth rate is used, the rational expectations hypothesis is not rejected at the 5% significance level. When the level is used, the null hypothesis is not rejected at the 1% significance level, but barely rejected at 5% significance level. Considering that the growth rate is used for an official announcement, a rational expectations hypothesis is judged to be accepted. In sum, an assumption that the Bank of Japan is announcing what they consider the best conditional estimate of money growth rate.

As explained in Section 3, the information set on which conditional forecasts are based contains the Bank of Japan private information. The private information possibly includes its policy action to be exercised in the next few months, but not yet announced. In the null hypothesis of rational expectations, "forecasts" is formed taking into account the private information, although the econometrician does not know its content. In that sense, having "forecasts" announced by the Bank of Japan is a powerful test. In fact, the procedure above is reminiscent of testing the rational

expectations hypothesis with "survey data" (see Mishkin (1983)).

5.C. Were the Bank of Japan "forecasts" better than mechanical forecasts?

As explained in Section 3, if we find an econometric model (eq. (3.11)) which performs significantly better than the BoJ forecasts (eq. (3.9)), it implies that either the Bank of Japan deliberately announces "biased" forecasts (which is unlikely on the basis of the evidence in the preceding subsection) or the private information is valuable enough to compensate for rounding errors in announcement.

After some experiments, I produced two simple models that trace the actual path of money supply reasonably well. Model 1 is simply a autoregressive model of the level of quarterly money supply, and Model 2 uses information of both money supply and real GNP. The second model also include the trend term. In both cases, the rolling regression is performed to simulate forecasting using only information available at the time forecasting. Then the one-step ahead forecast of M2 level is translated into the four-quarter growth rate.[6] Mechanical forecasts are compared against the BoJ forecasts in terms of forecast errors.

```
-------------------------------------------------------
                    Mean Absolute Error
           BoJ forecasts    MODEL-1    MODEL-2
-------------------------------------------------------
MAE 78:3-88:2    .348          .485       .478


-------------------------------------------------------
MAE 83:3-88:2    .353          .393       .398
-------------------------------------------------------
```

The mean absolute error (MAE) for an entire sample of 78:3-88:2 was 0.348 for the BoJ forecast, compared with 0.485 for Model 1, and 0.478 for Model 2. For the latter half of the sample (83:3 -88:2), the BOJ forecast MAE was .353, while the two models' MAEs were 0.393 and 0.398. The BoJ

forecasts are better than the econometrician's best effort, although the performance edge does not seems to be overwhelming. There are several ways to interpret these results. The results imply that an importance of having private information, PR(t-1) outweighs the possibility of non-honest announcement, i.e., $\bar{k} \neq k$, $\bar{b} \neq b$, $\bar{c} \neq c$; the rounding errors $w(t)$, and that the econometrician may have imprecise estimates due to small samples, i.e., $\hat{k} \neq k$, $\hat{b} \neq b$, $\hat{c} \neq c$. Put differently, if rational expectations (3.6¦ RE) is given, and if the econometrician has true parameter values, then the results show that PR(t-1) is very important in forecasting the money supply process. Yet another way of interpreting results is to regard results as a support of rational expectations (3.6¦ RE), given that there are a few variables which are private information of the Bank of Japan and that the econometrician can try many specifications. For if rational expectations were violated and if the information value of PR(t-1) was small, the econometrician would be able to obtain a better forecasting formula using PU(t-1) after many experimentations.

6. Concluding Remarks

   Findings in this paper suggest that the Bank of Japan did not practice what monetarists preached, contrary to a praise from U.S. monetarists. Although the Bank of Japan announced a "forecast" which could be taken as monetary targeting, the forecasts were flexible so that they would violate a rigid monetarist rule. In particular, when there is an unexpected jump in money supply, the base is adjusted to a new level (bygones are bygones) and a further accomodation (b>0) in growth is allowed in the new "forecasts."

   "Forecasts" by the Bank of Japan are found to be best conditional forecasts by the Bank of Japan, because the rational expectations hypothesis

is not rejected. The actual and "forecasts" processes responding to various public information are very similar. Hence, non-monetarist "forecasts" announcements can be regarded as a true reflection of the actual managment of money supply. (As explained in Section 3, there is an econometric advantage to use "forecasts" rather than ex post money supply.) The Bank of Japan "forecasts" are better than mechanical forecasts, suggesting that the private information of the Bank of Japan is important.

In the United States, it is acknowledged by many researchers that the monvement of monetary aggregates during the monetarist experiment of 1979-82 has no resemblance to what monetarists preached, leaving a question whether a monetarist rule was attempted and failed or it was not intended at all. This paper shows that even in Japan, that the monetarists and sympathisers regard as a dream land, monetarism in the strict sense was not practiced. In fact, the Bank of Japan is not a non-monetarist in practice, but is hesitant to look a non-monetarist in announcement. This is most evident in its announcement form, the four-quarter growth rate, which hides the large fluctuations in quarter-to-quarter growth rate forecasts.

