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The Return of "Structural" Monetary Policy?

The Case of the Bank of Japan

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Figures and Tables

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1. Introduction

In the late 70s, most major central banks accepted monetary stability as a precondition for a sound development of their economies, and vowed to refrain from interference into the economy in "real" or "structural" terms. Central banks seemed to have accepted, adopted, and even executed a monetarist paradigm, which claimed that monetary policy, although effective in the short-run, is at best neutral in the long run. Most central banks therefore tried to avoid any involvement into long-term, structural issues, became independent from government, and even tried to enhance their "neutrality" by adopting monetary policy rules.

More recently, however, at least two central banks stick out as major exceptions: the Federal Reserve of the U.S. and the Bank of Japan. Both institutions are confronted with economic conditions they consider as "structural" changes, and they react by overruling the conventional central banking wisdom, which calls for a mere stabilization of a given development path of the economy. The underlying arguments are simple and sweeping: revolutions in information technologies, market flexibility, and governance have changed the economy (U.S.), or have changed the world economy but not the domestic economy (Japan), and "neutrality" therefore requires an as-early-as possible adaptation of monetary policy to the new realities.

In the U.S., the Fed accommodated growth rates of a boom that would have been coined a "bubble" under (historically) normal conditions. Instead of fighting against booming demand and skyrocketing stock prices, which rang the alarm bells in its models, the Fed opted to accept, or even to cherish a "New Economy" with unexpected growth rates (see the Appendix, Figure 7). In the meantime, with some late help of the Fed to pick the bubble, many "new economy" stock prices came down to earth, of course. Still consistent with its former "structural" analysis, the Fed therefore tries to stabilize the economy on a high growth level by further monetary expansion.

In Japan on the other hand, the burst of a "bubble" and the following persistent financial crisis, which spread (or rooted?) in the very foundations of the economy

did not trigger expansionary action at the Bank of Japan beyond accommodating reactions of its standard short-term interest rate instrument to deteriorating conditions. Looking from outside, many earlier studies (i.e Clarida / Gali / Gertler 1997, Chinn / Dooley 1997) therefore concluded, that the BOJ had a much stronger stance against any inflationary development (and less concern about other developments) than comparable central banks (i.e. the German Bundesbank and the U.S. Federal Reserve).[1] This view was enforced by an ever-increasing exchange rate of the Yen, which demonstrates that international investors believe in the stability of the Yen, regardless how deep any crisis in Japan might be. Also, judging from inside, even Japanese domestic investors and households seem to have shared this "outside view." They saved and hoarded their money in the strong belief that the safest bet in Japan is the bet on the disflationary stance of the BOJ.

After opposing this view of its policy during the better part of the decade, the BOJ now more or less openly admits that it will refrain from any "real water" expansionary policy until "structural reforms" in terms of fiscal austerity of the Ministry of Finance (MOF), "bad loan" disposal of the financial industry, and increasing profitability of lackluster industries become clearly visible.[2] It explained, that it would not risk (hyper) inflation and a deteriorating balance sheet for bailing out the economy from a crisis that has its roots in (poor) economic policy and the inefficient economic structure.[3]

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1 Other studies on monetary policy decisions within the OECD enforced the impression that monetary policy internationally converged to systematic reactions on (especially) price developments, even though official policy announcements diverged considerably between more or less unsystematic, discretionary announcements or clear-cut rules based on different targets like a monetary aggregate. It seems that we can find the "same tune, different words" Chadha/Janssen (1998) in most OECD countries. Consequently, many central banks, i.e. New Zealand, Canada, Great Britain, took a further step, and openly adopted a "rule based" policy of "inflation targeting."

2 Here is a recent example: "Structural reforms will mean short-term pain for the economy," Hayami said. "But once the short-term pain is overcome, the benefits to the economy will be realized." Hayami added that some reforms, such as deregulation, are likely to limit economic hardship. By encouraging the formation of new industries, deregulation will help provide employment for laid-off workers from struggling industries, he said (Nikkei 2001.07.17).

3 Until about 1998, the BOJ insisted that it did care for aggregate demand, and did its utmost to solve the financial crisis by being (subsequently) expansionary up to a point were

The two structural monetary policies in Japan and the U.S. are not just mirror images of accommodation, however. While the FED claims to merely adjust to an ongoing change of the economy, the BOJ's argument must be regarded as more far-reaching. Basically, its argument is, that the economy and many of its institutions *have* to adjust to internationally given competitiveness to return on an otherwise inaccessible growth path.

Unfortunately, such an argument is not only risky, as it is in the case of the U.S., which adapts to a still unknown ("new") economy, it is also highly problematic because the BOJ, an independent and unelected institution, prescribes the necessary changes for the economy outside democratic control. The central bank law asks the BOJ to keep price stability and to provide to the "sound development" of the economy. It is highly unlikely, however, that lawmakers had decisions about a "sound structure" of the economy in mind when they formulated the law.

Furthermore, to enforce its prescription, and to reach its structural (microeconomic) targets, the BOJ did not only use its (limited) microeconomic means of mediation and administrative guidance. Instead, it used its macroeconomic policy instruments (money market rates and quantities), which have much broader impact and consequences. In Japan, this use of macroeconomic tools for microeconomic means, lead to the consequence of overall stagnation and deflation, but left the targeted sectors – finance and construction – rather unshettered. Ironically, it seems that the policy even yielded adverse results by increasing the financing costs in high-growth sectors, while the lacking profitability in labor-intensive sectors was made up by means of fiscal money.

As a consequence, this type of restrictive "active" monetary policy has to be regarded as problematic today, as earlier attempts to expansionary "active" mone-

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its policy instrument, the call rate, came down to effectively 0% (see Table 1). This argumentation (not the policy) gradually changed its stance from 1998 when standard indicators (stagnating GDP, falling prices, and exchange rate appreciation) continued to recommend further monetary easing, and the BOJ declared its inability to break deflationary expectations due to a "liquidity trap". From 1999 the BOJ (officially) started to argue that the structural problems of the economy demand a restrictive stance that would not dilute the pressure for restructuring finance and industry too early.

tary policy have been. As already mentioned, the failure of "structural" monetary policy during the heydays of Keynesian overall control, when it was used for expansion beyond economic means, lead to the often criticized consequence of long-term stagflation. It seems as if a similar policy at the opposite extreme lead to comparable results at the deflationary end of a monetary policy scale in Japan.

To prove the point we proceeded in several steps. The paper starts off with a short historical overview of monetary policy in Japan (section 2). Section 3 contrasts this tentative history and indicator presentation with the official BOJ statements and policy stance. To compare, we then fit some simple reaction functions, which link the two presumed key objectives of BOJ policy, price (inflation) and aggregate demand stabilization, with a short-term interest rate instrument following the internationally very successful "Taylor rule" concept (section 4).[4] After some promising results, we improve the reaction functions by adding interest rate smoothing, "forward looking" inflation forecasting behavior, and different possible alternatives for real demand targets to find significant demand related reactions of the BOJ (section 5). Finally, in section 8, we use the best fitting reaction functions we could find, and performed a small historical experiment by contrasting the fitted, rule based policy decisions of the BOJ (or its normal policy reactions) with its actual policy. Section 9 concludes that the BOJ is indeed an extreme inflation fighter, whose current, rare "discretionary" policy episode is a turn to a more restrictive policy than was "standard" during the last two decades, and might be the result of a "structural policy" experiment. Lastly, section 10 assembles some proofs and figures too space-consuming for the body of the text.

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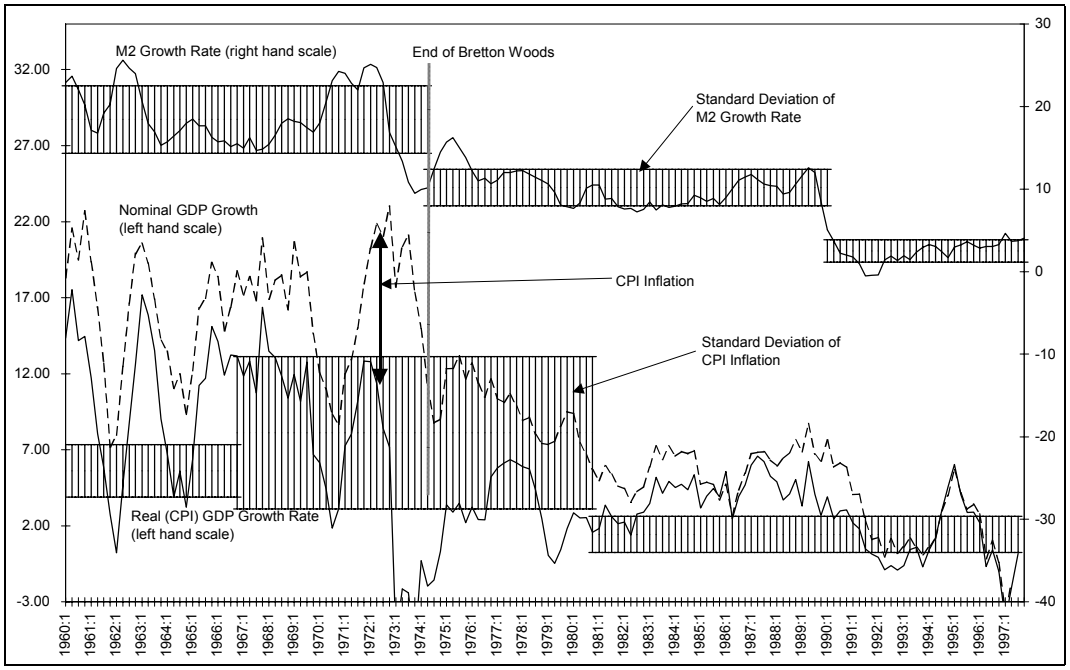
[4] In general, as long as the decisions of monetary policy makers are based on systematic economic knowledge, all monetary policy regimes can be described as a system of rules, even if they are hard to observe and difficult to define. On the other hand, any rule or operating procedure, which is intended to be efficient over time in reacting to unforeseen shocks or structural changes in a changing world, has to incorporate somewhat 'discretionary' elements (see, for example, Bryant / Hooper / Mann 1993). Therefore, the distinction between rules and discretion cannot be straightforward or clear-cut, and the underlying policy framework we are looking for in this paper, becomes "a framework, not a rule" or "constrained discretion" (Bernanke / Mishkin 1997).

2. A Short Monetary History

Japan has a long history of (relative) monetary stability and the BOJ has an outstanding reputation for achieving its preeminent targets. Figure 1 demonstrates that already during the Bretton Woods era the BOJ was able to hit its monetary policy target of fixing the exchange rate during the entire time. The same is true for the following new monetary policy goals of price stability (from the mid-70s), and stable money growth, which became a target for a period during the early 80s.

Figure 1 Growth Rate of Money Supply (M2), Inflation (CPI), and Real GDP Growth (%) (1960:1 – 1998:4)



Source: OECD, MEI, and IMF, IFS.

The history of monetary policy in Japan was not an unmixed success, however, if more factors than the foremost policy targets are accounted. The strict following of a fixed exchange rate target during Bretton Woods, for example, was hugely successful in terms of economic growth because of the undervalued currency, but it also had major disadvantages for Japanese consumers because of high domestic prices and bad environmental conditions.[5] The strong inflation during the time of

[5] Also, although sticking to non-equilibrium rates during the late Bretton Woods era was not unlawful for a surplus-country under the existing international agreements, doing so

adjustment to the new target of price stability under a system of flexible exchange rates resulted in a major destruction of personal wealth in an economy where a huge part of wealth was held in the form of nominal assets like bank deposits. Later, the high reputation for monetary stability, which was won during the 80s, could not be translated into an internationalization of the Yen or in gaining a key currency position in Asia because the financial and capital markets remained quite closed and underdeveloped. More recently, the trial of renovating and opening the financial markets by deregulation in the 80s was unsuccessful because the structure of the financial system remained non-transparent and inefficient, and later even provided to the development of the huge asset bubble of the 90s, which completely undermined the financial sector and led to a still-continuing financial crisis (Hoshi/Kashyap/Scharfstein 1990, Horiuchi 1995, Schulz 1997). Currently, failed attempts to clean up the bad debts of the financial sector, and the insistence to keep monetary policy within the proven realms of overnight interest rate instruments, could not revive money demand and economic activity. Figure 2 demonstrates the accompanying breakdown of money demand.[6]

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was definitely not in the spirit of a system, which was meant to stabilize the international financial system and the world economy.

[6] Already Figure 1 demonstrated that growth of M2+CD increased after 1986, strongly decreased after 1990, and increased after 1994 again – although at a lower rate. This behavior of money demand would be compatible with a "bubble" like cycle after the Plaza Agreement in 1985 (Schulz 1997). Empirically, however, it might also be possible that a regime change for real money demand with a lower growth rate has set in since 1990. The same might be true for velocity of money in Figure 2, which has had a decreasing trend until 1993, but was almost stable thereafter (1997 VAT was increased in Japan). For velocity, a financial crisis explanation of the broken trend is, however, even more likely than for money demand. Falling prices and low or negative output growth might have had a stronger impact than a general trend to lower money demand.

Figure 2 Real Money Demand and Velocity

Source: Data from IMF, IFS.

The sharp breakdown of the increasing trend of money supply from the banking sector and demand for deposits (quasi money) set in when the BOJ turned to a restrictive monetary policy to stop the development of a bubble on its asset markets. After 1990, along with the economy, demand for quasi money did not recover although the velocity of quasi money developed a short-term peak during the huge fiscal programs after 1996. This drastic development of financial crisis is, of course, not due to the BOJ.[7] It failed, however, to fix the crisis-induced shift of money demand to liquidity and cash.

Beyond the "pure" monetary sphere, the result of the financial crisis was (and is) a lasting slow down of the economy in companion with periods of deflation, which have not been effectively addressed yet (see Figure 3).

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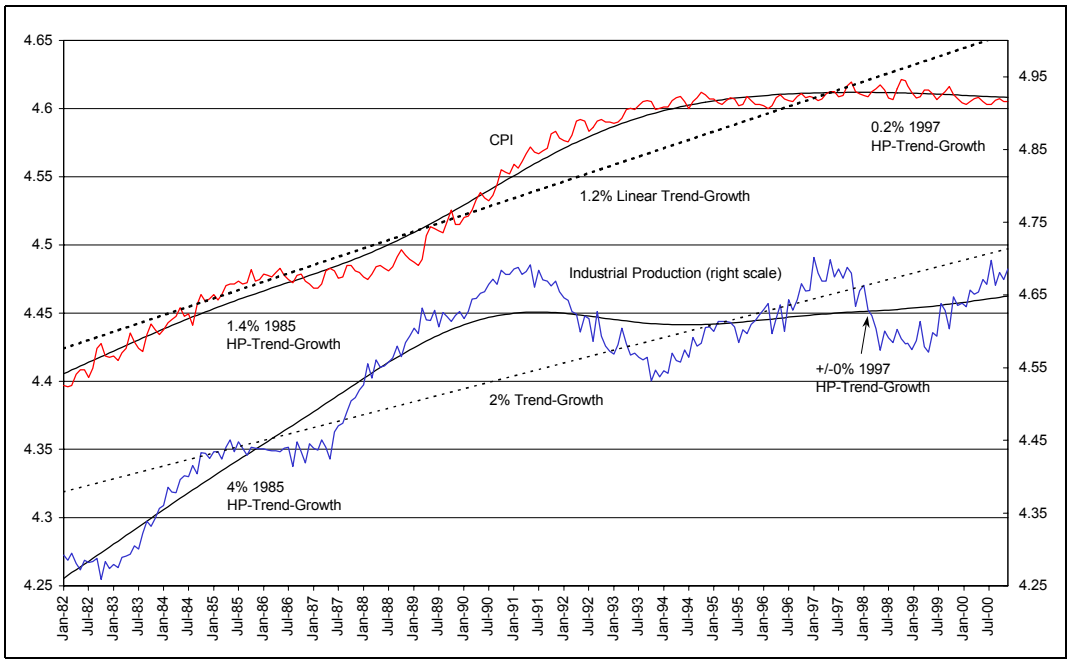
7 As Figure 8 in the Appendix demonstrates, the BOJ filled the hole in quasi money by supplying ample liquidity in terms of currency (M1). The sum (here M2+CD), therefore developed almost on its former trend.

Figure 3 Industrial Production, CPI, and Trend Development



Source: Data from IMF, IFS. The HP-filter is based on a smoothing-parameter of 129600 (see Ravn / Uhlig 1997).

3. The BOJ's Comments and Reactions

The BOJ has never been criticized as severely as during the current decade-long (financial) crisis. Most observers (from economists to private households) suspected that the BOJ actively or passively neglected the economic crisis by concentrating on inflation targets only – for better or for worse. The BOJ, in contrast, always stressed that it was very well able to equilibrate its competing goals. According to the bank, it concentrated on price stability, its major and final goal, of course, and tried to achieve one the world's lowest inflation records.[8] But beyond this, it successfully enhanced the international value and reputation of the Yen as a strong currency, and it was able to stabilize financial markets as well as real growth during one of the worst structural crises in Japanese history with a flexible, discretionary monetary policy. Also, it did not even hesitate to do its utmost to aid the ailing economy by advancing into the uncharted waters of a "0% interest rate policy" (zirp).

Along these lines, the policy announcements of the BOJ (see Table 1) have stringently stressed its emphasis on aggregate demand, which was the only variable always quoted as an objective of its policy since the mid-80s. Visible results of such intentions were rather hard to find, however. Inflation rates continued to fall during the 90s, and the disinflationary stance of the BOJ's policy even allowed for deflation during extended periods. Also, in terms of active solutions of the crisis by means of monetary policy, financial restructuring, or installation of effective prudential frameworks, the central bank remained rather silent and inactive. It even allowed that old structures were preserved and inefficient institutions became supported by governmental policy (Horiuchi 1996a).

Consequently, the BOJ lost credibility not only regarding its "sound development of the economy" goal, it even found itself in the situation to publicly detail its monetary target: "The monetary policy objective of Bank of Japan is to pursue

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[8] The BOJ Law, Article 2, says: "Currency and monetary control shall be aimed at, through the pursuit of price stability, contributing to the sound development of the national economy."

price stability, avoiding both inflation and deflation" (BOJ 9/1998, announcement of the Monetary Policy Meeting). Hardly anything changed, however, because the BOJ refused to follow up the announcement with an expansionary policy beyond the means of its short-term interest rate instrument, which already resided at the lowest possible level. At the end of 2000 the BOJ therefore further clarified its anti-deflation intentions by announcing "inflation forecasts," which were intended to draw the public perception of its policy closer to an active inflation targeting strategy. The forecasts, however, only consisted of tentative polls of the policy board members, and became dismissed as hardly transparent or binding.

As a result, all these announcements remained insufficient to break deflationary expectations, and real demand did not increase. Most recently (March 2001) the BOJ therefore decided to enforce its "inflation targeting strategy" by switching from a (0%) call rate target to quantitative expansion in the money markets as long as deflation remains. Given the low demand in the (overnight) money markets, however, even this instrument change has not become effective yet. The volumes targeted by the BOJ were either too low to spill over into other markets, or were not even reached because banks refused to take on further reserves at effectively 0% interest.