One might wonder what made monetarism (or rhetoric of monetarism) gain a popularity at one point in both the United States and Japan, and why the idea is not completely dismissed by the central banks. The answer could be political rather than economic: Justifying monetary supply as an intermediate target, it gives the central bank a convenient, and may be justified, weapon when its tight monetary policy is opposed by other branches of the government. Pierce (1984) suggested that "(p)erhaps the Fed had not really embraced monetarism. It may have found that focusing on money growth was a convenient means of absolving itself from responsibility for the record-high interest rates that occurred." According to this view,

the monetrist rule may be a weapon that a central bank needs only in an emergency. The Bank of Japan may as well maintain a monetarist rhetoric, i.e., announcement of "forecasts" just in case that the Bank of Japan needs to absolve itself from responsibility for raising the official discount rate against opposing political power. \7

1.   For a good survey of the Japanese monetary policy, see Hamada and Hayashi (1985) and Suzuki (1985).   For institutions and regulations in the Japanese financial markets in general, see the Bank of Japan (1987).   A recent rise in the money supply growth prompted studies on the stability of money demand function in Japan: See Bank of Japan (1988) and Ueda (1988).

2.   Suzuki (1985) calls Japanese monetary policy "eclectic gradualism," which is in between Keynesian fine-tuning and a monetarist k% rule. Although he diplomatically hedges his conclusion, his analysis (especially the observation about the experience after 1975) has a strong overtone of monetarism.

3.   It would be interesting to study whether there are "real" differences in the practices of the Bank of Japan and the practices of the Federal Reserve after correcting for these differences. For example, had the Federal Reserve announced monetary growth only monthly instead of weekly, while compensating secretly week-to-week monetary fluctuations within the month, would it have been more stabilizing to the economy? There is an evidence in the foreign exchange market during the 1979-82 that the Japanese monetary announcements were more or less ignored as "news," while the Fed's monetary announcements were watched closely as "news" (Ito and Roley (1985)) becoming a source of exchange rate fluctuations.

4.   If we may interpret "forecasts" as "targets," and jump to a conclusion, the Bank of Japan is judged to have resisted to a faster money supply growth until 87:3 by targeting a deceleration of money growth. Observing the large jump of 87:1, the Bank tried to slow down the money supply in 87:2. Finally, in 87:3, the target followed the actualy trend. This is hardly obvious, if we only watch the announced "forecasts" in terms

of four-quarter growth rates.

5. The information content of right-hand-side variables in eq. (6), if aggregated, is almost the same as that in specification (A) in the preceding subsection. If not only the four-quarter growth rate but also how the quarterly growth rates fluctuate recently is important, then it is the case for eq. (6) as opposed to specification (3). In a sense, if Table 1 is a good summary of information, then specification (3) in the preceding subsection is a correct one, while if Table 2 is a good summary, then either eq. (5) or eq. (6) should be used, depending on the relevant memory.

6. It is discovered in the process of experiments that forecasting the level first has better precision than forecasting the growth rate directly.

7. An oral tradition among experts on the monetary policy suggests a similar story in Japan. The Bank of Japan was politically defeated in 1972 and was "forced" to lower the discount rate against its will. If the Bank had had a sufficient political power to increase the discount rate then, the great inflation of 1973-74 would have been averted. Therefore, having money supply established as a "target," the Bank now has a contingent weapon in order to implement a necessary tightening (or interest rate hike) when it is needed. If this scenario is true, then I regret that, by writing this paper, I will weaken the political power of its weapon protecting its autonomy. However, unlike in 1972, the Bank of Japan has well established its credential by now, especially for its successful management, via fine-tuning not monetarism, through the period of second oil crisis, 1979-80. Thus, the Bank of Japan should realize that it could stand strong without a safety blanket of money supply targeting.

Table 1: "Forecast" and Actual M2+CD Growth Rate:
Compared to the same quarter of preceding year