In contrast to these official announcements, prone by poor communication or obvious differences between "words and actions," the BOJ slowly engaged into another line of argumentation. Since about 1998 – the year of independence of the BOJ – the central bank argues increasingly open and direct that the economy be in the midst of a structural crisis, which cannot and should not be helped by an expansionary monetary policy. Such arguments leaked only very gradually into official comments after most other lines of argumentation for its passivity dried up. The arguments for a role of the central bank as force behind structural changes seem to have been used first against expansionary demands of the government in rather internal debates, started to show up at (semi-) public academic conferences during 1999, and became one official line of argumentation late 2000.

When analyzing the different lines of policy comments from the BOJ against the background of its relative passivity (at least during the current financial crisis),

three possible explanations for its reactions can be differentiated:

- First, the economy seems to be stuck in a long-term "liquidity trap," which doomed monetary policy as ineffective.
- Second, the BOJ decided to refrain from active monetary policy, and settled for a demand driven interest rate smoothing strategy as long as inflation is not picking up (relative passivity).[9]
- Third, the BOJ thinks the economy is undergoing (and in need of) structural changes, which require a restrictive monetary policy to become effective (active neglect).[10]

A liquidity trap in Japan is a possibility – and the BOJ frequently stressed this line of argumentation with its declaration that it had "done everything possible by reducing the call rate to effectively 0%." Also, empirically, some indicators are indeed pointing to a liquidity trap. Saving rates, for example, are high in Japan, liquidity is very high, and money is often horded under the "mattress." After closer inspection, however, a trap seems to be highly unlikely. Saving rates are not at record highs, especially if the pending ageing of the Japanese society is taken into consideration. Real interest rates beyond 4% for corporate credit demonstrate demand, and are not even extremely low in comparison to other countries. Compared to the U.S. and Europe, for example, they seem to be rather high. Consumer demand for high-priced (luxury) and low-priced quality goods is high, and many high-grade importer and discount chains are enjoying peak profits.

Even more important is the argument that the BOJ has not yet tried reactions of money demand beyond the realms of its targeted (overnight) money markets by, for example, buying outright serious amounts of governmental bonds or U.S. dollars. Furthermore, as Krugman (1998) rightly pointed out: a liquidity trap can be

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[9] In this case, the evidence for positive real GDP growth reactions at the BOJ, with no clearly defined equilibrium level, becomes another indicator of a pure inflation fighting strategy, which uses real growth as another inflation indicator only.

[10] In this case the BOJ would have decided not to "bail out" the economy by means of a monetary expansion until, for example, the "bad loan problem" of the banking sector and low profitability in major industries is not solved by other political and corporate means.

broken by inflation expectations (as long the currency has not devalued completely, it should be added). The BOJ therefore seems to have decided to remain rather passive long before it could be considered as "trapped" by private preferences.

The rejection of a liquidity trap in Japan leaves the question for the two other possible explanations. Unfortunately, given the rather opaque explanations from the BOJ, is the differentiation between relative passivity and active neglect, which could be interpreted as a "structural" monetary policy, rather difficult. In the next sections, we will therefore try to identify a "best-fitting" reaction function as an approximation of its typical behavior and policy stance, and use this function for a discussion of periods of (active) deviation.

4. The BOJ's Policy in a Taylor-Rule Context

Given the two main objectives of the BOJ (inflation and growth), a good starting point for searching its "true" objective function is the "Taylor rule" (Taylor 1993), which links a short-term interest rate instrument with an inflation plus real GDP reaction function. This reaction function is (in different variants) internationally very successful in explaining monetary policy in OECD countries. For the case of Japan, it covers three key elements of Japanese monetary policy: the use of the call rate as the policy instrument, the policy emphasis on low inflation or price stability, and some emphasis on demand stabilization.

In the original Taylor rule (designed for the U.S.), the real GDP and inflation gaps both have the same weights, a feasible inflation rate was set to 2%, and the real long-term interest rate equaled a trend-based long-term growth rate of 3%. The rule is backward looking because policy indicators are based on (expected) current annual changes of inflation and the GDP-gap.

Eq. 1 $$i = 0.5(y - y^*) + 0.5(\dot{p} - \dot{p}^*) + r^*_{long} + \dot{p}$$

The astonishing result of the Taylor rule was (and is), that such a simple rule can produce such a good fit for monetary policy since the 1980s in the U.S. and many other countries including Japan (see Chadha / Janssen 1998; Chinn, Menzie D. / Michael P. Dooley 1997; Clarida / Gali / Gertler 1997; Gerlach / Schnabel 1999). Of course, to find a well-fitting function for any special country, it has to be adapted to the specific conditions of the country. Japan, for example, has had a much stronger emphasis on low and falling inflation than the Federal Reserve (Clarida / Gali / Gertler 1997). The targeted long-run inflation rate seems to be much closer to 1%, than the 2% in the U.S.[11] The real GDP trend growth rate during the period is estimated to be 2.5%, and we found an approximate long-term real interest rate of 3.2%. Using these parameters for the estimation of a Taylor-

[11] To estimate this, we used the results of a simple VAR model for inflation forecasts (see Schulz 1999).

type policy rule for Japanese quarterly data from 1983 to 2000, we find the following reaction function.[12]

Eq. 2 $$i_t = 3.20 + 0.06(y_{t-1} - y^*) + 2.02(\dot{p}_{t-1} - p^*) + \varepsilon$$

R2: 0.76 DW: 0.65 T: (21.20) (1.15) (14.15)

The result is an adapted Taylor-rule, which has a negligible and insignificant real GDP-gap component.[13] In essence, the function becomes a pure inflation-targeting rule. Even experiments with different specifications of the real GDP-gap[14] (based on HP-filters, and other basis periods) and estimation strategies (IV, GMM) did not improve this result significantly, leading us to suspect that the BOJ is not actively trying to equilibrate aggregate demand.

However, a less ambitious formulation of the central bank reaction function, in which the central bank targets only growth rates instead of levels, yielded significantly better results. As can be seen in Eq. 3, the replacement of the real GDP-gap (in levels) with real GDP growth ($\dot{y}$ is the log GDP growth rate; $\dot{y}^*$ is the long-run growth average of 2%, which was added only to get the constant more comparable) improved the fit of the rule significantly.[15]

Eq. 3 $$i_t = 3.09 + 0.31(\dot{y}_{t-1} - \dot{y}^*) + 1.66(\dot{p}_{t-1} - \dot{p}^*) + \varepsilon$$

R2: 0.82 DW: 0.59 T:(22.52) (4.98) (13.55)

Although these coefficients are numerically close to the original Taylor rule result with its even weights for inflation and the real GDP gap,[16] a major difference re-

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12 All data are OECD and IMF data, provided by Datastream. The interest rate (i) is the policy instrument of BOJ, the call rate. For price data, we use the consumer price index (CPI), and inflation is defined as the percentage change from twelve months before. The output gap is the deviation of the industrial production index from its log-linear trend.

13 Also, the constant, which represents the long-term interest rate in the function, is close to our pre-estimates.

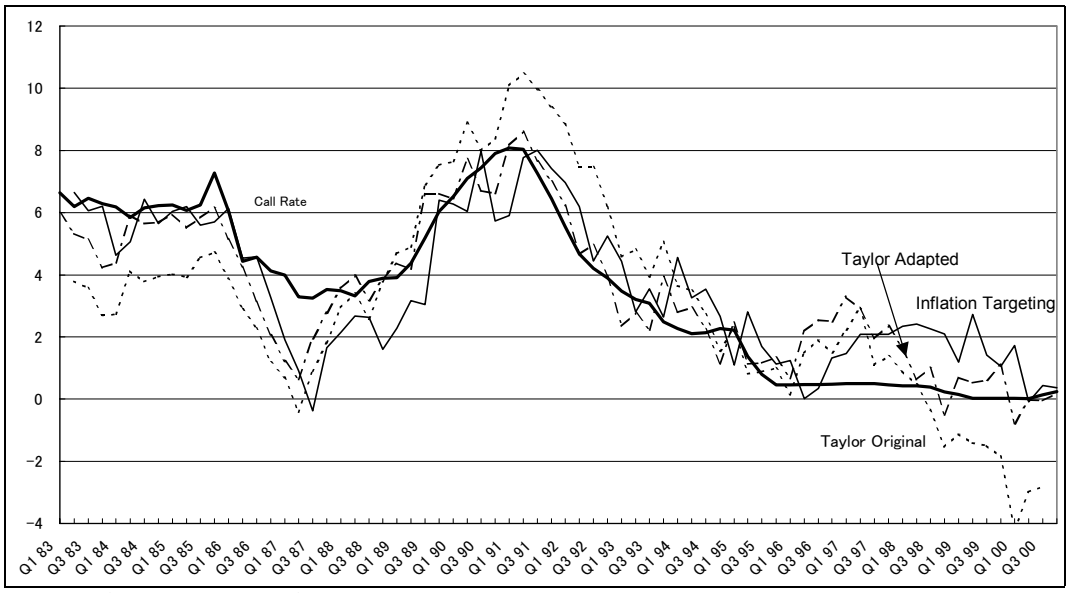
14 Our gap-definition is based on a simple linear trend for the period. The reason for the choice is the structural break in 1991, which leaves any other choice as arbitrary as this one. We have, of course, experimented with different other ones. One candidate was the deviation of the industrial production index from its smoothed trend by the Hodrick-Prescott filter. However, it did not perform well in our estimation. Also, it would have the consequence of a 0% growth target in the 90s (see Figure 3).

15 The inclusion of the target levels as constants is only intended to yield a more realistic constant for the reaction function. It won't change the statistical results.

16 Because we have not included actual inflation on the right twice (or estimated the equation

mains: the fitted reaction function implies that the BOJ is not trying to stabilize any real GDP trend, but settled for stabilizing a real GDP growth rate instead. By doing so, the BOJ uses the real growth only as an early inflation indicator, and does not try to stabilize the economy on a known or given path, which might lead to a path-dependency and time-inconsistency problem. To demonstrate the difference, Figure 4 shows the call rate recommendations of a pure inflation-targeting rule (Eq. 2), the original Taylor rule (Eq. 1), and the adapted, GDP growth based Taylor rule (Eq. 3) along with the historical data.