Qtr	--- Forecast -----			Actual	Shocks Act-Mean	Large shocks Outside (L,H)
	Low	Mean	High			
78.3	11.0	11.75	12.5	12.1	.35	
78.4	12.0	12.5	13.0	12.2	-.30	
79.1	12.0	12.5	13.0	12.3	-.20	
79.2	12.0	12.5	13.0	12.1	-.40	
79.3	11.5	12.0	12.5	11.7	-.30	
79.4	10.5	11.0	11.5	11.2	.20	
80.1	9.75	10.0	10.25	10.6	.60	+ 0.35
80.2	10.0	10.5	11.0	10.1	-.40	
80.3	9.5	9.75	10.0	8.4	-1.35	- 1.1
80.4	7.75	8.0	8.25	7.8	-.20	
81.1	6.75	7.0	7.25	7.6	.60	+ 0.35
81.2	7.0	7.5	8.0	7.9	.40	
81.3	9.0	9.5	10.0	9.6	.10	
81.4	10.0	10.5	11.0	10.6	.10	
82.1	10.5	11.0	11.5	10.6	-.40	
82.2	9.5	10.0	10.5	9.2	-.80	- 0.3
82.3	8.5	9.0	9.5	9.0	.00	
82.4	7.5	8.0	8.5	8.1	.10	
83.1	7.0	7.5	8.0	7.6	.10	
83.2	7.0	7.5	8.0	7.6	.10	
83.3	6.5	7.0	7.5	7.1	.10	
83.4	6.5	7.0	7.5	7.2	.20	
84.1	7.0	7.5	8.0	7.9	.40	
84.2	7.5	8.0	8.5	7.6	-.40	
84.3	7.5	8.0	8.5	7.8	-.20	
84.4	7.5	8.0	8.5	7.9	-.10	
85.1	7.5	8.0	8.5	7.9	-.10	
85.2	7.5	8.0	8.5	8.3	.30	
85.3	7.5	8.0	8.5	8.3	.30	
85.4	8.0	8.5	9.0	9.0	.50	
86.1	8.5	9.0	9.5	9.0	.00	
86.2	8.0	8.75	9.5	8.5	-.25	
86.3	8.0	8.5	9.0	8.8	.30	
86.4	8.0	8.5	9.0	8.3	-.20	
87.1	7.5	8.0	8.5	8.8	.80	+ 0.3
87.2	8.5	9.0	9.5	10.0	1.00	+ 0.5
87.3	9.5	10.0	10.5	10.8	.80	+ 0.3
87.4	11.0	11.5	12.0	11.8	.30	
88.1	11.5	12.0	12.5	12.1	.10	
88.2	11.5	12.0	12.5	11.3	-.70	- 0.2
88.3	10.0	10.5	11.0	10.9	+.40	
88.4	10.0	10.5	11.0			

Notes to Table 1

1. A quarterly M2+CD is a three-month average of monthly average of balances. To be precise, before May 1979, no CDs were issued. Thus, original statistics are M2 before 1979:3 and M2+CD on and after 1979:3.

2.   An actual announcement of a "forecast" does not contain the range, but some wording suggesting some range. The following is my interpretation of the expression:

Japanese expression	interpretation			English translation
	low	target	high	
10.0 zengo	9.5	10.0	10.5	around 10.0
10.0 dai	10.0	10.5	11.0	the 10s
10.0 teido	9.75	10.0	10.25	near 10.0 .
10.0 jaku	9.5	9.75	10.0	less than 10.0
*	10.0	10.75	11.5	**

* 10.0 dai, jakkan no fure wa attemo 11.0 zengo.
** the 10s, but could be around 11.0

3.   Periods of "large shocks" are defined as ones in which actual growth rates are either above the high or below the low of the forecasts. In the former, the difference between actual and high, in the latter, the difference between actual and low are recorded.

TABLE 2:   Conversion to Quarter-to-Quarter Growth Rates

"Forecast" and Actual M2+CD Growth Rate:
Calculated to implied quarter-to-quarter rate

| Qtr | ---- Forecast ------- | | | Actual | Shocks | Large shock |
	Low	Mean	High		Act-Mean	Outside(L,H)
78:3	8.87	11.63	14.39	13.06	1.43	
78:4	9.52	11.35	13.18	10.25	-1.10	
79:1	8.94	10.76	12.59	9.93	-.83	
79:2	12.76	14.60	16.44	13.84	-.76	
79:3	10.14	11.98	13.81	10.91	-1.06	
79:4	5.80	7.63	9.47	8.33	.70	
80:1	4.62	5.54	6.46	7.93	2.39	+1.47
80:2	11.42	13.29	15.16	11.80	-1.49	
80:3	8.67	9.60	10.53	4.42	-5.18	-4.25
80:4	6.03	6.97	7.92	6.13	-.84	
81:1	4.05	4.99	5.94	7.11	2.11	+1.17
81:2	9.66	11.57	13.49	13.07	1.50	
81:3	8.57	10.45	12.32	10.76	.31	
81:4	7.67	9.53	11.38	9.78	.25	
82:1	6.86	8.70	10.54	7.21	-1.49	
82:2	8.98	10.85	12.71	7.75	-3.09	-1.23
82:3	8.23	10.11	11.99	10.25	.14	
82:4	4.01	5.89	7.76	6.14	.27	
83:1	3.18	5.07	6.95	5.31	.24	
83:2	5.61	7.51	9.40	7.90	.39	
83:3	6.04	7.95	9.86	8.21	.26	
83:4	3.99	5.89	7.78	6.62	.74	
84:1	4.57	6.46	8.36	8.16	1.70	
84:2	6.20	8.09	9.98	6.44	-1.65	
84:3	7.96	9.86	11.76	9.23	-.63	
84:4	5.37	7.25	9.14	6.78	-.47	
85:1	6.74	8.64	10.53	8.32	-.31	
85:2	4.87	6.76	8.64	7.99	1.23	
85:3	6.11	7.99	9.88	8.96	.97	
85:4	5.82	7.70	9.58	9.54	1.84	
86:1	6.49	8.36	10.23	8.38	.16	
86:2	4.23	7.03	9.84	5.97	-1.07	
86:3	7.21	9.09	10.98	10.34	1.24	
86:4	6.42	8.30	10.18	7.71	-.60	
87:1	5.20	7.09	8.97	10.13	3.04	+1.15
87:2	4.82	6.69	8.55	10.46	3.77	+1.91
87:3	8.43	10.30	12.16	13.27	2.98	+1.11
87:4	8.45	10.29	12.13	11.47	1.18	
88:1	8.95	10.78	12.61	10.97	.19	
88:2	8.44	10.27	12.10	7.74	-2.53	-0.70
88:3	8.42	10.27	12.13	11.76	1.49	
88:4	8.13	9.99	11.84			

Notes: See notes to Table 1.