Figure 4 The Taylor Rule, Pure Inflation Targeting, and Inflation Plus Real GDP Growth Targeting



Note: Data from OECD, MEI, and IMF, IFS.

Reacting to the levels of inflation and the real GDP gap, the original Taylor rule would have been much more expansionary in the early 80s to guide GDP in a direction of a higher average level for the two decades. However, the rule would have also raised the call rate earlier than the BOJ – as early as 1987, to counteract the expansionary policy results of the Plaza Agreement. In 1988 it would have

with the real interest rate), a coefficient of 1.66 in our equation is, for small changes in inflation, equivalent to 0.66 in the original rule. However, inflation changed considerably on a quarterly basis during the period, the result is therefore numerically somewhat different. Estimating the function with the real call rate (the inclusion of the inflation rate on the left or right side of the equation), yields parameters of 2.16 for the constant (real interest rate), 0.23 for the real GDP growth-gap, and 0.81 for the inflation gap.

recommended a more restrictive policy than the BOJ actually implemented to fight the development of the "bubble." During and after the burst of the bubble in 1990 it would have still been more restrictive with higher interest rates than the BOJ. Later, after becoming a little more expansionary in 1995, it would have increased interest rates again to fight the effect of the huge fiscal programs in 1996. From 1998, however, in an attempt to fight deflation and a high negative real GDP gap it would have been more expansionary than the BOJ, and would have even tried to implement negative nominal interest rates[17].

In contrast to the "Taylor rule" the two adapted rules are much closer to the actual call rate development, and they behave quite similarly to each other. Of the two, only the pure inflation-targeting rule is somewhat more expansionary before 1991, but becomes more restrictive thereafter, and it is the only rule that recommended strictly positive interest rates after 1998.

If we compare the actual BOJ policy with the recommendations of the (adapted) Taylor rules using the historical results of the 80s and 90s (or boom and bust) as a yardstick, a policy reaction function with some weight on real GDP targeting might arguably have been preferable to pure inflation targeting. The GDP-rules not only counter-reacted earlier to the huge expansion after the Plaza Agreement, which might have been helpful to dampen the development of the bubble, they also tended to be more expansionary during the following (financial) crisis, which might have been helpful to solve the crisis earlier.

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[17] We have not restricted the model to positive interest rates. To get policy recommendations from the rules, this is feasible in our view. In applied policy rules, the model could be restricted, or the negative interest rate recommendation could be translated into an expansionary aggregate policy with zero interest rates instead.

5. The BOJ's Reaction Function: Slow-Handed Inflation Fighting

The main difference between BOJ policy and the original Taylor rule with its huge level corrections is the much smoother character of BOJ policy decisions. Also, the BOJ seems to have concentrated on a strategy of pure inflation targeting (Eq. 2). The better fit of the reaction function based on growth rates instead of level targets for demand (Eq. 3) implies that the central bank seems not to care much about level deviations in its short-term operations.

To start the quest for better fitting reaction functions of the BOJ we therefore have to take care about the relative passivity of its anti-inflationary policy, i.e. its stance to strong "interest rate smoothing."[18] The general idea of such a policy concept is quite easily explained: most central banks smooth interest rates because they fear probable disruptive impacts of strong central bank moves in the money markets. Huge changes in overnight rates are not only seen as problematic because the central bank acts as a monopoly supplier; strong moves could also trigger wrong interpretations of policy intentions (Goodfriend 1991).

Interest rate smoothing, however, is not free of costs. Goodhart (1992), for example, rightly argues that interest rate smoothing can result in a monetary policy which implements necessary corrections always too late and too little. Especially in combination with the already stated tendency of the BOJ to target only price and real GDP changes instead of their levels, such a policy runs a high risk of becoming cyclical and biased.

To estimate the impact of interest rate smoothing on the policy instrument in Japan, we therefore have to partially adjust the targeted rate to the actual rate:

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[18] More technically, an inspection of the residuals shows that the low Durbin Watson and R2 statistics are due to a strong first-order serial correlation in the error term. This points in the direction of strong interest rate smoothing by BOJ. With interest rate smoothing applied, the central bank usually sets the current interest rate close to the former one, which will result in the strong AR(1) process we found.

Eq. 4 $$i_t = (1-\lambda)i_t^* + \lambda i_{t-1}$$

Applied to our inflation plus GDP targeting reaction function, the smoothed Taylor-rule becomes:

Eq. 5 $$i_t = \lambda i_{t-1} + (1-\lambda)(\beta(\dot{p}_t - p_t^*) + \gamma(y_t - y_t^*) + i_t^*))$$

Smoothing, as long as it is not a full-fledged interest rate targeting policy, is not done on a quarterly or yearly basis, of course. We will therefore switch the empirical investigation to monthly data, which are closer to the conduct of monetary policy decisions and to the daily central bank operations. Unfortunately, however, we have to replace the GDP time series with industrial production at the same time, because it is the only demand series available on a monthly basis.[19]

First, we re-estimate the Taylor-type reaction function (backward-looking real GDP and inflation-targeting) with interest rate smoothing by Instrumental Variables.[20] The strong impact of smoothing behavior at the BOJ is obvious in Eq. 6.

Eq. 6 $$i_t = 0.03 + 0.96 i_{t-1} + 0.04(0.10(y_{t-1} - y^*) + 1.78(\dot{p}_{t-1})) + 0.17\,AR(1) + \varepsilon$$

R2: 0.99 DW: 1.99 T: (0.79) (67.35) (1.11) (3.59) (2.49)

The coefficient of the lagged interest rate dominates the entire equation. With a value of 0.96 for the coefficient of the call rate, the interest rate behavior is close to a random walk. Also, an Augmented-Dickey-Fuller-Test re-enforces the hypothesis of a random walk.[21]

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19 The two series are closely related, however, and the BOJ is not in a much better position at this empirical matter.

20 We use IV because of the lagged dependent variable on the left. The difference to an OLS estimation is, however, negligible. Instruments are the lagged dependent and independent variables with lags down to six months.

21 An ADF-test reveals a first order unit root for the call rate. The F-Statistic, with a value of 0.47, is well below the MacKinnon 5% critical value of 2.87. For the first difference, however, the hypothesis of a unit root can be rejected even for the 1% critical value (F-Statistic: 8.76; 1% Critical Value 3.46).

The coefficient of the lagged interest rate or the impact of interest rate smoothing on the reaction function would be much lower for a longer horizon as in the case of estimations with quarterly data, of course. In our estimates, the coefficient for the lagged call rate in the same setup with quarterly data becomes 0.88. Even the quarterly data for the call rate are, however, not stationary.

If we accept that the behavior of the call rate resembles a random walk, but do not suspect that the BOJ flips coins to set its level, the "smoothing" explanation of this behavior is, that the central bank fixes the interest rate instrument for a considerable period of time to force other market participants to adapt to its (exogenously set) policy level in the mid- and long-run, and concentrates in its daily operations on changes in the interest rate instrument only.

To check for this possibility, we reformulate the policy rule by shifting the lagged call rate to the left side (i.e., using first differences) of the reaction function and experiment with different formulations of changes in industrial production and consumer prices on the right.[22] As a result, the best-fitting reaction function seems to be a function that uses changes in the call rate to target changes in inflation and yearly growth of industrial production from the month before.

Eq. 7 $$(i_t - i_{t-1}) = \underset{(-2.61)}{-0.057} + \underset{(2.85)}{0.010}(\dot{y}_{t-1}) + \underset{(2.28)}{0.071}(\dot{p}_{t-1} - \dot{p}_{t-2}) + ARMA + \varepsilon$$

R2: 0.23 DW: 1.99 T:

$$ARMA = \underset{(4.57)}{0.30}AR(1) + \underset{(2.82)}{0.19}MA(6) - \underset{(-2.92)}{0.20}MA(12)$$

Judging from this reaction function, the BOJ does not look like a pure inflation-targeter anymore. For the first time, we get a significant industrial production (growth) target. Yearly changes of industrial production seem to have had significant – but small – impacts on changes of the call rate. However, after some experiments with the differenced reaction function, we found that only a small part of the monthly changes in the call rate can be explained by the (supposedly) targeted variables. Not only is the R2 of the estimation quite low; also, the structure of the "pure time-series" ARIMA(1;1;6,12) model, i.e., the lagged values of the residual and the lagged values of the forecast error, are very important for a forecast of the call rate.

According to this reaction function, the BOJ would adjust the call rate only by very small amounts, which could only smooth price developments a little, but would not offset any such movement of prices or industrial production entirely.

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[22] In this differenced policy formulation seasonality in the data proved to be important. We

For our following policy discussions, the acceptance of such a purely smoothing function is not very helpful, however. At least for the policy instrument, the call rate, we should stick to a level formulation, because the BOJ is able to set and defend the level of its main instrument at its discretion, and uses it as a strong policy signal. During the current 0% interest rate policy, for example, the BOJ insisted for a long time that this level is appropriate and has to be maintained.[23]

The following reaction function (Eq. 8) therefore determines the level of the policy instrument with a strong smoothing coefficient of 0.96 for the lagged call rate, but with no level considerations for the targets. Both consumer prices and industrial production are lagged growth rates from a year before.

Eq. 8 $$i_t = -0.001 + 0.96 i_{t-1} + 0.04(0.29(\dot{y}_{t-1}) + 1.99(\dot{p}_{t-1})) + \varepsilon$$

R2: 0.99 DW: 1.74 T: (-0.02) (80.32) (2.82) (5.98)

Again, as in the differenced function (Eq. 7) for changes in the call rate, the yearly changes in industrial production are significant. As before, the BOJ reacts strongly (given the most important smoothing component) to past inflation and with a much lower, but significant, weight to changes in industrial production.[24]

To conclude the discussion of interest rate smoothing in Japan it has to be pointed out that such a slow-handed monetary policy is not uncommon among leading central banks. The monetary targeting objective function of the German Bundesbank (which has been in use for about 25 years), for example, was also slow in adapting to changing market conditions, and was also based on targets of changes in inflation and real GDP, instead of their levels as in the Taylor rule.[25] But to remain effective, such a slow-handed stance of monetary policy, which is not visi-

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have therefore seasonally adjusted all series by the X11-census method.

23 Technically, this means that we do not fully accept the random walk hypothesis for the call rate in its last consequences.

24 For comparison with the original Taylor rule: If current inflation is included on the right side, the coefficient for lagged inflation becomes 1.57, which is much higher as in the U.S.-based, even weight rule (0.5).

25 The monetary targeting rule of the Bundesbank can easily be transformed into a similar real GDP plus inflation-targeting rule. See Schulz (1999), and Deutsche Bundesbank (1999).

ble in daily, monthly, or quarterly operations of the central bank, has to be well explained and the long-run stance of the policy must be clear and credible.

To enforce this, the Bundesbank used an intermediate monetary growth target. In contrast, the BOJ has no such long-run policy stance or target, except the successful and proven ability to reduce inflation rates to historically low levels during the last two decades. At the same time, however, the accompanying slowing of real GDP growth has hardly triggered any (other than adaptive) reaction of BOJ. Even the significant industrial production variable might therefore be interpreted as another inflation forecasting variable within the setup of a pure inflation fighting policy.[26]

[26] Interpreted as a rule, the BOJ would not only react to an increase of the inflation rate by raising the call rate, it would also interpret any increase of the industrial production as a potential source of future inflation and would gradually increase the call rate to fight inflation before it picks up. Instead of stabilizing some predetermined (equilibrium) level of prices, inflation, industrial production, or growth, would this rule only counteract any change in inflation and growth to damp the potential threat to the path of price developments.

6. Was the BOJ forward looking?

As the original "Taylor rule," our last model had the short-coming of being restricted to lagged growth and inflation as its indicator variables to target future inflationary developments. This is not very realistic, of course. The central bank is not limited to base its policy reactions on simple models of backward looking indicators. On the contrary, it has potentially strong incentives to use its capacities and superior market information to run more sophisticated inflation forecasts than the lagged variables are providing.[27] In the following, we will therefore extend the approach by explicitly fitting forward-looking inflation forecasting models to historic BOJ policy decisions.

The main difference between forward and backward looking rules is that backward looking rules are usually based on much less information.[28] For example, the Taylor rule only processes information stemming from the information set incorporated in GDP and CPI developments. The main argument for choosing such a rule is that the public and most practical policy makers will be more easily convinced by models that are close to their presumably adaptive and history oriented analysis procedures, than by the rather abstract assumptions and procedures of inflation forecasting models. Furthermore, it can be argued that during phases of structural change (and the introduction of a monetary policy rule can itself be regarded as a structural change) backward looking models are a safer bet than untested forecasting models (Taylor 1998).

As mentioned before, the central bank, on the other hand, might be in favor of an explicit forward-looking behavior, based on sophisticated forecasting models, to

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[27] Even the already estimated "backward looking" reaction functions were not truly backward looking, because a time lag of only one month is not sufficient for having the "true" data available at the central bank. CPI and especially industrial production or GDP data take at least a few months to gather and to consolidate. The estimated reaction functions are therefore already using (implicit) forecasts for the targeted variables, but fared much better than longer lags of, say, 3 months.

[28] Another important difference is, that a forward-looking rule can be interpreted as a rule which uses the inflation expectation or forecast as an intermediate target (Svensson 1996a, Haldane / Batini 1998).

close the time lag (of about 1.5 years) between its policy actions and the "real" results of its policy.[29] This is especially true, because targeting inflation forecasts gives a much higher degree of freedom to the central bank than a backward looking reaction function. Especially when the underlying models of the inflation forecasts are non-disclosed, a model based on forward-looking policy becomes almost indistinguishable from a pure discretionary policy.

The problem of testing such a forward-looking policy model for the BOJ is, however, that the BOJ has not yet published its internal inflation forecasts. Furthermore, other sources of consistent inflation forecasts are also sparse in Japan. There is no market for indexed bonds, which could provide a yardstick for inflation expectations; no survey data are available; and the forecasts of research institutes are much less sophisticated than the consensus forecasts in the U.S., for example. [30]

To close the gap, we will employ two simple (ex-post) inflation-forecasting models, which might be close to the BOJ model. If so, they should improve the forecasting power of the (lagged CPI inflation) Taylor-equation inflation model of the last sections. The first model is readily available anywhere: we simply use the known historical data a couple of months ahead as the current inflation forecast. The underlying assumption of this model is therefore just the opposite of the backward looking model before: the BOJ bases its forecasts on perfect foresight.

The second model is a simple VAR-based model, fitted to the Japanese economy

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29 Because inflation takes time to build up within an economy and because any monetary policy reaction will also need some time to work through the transmission mechanism to finally reach prices, inflation forecasts at the central bank might be a tool to close the gap and to shift the instrument closer to its target ("inflation forecast targeting" as termed by Svensson 1996a).

30 Different estimates exist, of course. Higo (1998) for example, constructed inflation forecasts on the basis of corporate expectations, which can be extracted from three years expected real growth rates data of the "Report of Survey Research Concerning Corporate Behavior" of the EPA (Economic Planning Agency). The JCER (Japan Center for Economic Research) regularly publishes inflation forecasts, based on CPI, WPI, Unit Labor Costs, and World Commodity Price data. It is, however, unlikely that these approaches can form a basis of BOJ decisions. The Higo approach uses severely filtered and transformed annual datasets, which are interesting as comparison yard-stick or informational variable, but not as a basis of regular forecasts. The JCER approach on the other hand, is based on an extremely restricted, partial model of the economy only.

of the 80s and 90s. This approach is a little more realistic and might be the best way to get close to the actual model of the BOJ. Of course, this model is also estimated on the basis of known data to estimate and forecast developments during the same period, and is therefore beyond the possible knowledge of the BOJ at any given time. But because the model is restricted to some core-variables (four variables only), which are highly likely to be decisive in any inflation-forecasting model, the model is probably not completely unrealistic. Also, VAR-based models are used by many central banks as benchmarks for their structural models and the differing models seem to have converged somewhat in the meantime.

To start with the ex-post inflation-forecasting model (Eq. 9), we first use only a forecast for CPI-inflation (or the data twelve months ahead) Eq. 10, but still use the lagged series for real demand. In Eq. 12, we then extend the forecasting approach to both the inflation and the industrial production gap series.[31] The introduction of forecasted inflation into Eq. 10 implies that the BOJ is targeting a 12-months (perfect foresight) inflation forecast while using the lagged real growth as a (backward looking) inflation indicator. The further introduction of a forecast for the industrial production gap in Eq. 12 extends this approach to the possibility of a future real demand level target.[32]

Eq. 9 $$\dot{p}^{e}_{t+12} = \dot{p}_{t+12}$$

Eq. 10 $$i_t = -0.01 + 0.97 i_{t-1} + 0.30(0.2(\dot{y}_{t-1}) + 2.50(\dot{p}^{e}_{t+12})) + \varepsilon$$

R2: 0.99 DW: 1.81 T: (-0.37) (111.17) (1.53) (4.13)

Eq. 11 $$y^{e}_{t+12} = y_{t+12}$$

Eq. 12 $$i_t = -0.001 + 0.97 i_{t-1} + 0.3(0.16(y^{e}_{t+12} - y^{*}) + 2.30(\dot{p}^{e}_{t+12})) + \varepsilon$$

R2: 0.99 DW: 1.80 T: (-0.30) (110.78) (1.20) (3.31)

From the (huge) set of possible forward-looking reaction functions, we chose

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31 Although experiments with different VAR models suggest that the time gap between a change of the call rate instrument to an inflation reaction is closer to 15-18 months, the twelve months forecasting horizon produced the best results within the reaction function.

32 Svensson (1998a) points out, that while a backward looking rule with predetermined variables is a reaction function, a forward looking rule is an equilibrium condition, because there are endogenous variables on both sides of the equation.

again the best fitting ones. Both functions have interest rate-smoothing components with very high coefficients of 0.97. Also, with perfect foresight about inflationary developments, the BOJ does not seem to target future output gaps or to use lagged or current industrial production growth as an additional inflation indicator. Any tested real demand variable came out with very small coefficients and was insignificant. However, if we check Eq. 10 against its stationary alternative, i.e. the reaction function in first differences of the call rate, we find that lagged industrial production growth becomes significant, but its impact on the result remains very limited.[33] According to these forward-looking reaction functions, the BOJ is a pure inflation fighter with a very slow hand (for a forward-looking model based on VAR estimates, see Schulz 1999).[34]

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33 Again, the equation was by and large explained by the ARIMA (pure) time-series model.

34 With such an overwhelmingly important interest rate smoothing weight we again get an almost perfect fit in the graphical representation of the fitted to the historical call rate. The curves are therefore visually hardly distinguishable from each other and the deviation data beneath the level series have to represent the difference in 10s of basis points (right scale).

7. Targeting a Disinflationary Trend?

As a last step in our quest for demand reactions at the BOJ, we will introduce a falling trend rate of inflation (from 2.4% in 1982 to 0% in 2000) into the policy reaction function.[35] In Japan, the BOJ has clearly adjusted its inflation target to ever-lower levels, which is in line with the monetary policy stance in most developed countries. The enforcement of a low-inflation policy from the early 80s was much more extreme in Japan than in any other industrialized country (see the long-term HP-filter growth rates for the different periods in Figure 3), however, and the gradual reduction of inflation and inflation expectations to a level of currently close to 0% might have biased the estimates in favor of a pure inflation targeting result.