Table 3: Determinants of Targets: Quarter-to-quarter growth rate: One lag

$$QTG(T)-QTG(T-1) = a_0 + b(QM(T-1)-QTG(T-1)) + d*x(T-1) + e(T)$$

x = (Trend, Inflation, Real GNP growth rate),   (.) = stand. error

	Constant	Act-Target	Quarterly Inflation	Quarterly GNPgrowth	$\bar{R}^2$/SEE	DW/RHO
OLS 78:4-88:1	-0.046 (0.473)	0.762 (0.303)	---	---	$\bar{R}^2$=0.156 SEE=2.420	DW=2.59
AR1 79:1-88:1	-0.005 (0.364)	0.768 (0.273)			$\bar{R}^2$=0.211 SEE=2.355	RHO=-0.304 (0.188)
OLS 78:4-88:1	0.240 (0.702)	0.755 (0.307)	0.005 (0.123)		$\bar{R}^2$=0.134 SEE=2.620	DW=2.57
AR1 79:1-88:1	0.161 (0.622)	0.760 (0.280)	-0.049 (0.145)		$\bar{R}^2$=0.184 SEE=2.589	RHO=-0.297 (0.198)
OLS 78:4-88:1	-1.115 (0.857)	0.582 (0.232)		0.238 (0.188)	$\bar{R}^2$=0.154 SEE=2.400	DW=2.57
AR1 79:1-88:1	-0.904 (0.799)	0.592 (0.200)		0.193 (0.185)	$\bar{R}^2$=0.209 SEE=2.353	RHO=-0.297 (0.167)
OLS 78:4-88:1	-1.230 (0.990)	0.589 (0.237)	0.030 (0.124)	0.245 (0.193)	$\bar{R}^2$=0.130 SEE=2.433	DW=2.566
AR1 79:1-88:1	-1.003 (0.890)	0.603 (0.207)	0.030 (0.113)	0.196 (0.188)	$\bar{R}^2$=0.186 SEE=2.386	RHO=-0.297 (0.171)
OLS 78:4-86:1	-0.046 (0.473)	0.762 (0.303)			$\bar{R}^2$=0.156 SEE=2.587	DW=2.594
AR1 79:1-86:1	-0.005 (0.364)	0.768 (0.273)			$\bar{R}^2$=0.211 SEE=2.545	RHO=-0.304 (0.188)
OLS 78:4-86:1	-2.385 (1.460)	0.687 (0.292)	-0.029 (0.145)	0.579 (0.287)	$\bar{R}^2$=0.223 SEE=2.482	DW=2.346
AR1 79:1-86:1	-2.020 (1.424)	0.726 (0.284)	-0.016 (0.144)	0.496 (0.294)	$\bar{R}^2$=0.239 SEE=2.500	RHO=-0.212 (0.213)

Notes: 1. First-order autocorrelations in the error term was corrected by the Cochrane-Orcutt method.

2. In this panel, the trend term is dropped because it is not significant, when added, in any specification.

Table 4: Determinants of Targets: Quarter-to-quarter growth rate: Four Lags

$$QTG(T)-QTG(T-1) = a_0 + b_j*(QM(T-j)-TARGET(T-j))$$
$$+ c_j*QINFL(T-j) + d_j*GNP(T-j) + e(T)$$

Estimation period 79:3 - 88:1, method: OLS

(.) std. err.

Const.	b Act-Target				c Inflation				d GNPgrowth			
	j-1	j-2	j-3	j-4	j-1	j-2	j-3	j-4	j-1	j-2	j-3	j-4
-.28	.48	.48	-.55	.30								
(.40)	(.26)	(.30)	(.30)	(.28)								

$\bar{R}^2$=.203   H0: b=0
SEE=2.354   F(4,30)=3.163
DW=2.49   signif.= 0.028

| -.98 | .39 | .77 | -.36 | .16 | -.15 | -.24 | .22 | .41 | | | | |
| (.69) | (.27) | (.32) | (.34) | (.30) | (.15) | (.16) | (.15) | (.16) | | | | |

$\bar{R}^2$=.326   H0: b=0   H0: c=0
SEE=2.164   F(4,26)=3.297   F(4,26)=2.372
DW=2.749   signif.= 0.026   signif.= 0.078

| .52 | .36 | .71 | -.77 | .23 | | | | | .29 | -.35 | -.21 | .06 |
| (1.68) | (.27) | (.31) | (.30) | (.30) | | | | | (.20) | (.21) | (.22) | (.22) |