Eq. 13 $i_t = -0.01 + 0.91 i_{t-1} + 0.09(0.11(y^e_{t-1} - y^*) + 0.95(\dot{p}_{t-3}) + 1.97(\dot{p}^{trend})) + \varepsilon$

R2: 0.99 DW: 1.66 T: (-0.38) (43.32) (3.20) (4.47) (6.25)

In Eq. 13 the introduction of a long-term trend against price stability elevated the industrial production gap to significance for the first time and improved the reaction function considerably. Does this mean that the BOJ effectively cared for real demand after correcting for the (exogenous, long-term) trend in inflation? If so, this policy was particularly ill fated. First, most policy makers and economists agree that an inflation rate below 1% is not desirable because of the risk of being moved into deflationary waters by measurement errors and/or even minor exogenous shocks. Targeting a 0% inflation rate therefore constitutes a policy that places real growth at high risk.

To summarize the results for the different possible reaction functions of the BOJ it is save to say that strong interest rate smoothing – or a policy of a very slow hand – has been exceptionally important in Japan. Also, the entire set of tested functions shared a strong emphasis on inflation reactions, while the IP-gap was found

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35 Long-run adjustments are difficult to evaluate. Asako / Kanoh (1997), for example, had to estimate quite sophisticated Time-Varying Logit models to find any sensitive reaction function for the rather infrequent discount rate operations of BOJ (their result was, that monetary policy in Japan uses this instrument to adjust for inflation and real demand).

to be significant only if a falling trend rate for inflation targets down to 0% was added to the strong inflation reactions (see Eq. 13). Reactions on changes in industrial production, on the other hand, were also found to be weak, and only significant in the backward looking policy formulations (see Eq. 8). These backward looking growth-based reactions, however, do not indicate a GDP-level stabilizing policy as, for example, in the Taylor rule. Instead, they point to a policy, which either uses changes in industrial production as an indicator for future inflation, or as a target for smoothing, regardless of the current situation of the economy. The forward-looking functions (see Eq. 10) yield comparable results with a lower and insignificant weigh on IP growth, probably because the perfect foresight for inflation leaves even less room for another indicator.

Which one is the best or closest formulation of the BOJ's policy reactions? Unfortunately, we do not have a clear-cut winner. When using the reaction functions for dynamic forecasts[36] between 1983 and 2000, the IP-gap based function becomes the clear loser in terms of high RMSE (1.45), and Theil Inequality Coefficient (0.17). The forward and backward looking IP-growth based functions yielded almost the same results (Eq. 10: 0.96/0.11 and Eq. 8: 0.95/0.11 respectively), and the best overall fit with the lowest error and coefficient was found for the inflation trend encompassing function (Eq. 13: 0.8/0.09).

Visual inspection of the forecasts in Figure 5 shows, however, that the functions behave quite different during the different phases. The generally good fit of the trend-based function (Eq. 13) seems to be out of step at the beginning of the period, when the high trend rate enhances exogenous inflation reactions and leaves the functions' reactions lower the actual BOJ policy rates, and at the very end, when the function would sharply reduce interest rates because the trend rate is already at 0%. The forward looking function (Eq. 10) yields the best fit during the development of the bubble when its perfect foresight on inflationary developments would have increased the call rate even faster than the BOJ. Interestingly, from

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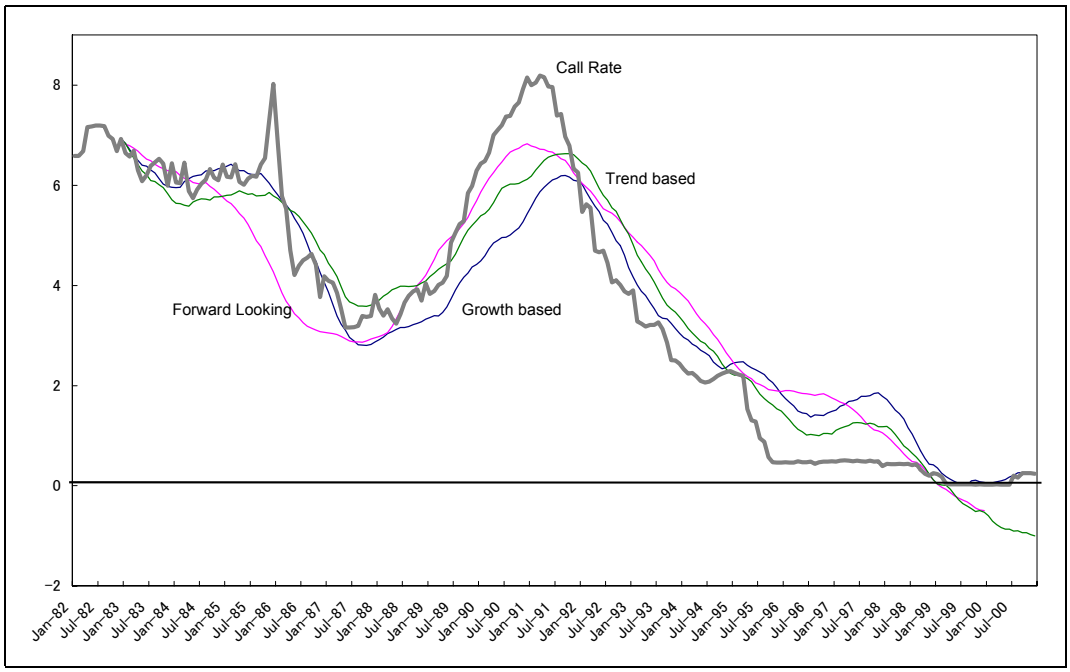
[36] The multi-step forecast model (using estimated values after the first period) is restricted by the actual values of the exogenous variables.

1998, it would have reduced the call rate as sharply as the trend-based function. The backward looking IP-growth based function (Eq. 8) failed, not surprisingly, to react strongly to the bubble, but reacted the most to the fiscal, demand-boosting programs after 1996, and is the only function in line with the BOJ from 1999. With no build-in level considerations, the function just counteracts any new development in the beginning, but then adapts to the new trend.

Figure 5 Dynamic Forecasts from Different Reaction Function



Note: Data from OECD, MEI, and IMF, IFS.

When putting these differing reactions during the different phases together,

- the BOJ seems to have targeted a falling trend-rate of inflation,
- it seems to have behaved forward looking at least during the development of the "bubble,"
- it has known about the fiscal programs of the mid-nineties and did not counter-act as the functions did,
- and it has become, in line with the growth-only reaction function, more restrictive than the forward-looking or the level-reverting, trend-based functions from 1999.

8. Monetary Policy With Structural Targets?

The result of our empirical experiments with different reaction functions was, that the BOJ targeted primarily inflation in a quite systematic way, while real demand developments were insignificant and/or unimportant for its policy decisions. The BOJ, however, claims almost the opposite. Its monetary policy decisions are said to constitute a discretionary policy, which keeps prices stable, but takes due care of overall demand responsibilities and the stabilization of the financial system.

And indeed, during phases, the BOJ policy deviated considerably from our otherwise well-fitting (almost) inflation-only reaction function, which could support the active "discretion" claim of the BOJ. During the last phase of the "bubble" in 1989, for example, actual BOJ policy was more restrictive than our function estimates, and it became more expansionary for a short time after the financial crisis set in. Also, it calmly left its policy rate close to 0% after huge fiscal programs tried to supplement aggregate demand in 1996.

In Figure 6, we have plotted the results of the overall best fitting inflation (trend) targeting reaction function (Eq. 13), the forward looking function (Eq. 10), and the BOJ's actual policy decisions to compare the estimated policy reactions in a more meaningful way than in the last section with its dynamic forecasts.[37] To compare the policy reactions we have to transform the series somewhat to make the almost perfectly fitting forecasts distinguishable from each other and from the original call rate.[38] We therefore constructed and added two series for the one-month ahead policy recommendations (point forecasts) of the estimated reaction functions along with actual (t+1) call rate changes for the next month (with a scale on the

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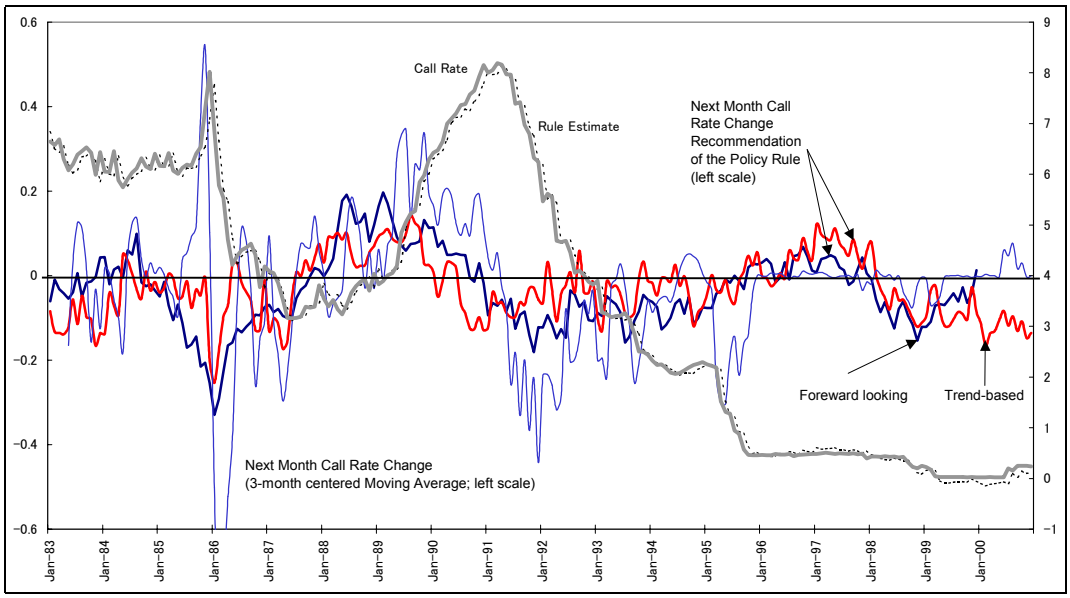
[37] The problem with the multi-step forecast model (using estimated values after the first period) is that the BOJ of course knows its own actions of the period before and takes them into account. The multi-step dynamic forecast over the entire sample is therefore only interesting for evaluating the fit of the reaction functions. For comparisons of policy recommendations, on the other hand, we have to use point forecasts at the time of any decision.

[38] The extreme weight of the lagged interest rate resulted in an almost perfect fit of the forecast.

right).[39] Technically, these series are constructed by calculating the monthly point forecasts, or by adding the monthly change of the call rate to the negative error (see appendix, section 10).

Figure 6 A Smoothed, Inflation-Trend, and a Forward Looking Function



Note: Data from OECD, MEI, and IMF, IFS.

When comparing changes of the call rate, or actual monetary policy decisions of the BOJ, with the series of one-month-ahead point estimates of the reaction functions, we find that the actual policy decisions were very much in line with its fitted trend-based reaction function until 1988. The forward-looking function would have been consistently more expansionary after the huge appreciations of the yen because of the Plaza Agreement, on the other hand. In 1988, when first clear signs of the "bubble" became visible, especially the forward-looking reaction function would have recommended raising policy rates earlier and consistently, while the BOJ remained ambiguous about the policy direction and allowed the call rate to

39 Another solution to this problem would be to ignore the smoothing part of the rule, which is irrelevant for the direction of the policy decision, and to plot the policy relevant non-smoothed inflation plus real GDP targeting part of the rule separately. This would imply, however, a level component of the non-smoothed part of the rule which is actually only provided by the past level of the call rate. Unlike the original Taylor rule, for example, the smoothed rule has no separate level component like a long-term interest rate (or relevant constant). The starting level of any rule based policy decision with interest rate smoothing is therefore the currently existing interest rate plus or minus a fraction of the deviation of inflation and real GDP from their respective equilibrium levels.

rise and fall. In 1989, however, the BOJ started to raise rates in fast and huge steps of up to 30 basis points. The reaction functions, in contrast, already started to relax the strong restrictive monetary course in 1990, before the burst of the bubble. After the financial crisis set in, the BOJ also reversed the stance of its policy, and lowered its policy rate by up to 40 basis points per month. The reaction functions would have recommended a more moderate expansionary course until 1993 in case of the trend-based function, and a moderate but consistent expansion until 1995 in case of the forward-looking function.

Finally, until 1998, and especially during 1996-97, when the huge fiscal programs and the increase in the consumption tax send adverse signals about the state of economy, the BOJ's reaction functions would have been more restrictive than the actual policy was. This changed in 1998, when the reaction functions would have recommended a much more expansionary monetary policy, effectively sending the interest rate into negative territory.[40] Thereafter, the inflation trend-based, IP-level reverting function would have remained consistently expansionary until the end of our time series in 2000 (and the deflationary and stagnant situation in Japan did not change until today).

It is important for the interpretation of these results to keep in mind that the "policy recommendations" of the reaction function are only a fitted mirror of the BOJ's actual call rate steering during the last two decades. Any differing "recommendation" is therefore only an "error" of our estimation strategy, or, looking from the other side and trusting our results, a "discretionary" innovation to its "normal" behavior according to our inflation-targeting estimate. Given the good general fit of the reaction functions, it is therefore interesting to note that the only

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40 Of course, if we interpret the reaction function as a monetary policy rule, such an impossible policy recommendation would have to be translated into an expansionary policy by means of other central bank instruments, like volume oriented buying operations of governmental and corporate bonds.

If we, on the other hand, consider a "liquidity trap" in contrast to this basically monetarist argument, we would need a beyond zero inflation targeting policy or some other long-term commitment of the central bank to future inflation to keep monetary policy efficient (Krugman 1998). For simplicity, and instead of developing different strategies, we simply stick to our formulation of non-restricted reaction functions, which ask for monetary ex-

phases when the BOJ really used its proclaimed discretionary power in an expansionary way were in 1988-89 during the development of the "bubble," and in 1991-92 after the bubble burst. A more passive expansionary stance can be observed during the introduction of the huge fiscal programs to fight against the financial crisis in 1996, and in 1997 when a new consumption tax was somewhat ill fatedly introduced to restore governmental finances. On these occasions, actual BOJ policy remained calm and did not counter-act to rising prices and growing GDP.

However, these are rare exceptions to a generally restrictive policy stance, and it might even be argued that the "discretionary" expansion during the financial crisis of 1991-92 was only a follow-up event, which became necessary to repair the results of the "discretionary" expansion-restriction cycles during the development of the bubble. Judging from our results, it remains unclear if the BOJ did not recognize the bubble earlier because it concentrated only on its backward-looking inflation data, if it still felt bound to the international agreement to remain expansionary (the Plaza-Louvre Agreement), or if it started to believe in the chances of the bubble economy itself. In any case, the strong restrictive reactions after 1989, which led to the burst of the bubble in 1991, and the fast lowering of interest rates after 1991 seem to point to a conviction at the BOJ that its policy was wrong before and therefore had to be corrected forecfully.

A series of studies claims that the Japanese economy was undergoing a structural change in finance and (especially) banking starting from the financial reforms in 1982. The hypothesis goes that the development of liberalized financial markets in Japan allowed major corporations to raise their funds on their own, and left Japanese city banks – mainly catering big business – with a declining customer and asset base. To make up for the shortfalls they ventured into credit lines to smaller corporations with no (implicit) governmental guarantees, and asked – in a classic banking way – for real estate as collateral. The following spiral of increasing asset prices, collateral value, and credit extensions then developed into the bubble of the

pansion by resulting in negative interest rates.

late 80s because banks did not develop fitting risk-valuation schemes to avoid the macroeconomic trap of their microeconomic calculations.

If this is the case – and evidence from the extended financial crisis after the burst of the bubble seems to backup the hypothesis –, it has to be concluded that the actual policy of the BOJ clearly was not well suited to deal with such structural change. The policy first went forth and back pro-cyclically, and then returned to its general anti-inflationary stance from 1993 (or turned in line with its reaction functions again). It did not, however, get to the root of the problem by, for example, introducing a fast cleanup of the debt ridden banking sector, and/or an overhaul of business procedures and models of the burnt city banks. Instead, many of the monetary "zombies" were kept alive, first by BOJ credit lines, then by fiscal public money. After 1996, when the BOJ started to rule out further interest rate decreases, the Ministry of Finance even tried to make up for lacking business demand by shelling out huge construction projects, and started to supply credit directly from postal deposits to small and midsize enterprises through the public fiscal investment and loans program.

As can be seen in Figure 6, the BOJ's policy deviated from its generally restrictive course since 1998 again – a change, which interestingly coincided with the BOJ's independence. The current monetary policy, even though it brought down interest rates to (effectively) 0%, is much more restrictive than its strongly inflation-fighting, reaction function based policy stance would have recommended.

9. Conclusion

In this paper, we set out with the suspicion that the BOJ might have used its general policy instruments for a restrictive policy intended to force structural changes in Japan's economy and governance. To identify its targets and stance, we fitted different monetary reaction functions to its interest rate policy instrument during the last 20 years. As a result, we found that different objective functions describe the behavior of the BOJ quite well. All the estimated reaction functions have two patterns in common: the BOJ smoothed its interest rate decisions heavily, and reacted almost only on inflationary developments.

On top of this, the few "discretionary" policy episodes, i.e. the historic interest rate decisions which are not well-explained by the inflation targeting reaction functions, are centered around the development and burst of the "bubble" in Japanese stock markets, and the current "financial" crisis. When the "bubble" developed, the BOJ was more expansionary than its general policy stance indicated, and during the burst of the "bubble" it was more restrictive – only to become more expansionary once again as it faced the need to respond to the damages. During the current disinflationary or even deflationary phase since 1998, however, the BOJ has clearly been more restrictive than indicated by its general – anti-inflationary – policy stance.

Of the three possible explanations for this "pure inflation fighting" stance during the worst post-war crisis in Japan, we ruled out the first one, a "liquidity trap," which dooms monetary policy as ineffective, because the obvious countermeasures, producing inflation expectations and cleaning up the banking sector, were not really tried.

The second one, on the other hand, the possibility of intentional relative passivity (the BOJ decided to refrain from active monetary policy, and settled for a demand driven interest rate smoothing strategy as long as inflation is not picking up), is supported by our data. The BOJ claims to use a discretionary, flexible monetary policy to support the "sound development of the national economy," but its actual monetary policy was rarely "discretionary" or "flexible." It seems to follow, in

contrast to it's claim, a systematic "inflation fighting" – but not inflation targeting – strategy, which accommodated disinflationary, or even accepted deflationary developments. But it did not react, either systematically or discretionarily, to signs of distress in real demand. This policy, on the other hand, did not constitute an active "structural" monetary policy, which systematically targets structural changes in the economy – beyond the (simple) realization of a zero-inflation economy.

The third possibility, which claims that the BOJ actively pursued a restrictive monetary policy to enforce supposedly necessary structural changes of the economy, could only be found during the most recent period from 1998, when the BOJ became even more restrictive than its otherwise well-fitting anti-inflationary reaction functions. Unfortunately, the policy results of this restrictive monetary policy experiment are, as a mirror image of the expansionary Keynesian experiments of the 70s, stagnation and deflation with few structural changes to the better.

In the meantime, the BOJ seems to have given up on its policy experiment, at least in its plans and announcements. Starting last year, it publishes tentative inflation forecasts (though only on basis of board member polls), declared deflation as bad as inflation, and promised quantitative monetary expansion. Unfortunately, the (former?) difference between the BOJ's words and its actions – in other words, the lack of transparency – has built a hurdle that has to be passed before financial markets and the general public will believe in a clear-cut (anti-deflation) inflation targeting policy at the BOJ.