$\bar{R}^2$=.244   H0: b=0   H0: d=0
SEE=2.293   F(4,26)=3.851   F(4,26)=1.403
DW=2.367   signif.= 0.0137   signif.= 0.260

| -1.43 | .26 | .95 | -.50 | .06 | -.10 | -.32 | .21 | .43 | .35 | -.28 | -.07 | .1 |
| (1.67) | (.28) | (.31) | (.34) | (.30) | (.17) | (.17) | (.15) | (.16) | (.18) | (.20) | (.23) | (.2 |

$\bar{R}^2$=.391   H0: b=0   H0: c=d=0
SEE=1.058   F(4,22)=4.259   F(8,22)=2.157
DW=2.610   signif.=0.0105   signif.= 0.073

1. When a trend term is added, it is not significant in any specification.

Table 5: Determinants of Target and Actual Money Supply

1. Growth Rates:

actual process

$$M(t) = a + \sum_{j=1}^{4} b_j * M(t-j) + c*QGNP + d*QINFL$$

target process

$$TG(t) = a + \sum_{j=1}^{4} b_j * M(t-j) + c*QGNP + d*QINFL$$

method = OLS   (.) std err

period	a	b_1	b_2	b_3	b_4	c	d	$\bar{R}^2$/SEE/DW
Actual 78:3 - 88:1	2.422 (1.944)	0.330 (0.145)	0.039 (0.151)	-0.024 (0.158)	0.358 (0.152)	0.197 (0.164)	-0.295 (0.165)	$\bar{R}^2$=0.256 SEE=1.992 DW =2.052
Target 78:3 - 88:1	0.440 (1.587)	0.307 (0.119)	0.059 (0.123)	-0.090 (0.129)	0.551 (0.124)	0.158 (0.134)	0.133 (0.135)	$\bar{R}^2$=0.492 SEE=1.626 DW =1.725

Chow Test, H_0: (a, b_1, ..., c, d) are the same in the two eq.
    $F(7, 64) = .970$,   Significance level = 0.461

Note: When a trend term is added, it is not significant, and similar results: $F(8, 62) = .824$, Significance level = 0.584

2. Level

actual process

$$\log M(t) = a + \sum_{j=1}^{4} b_j * \log M(t-j) + c*\log GNP + d*\log PRICE$$

target process

$$\log TG(t) = a + \sum_{j=1}^{4} b_j * \log M(t-j) + c*\log GNP + d*\log PRICE$$

method = OLS   (.) std err

period	a	b_1	b_2	b_3	b_4	c	d	$\bar{R}^2$/SEE/DW
Actual 78:3 - 88:1	0.337 (0.536)	1.118 (0.169)	-0.203 (0,252)	-0.004 (0.255)	0.075 (0.176)	0.115 (0.111)	-0.189 (0.090)	$\bar{R}^2$=0.999 SEE=0.005 DW =1.860
Target 78:3 - 88:1	0.008 (0.526)	1.251 (0.166)	-0.265 (0.247)	-0.029 (0.250)	0.004 (0.173)	0.098 (0.109)	-0.069 (0.088)	$\bar{R}^2$=0.999 SEE=0.005 DW =1.992

Chow Test, H_0: (a, b_1, ..., c, d) are the same in the two eq.
    $F(7, 64) = .413$,   Significance level = 0.890

Note: When a trend term is added, it is not significant, and similar results: $F(8, 62) = .396$, Significance level = 0.919

Table 6: Tests, Rational Expectation

<u>1.</u> <u>Growth</u> <u>Rates</u>

A. Unbiasedness, $M(t) - M(t-1) = a + b*\log(TG(t)-M(t-1))$

Estimates and (st.er.) sample 78:4 - 88:3

a	b	$\bar{R}^2$ / DW	RE Hypothesis $TG(t) = M(t)$ H_0: $(a,b) = (0,1)$
0.123	0.879	$\bar{R}^2 = 0.607$	$F(2,38) = 0.719$
(0.273)	(0.112)	DW = 1.50	significance = 0.493

B. Orthogonality , $M(t)-TG(t) = a + b*x(t-1)$

$x(t-1) = \{M(t-1))-TG(t-1)), GNPGR(t-1), INFL(t-1)\}$

estimates and (st. er.), sample = 78:4 - 88:1

a	b_1	b_2	b_3		RE hypothesis: H_0 : (a, b) = (0,
0.388	0.331	0.025	-0.001	$\bar{R}^2 = 0.1852$	$F(4,34) = 2.413$
(0.064)	(0.153)	(0.126)	(0.001)	DW = 1.668	significance = 0.06

<u>2.</u> <u>Level</u>

A. Unbiasedness, $\log(M2(t))-\log M2(t-1) = a + b*\log(TGM2(t)-\log M2(t-1))$

Estimates and (st. er), sample 78:4 - 88:3

a	b		RE Hypothesis $\log(TGM2(t)) = \log(M2(t)$ H_0: $(a,b) = (0,1)$
0.007	0.704	$\bar{R}^2 = 0.48$	$F(2,38) = 3.424$
(0.003)	(0.116)	DW = 1.41	significance = 0.043

B. Orthogonality
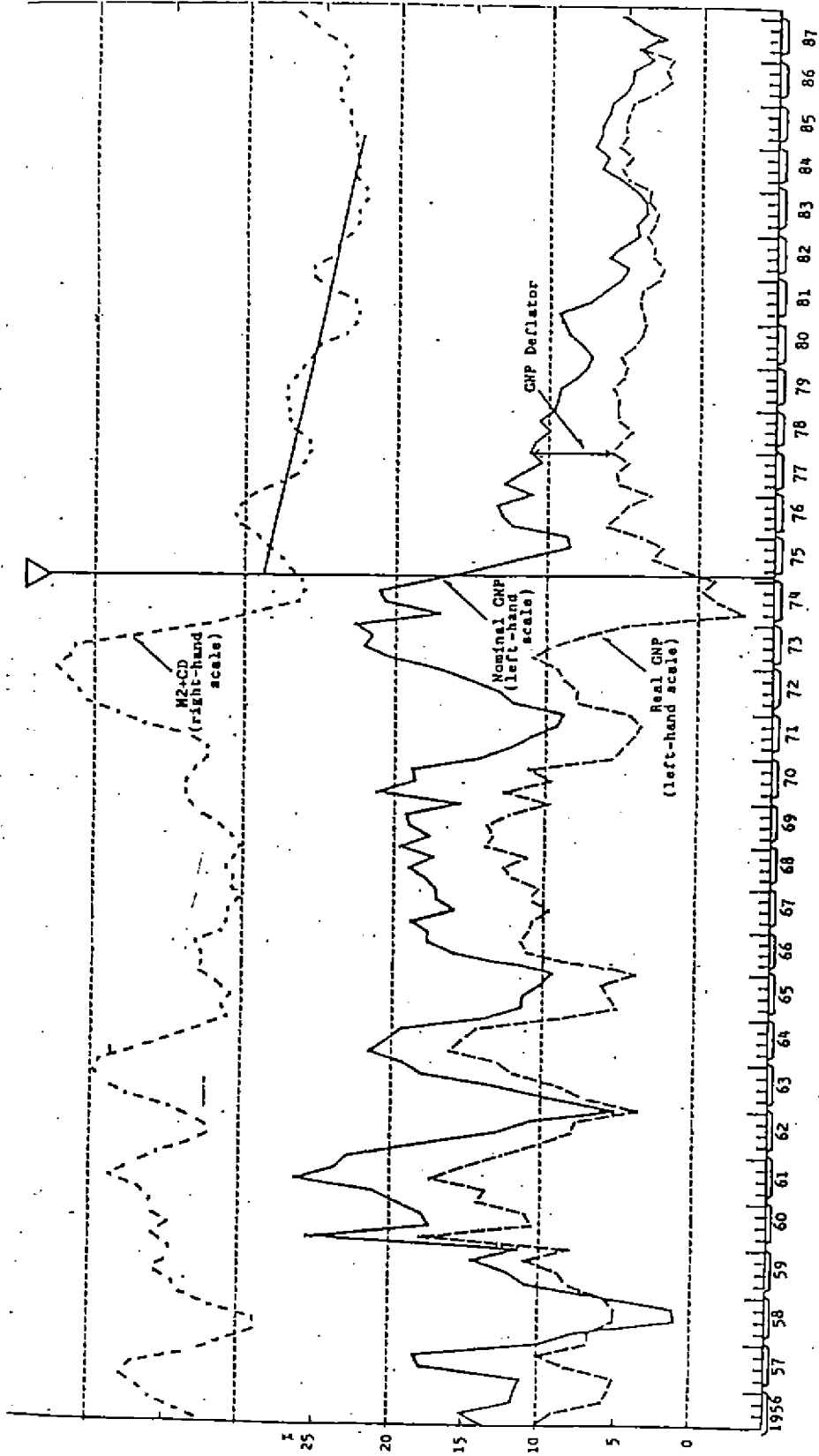
$\log(TGM2(t))-\log(M2(t)) = a + b*x(t-1)$

$x(t-1) = (\log(TGM2(t-1))-\log(M2(t-1)), \log GNP(t-1), \log(CPI(t-1))$

estimates and (st. er.), sample = 78:4 - 88:1

a	b_1	b_2	b_3		RE hypothesis: H_0 : (a, b) = (0, 0)
-0.062	0.215	0.025	-0.017	$\bar{R}^2 = 0.168$	$F(4,34) = 2.756$
(0.037)	(0.167)	(0.018)	(0.023)	DW = 1.707	significance = 0.044

Figure 1: Money Stock and GNP in Japan

Notes. 1) Growth rates of money stock and GNP are calculated not against the previous quarter, but against the same quarter in the previous year.

2) "M2+CD" (before I/1979, "M2") is an average of end-of-month observations. For example, the value for the first quarter is an average of the values at the end of January, February and March.