10. Appendix

Defining Reaction Function Recommendations

The reaction function-based, next-month policy recommendation is technically just the monthly change of the call rate plus the negative error. However, because the concept is used at a prominent place in the paper, it might be worthwhile to sketch the mechanics.

In one formulation, we used the following true model for the call rate:

Eq. 14 $$i_t = \lambda i_{t-1} + (1-\lambda)(\phi(y_{t-1} - y^*) + \varphi(\dot{p}_{t-1})) + \varepsilon_t$$

The point forecast for this unknown model was obtained by estimating the unknown parameters, and setting the error term (i.i.d.) equal to its mean value of zero.

Eq. 15 $$i_{t+1} = \lambda i_t + (1-\lambda)(\phi(y_t - y^*) + \varphi(\dot{p}_t)) + \varepsilon_{t+1}$$

Eq. 16 $$\hat{i}_{t+1} = \hat{\lambda} i_t + (1-\hat{\lambda})(\hat{\phi}(y_t - y^*) + \hat{\varphi}(\dot{p}_t))$$

Eq. 17 $$\hat{i}_{t+1} = i_{t+1} - \varepsilon_{t+1}$$

We are, however, not only interested in the forecasted value of $\hat{i}_{t+1}$, or its difference to the actual realization of the call rate (the error $\varepsilon_{t+1} = i_{t+1} - \hat{i}_{t+1}$). For the graphical representation, we are interested in the difference between the actual call rate decision of the BOJ, or $\Delta i = i_{t+1} - i_t$, and recommendation for a change of the reaction function, or $(\hat{\Delta} i)_{\hat{i}_{t+1} - i_t} = \hat{i}_{t+1} - i_t$. To derive this, we only have to add i_t on both sides of Eq. 16 or Eq. 17.

Eq. 18 $$\hat{i}_{t+1} - i_t = (\hat{\lambda} - 1) i_t + (1-\hat{\lambda})(\hat{\phi}(y_t - y^*) + \hat{\varphi}(\dot{p}_t))$$

Eq. 19 $$\hat{i}_{t+1} - i_t = i_{t+1} - i_t - \varepsilon_{t+1}$$

The difference between the forecasted call rate $\hat{i}_{t+1}$ (or policy recommendations of the fitted rule) to the actual call rate i_t at the time of a policy decision is just the monthly change of the call rate plus the negative error (Eq. 17). Eq. 18 reminds, however, that the changes are only equivalent, but not identical, to the recommendations of the non-smoothed part of the function. With an important smoothing component, as in our case of $\lambda = 0.97$, it will take several months for the time series to converge to its equilibrium level.

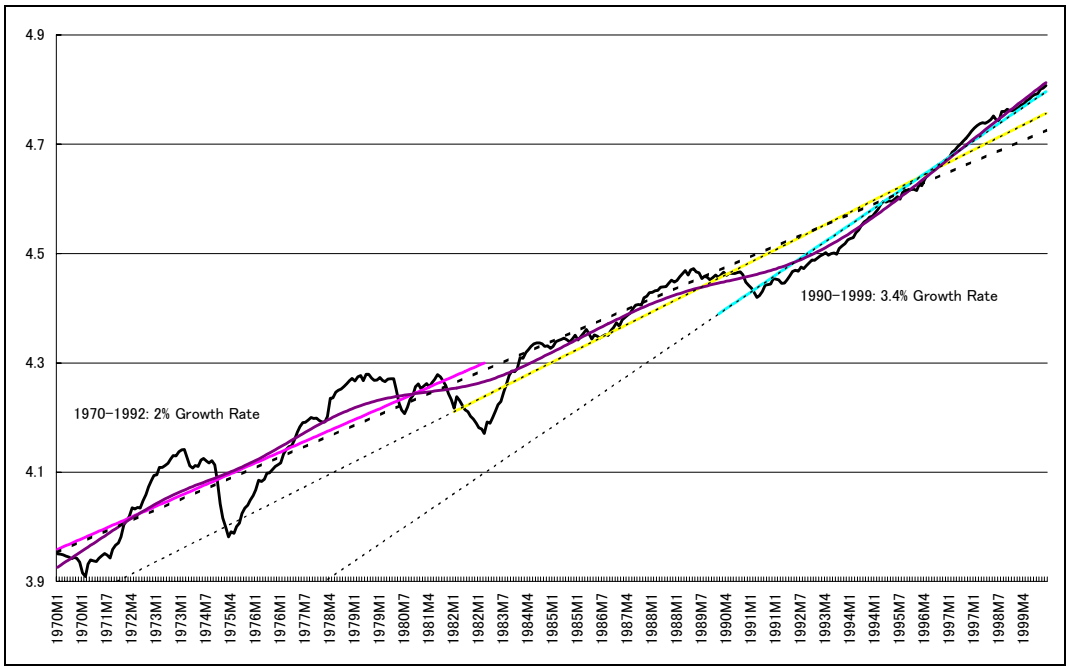
Figures & Tables

Table 1 BOJ Statements Accompanying Discount Rate Changes and Major Call Rate Changes (1986-99)

Date	Rate	Prices	Effective demand	Exchange Rate	Current Account	Money supply	Market rates	Comment
01/86	4.97	♣	☆	♣	☆			First decrease after Plaza Agreement
03/86	4.15	♣	☆	☆	☆			
04/86	3.83		☆	☆	☆			Implied concerted decrease in interest rates
11/86	3	♣	☆	☆		♣		
02/87	2.89		☆	☆		♣		Reference to international coordination
05/89	2.5	☆	☆	◆	☆		◆	
10/89	3.59	☆	☆	◆		◆	◆	First change effective the same day
12/89	3.86	☆	☆	◆		◆	◆	
03/90	4.64	☆	☆	◆		◆	☆	First reference to market stability
08/90	5.3	☆	☆	◆		◆	☆	
07/91	5.5	◆	☆					Emphasis on price stability.
11/91	5.22	◆	☆	◆				As before
12/91	4.97	☆						Explicit reference to the objective of supporting supply-side economic activities.
04/92	3.75	◆	☆					Reference to the concern about economic impact of low interest rate.
07/92	3.25	◆	☆	◆				Same as above.
04/93	2.5	◆	☆	◆	◆			
09/93	1.75	◆	☆	◆	◆			Reference to the concern about economic impact of the lowest interest rate ever.
04/95	1	◆	☆	◆				
09/95	0.5	◆	☆	◆				Reference to provide more money to lead lower market rates.
12/97	0.5							Call rate targeted to be lower as discount rate.
09/98	0.5	☆	☆			◆	☆	Call rate targeted to be as low as 0.25%.
02/99	0.5	◆	◆	◆		♣	☆	Call rate to be as low as possible.

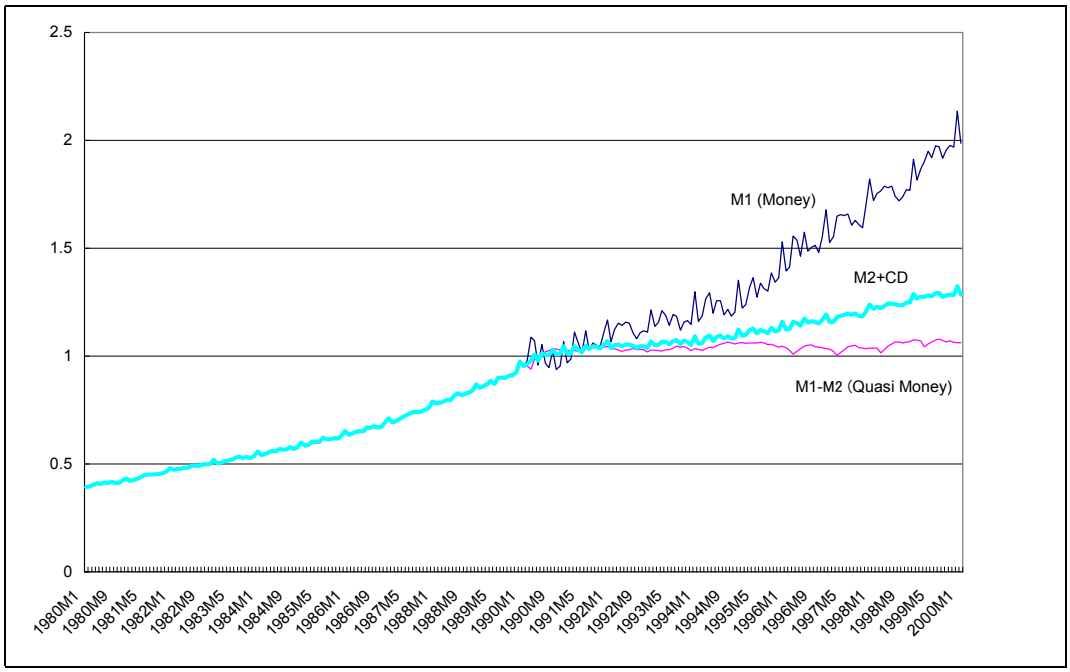
Note: Announcements of BOJ during discount rate or major call rate changes have been categorized into announcements where the mentioned variables (in columns) have been declared or mentioned as the major indicator (cross), background (diamond), or objective (star) of policy action.
Source: Nakao / Horii (1991). BOJ, Chôsa Geppô. BOJ, Internet Homepage.

Figure 7 U.S. Industrial Production and Trends



Source: Data from IMF, IFS. The HP-filter is based on a smoothing-parameter of 129600.

Figure 8 Japan's Money Demand (1990=100)



Note: By using 1990 as a standard, the sum of money, quasi money, and CD's (M2+CD).remains lower than money alone. This demonstrates the different development of the aggregates.
Source: Data from IMF, IFS.

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