Adopted from
Suzuki, et al. (1988).
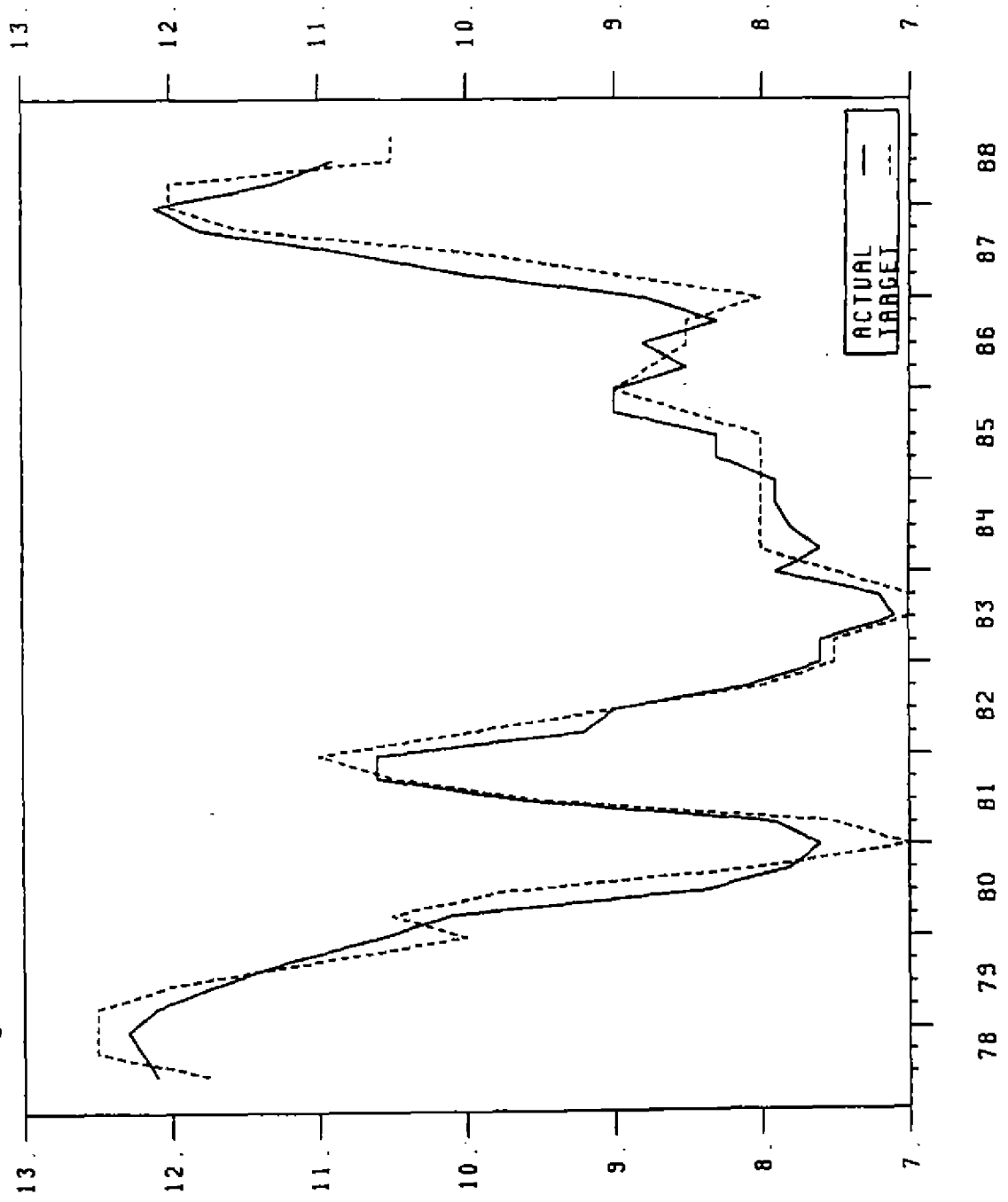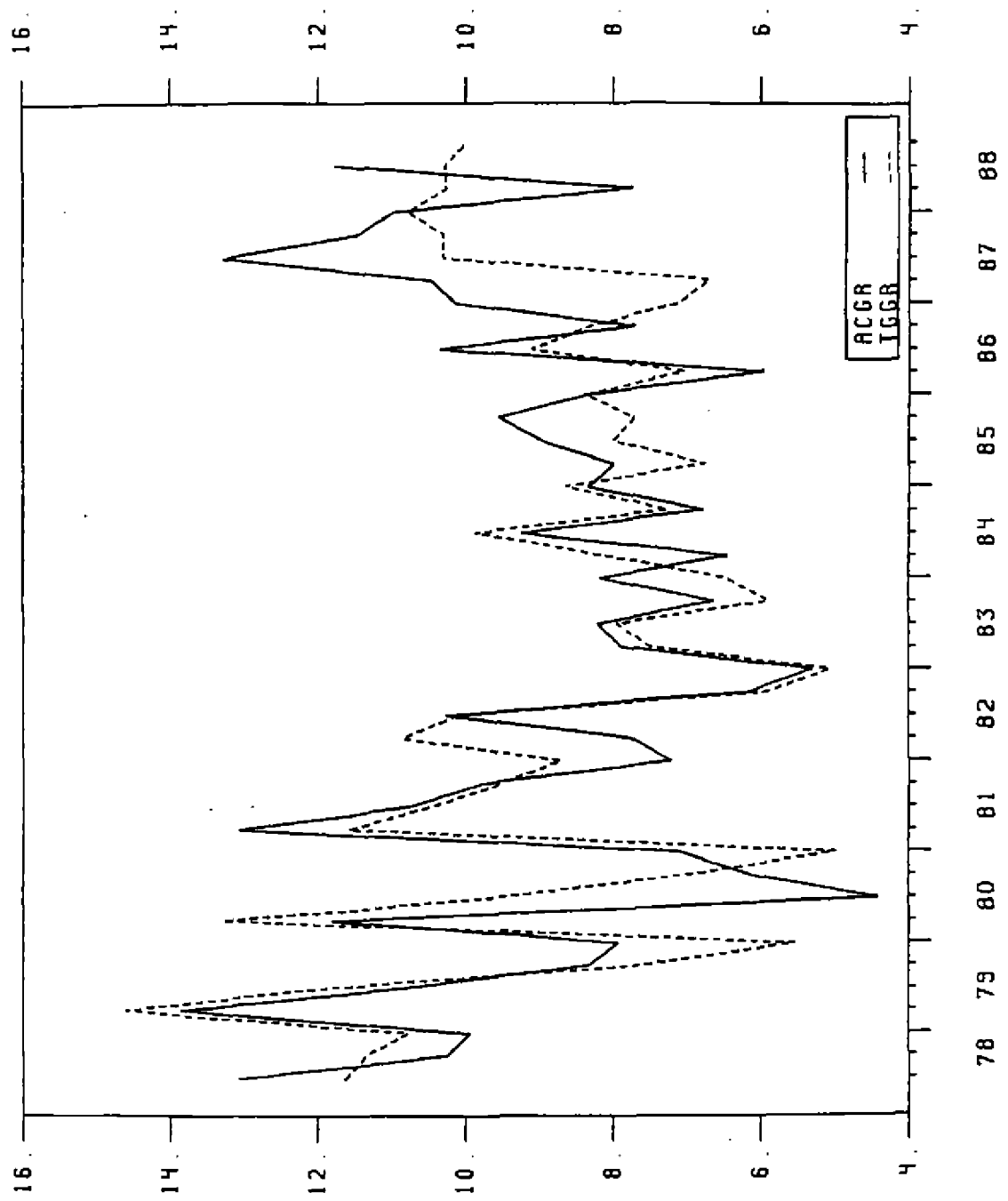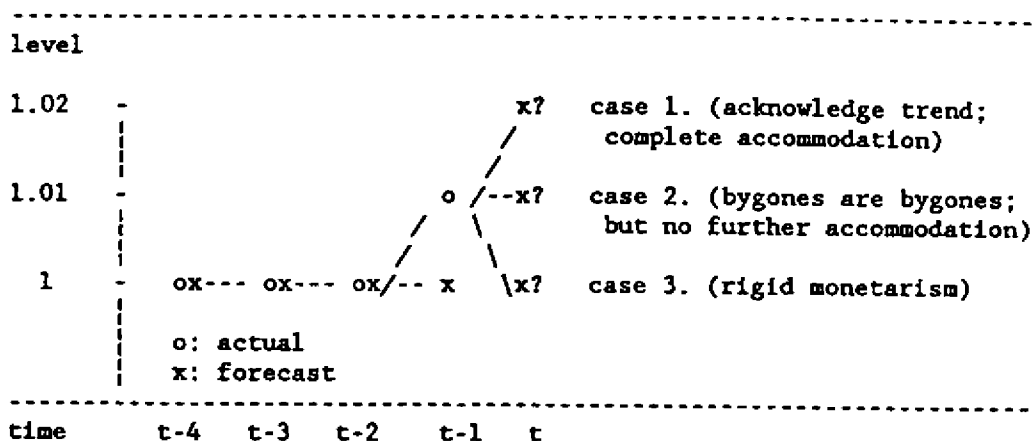
Fig 2   MONEY TARGET AND ACTURAL

ACTUAL ——
TARGET - - -

Fig 3   Q-Q RATE, TARGET & ACTURAL

Figure 4:   Hypothetical Money Supply Path

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   ------------------------------------------------------------
   level

   1.02    -                                  x?   case 1. (acknowledge trend;
           |                                /          complete accommodation)
           |                              /
   1.01    -                        o  /--x?   case 2. (bygones are bygones;
           |                         /   \         but no further accommodation)
           |                       /       \
   1      -      ox--- ox--- ox/-- x      \x?   case 3. (rigid monetarism)
           |
           |      o: actual
           |      x: forecast
   ----------------------------------------------------------------
   time        t-4    t-3    t-2    t-1    t
```

Implied growth rates of the three cases:

(i)   Official four-quarter basis

time	t-4	t-3	t-2	t-1	t
actual		0.0	0.0	1.0	
forecast					
case 1				0.0	2.0
case 2				0.0	1.0
case 3				0.0	0.0

(ii) Quarter-to-quarter basis

time	t-4	t-3	t-2	t-1	t
M(t)		0.0	0.0	1.0	
TG(t)					
case 1				0.0	1.0
case 2				0.0	0.0
case 3				0.0	-1.0

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