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Could Japan Target the Price Level or Inflation – What Happens to Monetary Policy Effectiveness during Disinflation?

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Could Japan Target the Price Level or Inflation - What Happens to Monetary Policy Effectiveness during Disinflation?*

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Abstract

The aim of this paper is to study whether price level or inflation targeting would be appropriate monetary policy regimes for Japan. A necessary condition for such regimes is that the rate of interest remain a positive tool of monetary policy. Using VAR and SVAR approaches, we investigate whether changes in the real ex ante and the nominal interest rate are able to stimulate an economy with a low inflation rate or deflation. Both with perfect foresight and using backward-looking schemes to predict the future price level, monetary policy remains potent even with declining inflation rates. This is confirmed by the stability of the estimated system throughout the examination period. A tax on currency, or 'Gesell money' would be a possible alternative for Japan in order to lower the zero interest rate floor. We also find that monetary expansion in terms of broad money, broadly defined liquidity and M2+CDs, can bring Japan back to positive inflation rates. This must be supported by a higher interest rate differential between components of broad and narrow money. Moreover, expansion of direct funding in terms of corporate bonds could be beneficial for output growth while the non-performing loans problem in the economy is being tackled. Importantly, these results indicate that monetary policy alone is not able to pull Japan out of deflation and that fiscal measures need to be implemented in unison with monetary policy.

Keywords: disinflation, deflation, price level targeting, inflation targeting
JEL classification: E31, E42

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1 INTRODUCTION

The protracted economic slump in Japan during the 1990s has raised the attention of economists worldwide and led to numerous policy proposals. A clear reason for this is that the slump has been much longer than a simple cyclical downturn. But even more importantly, this so-called "lost decade" in the Japanese economy has brought to life economic phenomena that have created a veritable challenge for the Japanese policy makers: deflation and the zero bound on nominal interest rates. Interestingly, as the country is now experiencing its fourth consecutive year of deflation and nominal interest rates have been effectively zero since 1995, the Bank of Japan (BOJ) has been unwilling to adopt either an inflation or a price level targeting strategy. On the surface, this may seem surprising given the potential benefits of either of these approaches and the widespread adoption of inflation targeting by central banks worldwide.

Basically, a central bank could adopt an explicit strategy to target prices by two different means. One is the popularly used inflation targeting where the goal is a stable inflation rate. The other alternative is price level targeting, not currently used by any central bank, which implies a stable price level or a steadily increasing level as the target. An important distinction between the two strategies is that inflation targeting treats inflation shocks as bygones; it allows base drift of the price level. In the case of price level targeting, the central bank is expected to bring inflation down below its medium-term price level stability objective after there has been a positive shock in inflation. Credible price level targeting can provide a partial solution to the problem of the zero nominal interest rate floor. With price level targeting, if credible, a decline in prices triggers an expectation of future inflation. This in turn reduces the real ex ante interest rate and works as an automatic stabilizer.

The aim of our study is to investigate whether price level or inflation targeting would be appropriate policy choices for Japan. Our paper tackles the issue from two viewpoints. Firstly, it is imperative for a well-functioning inflation or price level targeting strategy that nominal and real rates remain effective in stimulating output also during a period of disinflation. Thus, we examine what has happened to monetary policy effectiveness when the economy moves from positive inflation rates to deflation, as it is possible that Japan's extraordinary circumstances could have significantly altered the functioning of the monetary transmission mechanism. Secondly, the price level targeting needs to be credible, i.e. the central bank needs to have control over the future price level, possibly with the aid of fiscal measures. If these two conditions are not met, then suggestions of an inflation or a price level target would surely lose their ground.

The issue of monetary policy effectiveness during decreasing inflation rates is clearly a topic that is no longer limited in interest only to Japan. In the US, the Federal Funds rate was lowered to 1 percent in June 2003. Being so close to the zero bound has increased concerns of not being able to use conventional interest rate policy in the future. Even as the European Central Bank (ECB) has in public seemed to downplay the possibility of deflation and the zero bound on nominal interest

rates in the Euro Area, it did indeed argue that the clarification in May 2003 of its inflation target of "close to 2 percent" was aimed at creating a sufficient safety margin against deflation (ECB 2003).

Traditionally, price level targeting was seen as increasing output and inflation variability, when compared with inflation targeting. According to Fischer (1994), price level targeting added unnecessary short-term fluctuations to the economy. Further, it added more variance and uncertainty to the short-term inflation rates than was the case with an inflation target. Taking a similar view, Haldane and Salmon (1995) estimated a backward-looking IS/LM model with an expectational Phillips curve. Their simulations found that inflation targeting implied a higher low-frequency price level uncertainty than price level targeting but reduced high-frequency inflation and output variability.

A theoretical study by Svensson (1996) challenged this view. He found that with persistence in employment, price level targeting provides a free lunch of identical output variability and reduced inflation variability, compared to inflation targeting. Gaspar and Smets (2000) also argued that with forward-lookingness of economic agents and credibility of the central bank, price level targeting could actually reduce both inflation and output variability. They also mentioned the beneficial effect of expectations on real interest rates: the nominal rate has to adjust less, and the lower real ex ante interest rate can stimulate the economy after a period of disinflation. Smets (2000) found that price level targets were superior to inflation targets over a long horizon, whereas in the short run inflation targets were preferable. Within a given horizon after a price shock, in order to get the price level back to the pre-shock level, both output and interest rates have to move by more than would be the case with an inflation target. However, at the same time inflation variability will also be smaller. This would then imply that lengthening the horizon for the price level objective (as opposed to the horizon for the inflation objective) would allow the central bank to trade off less interest rate and output variability for higher inflation variability.

The topic of how to escape from a liquidity trap has also been tackled in the literature. Svensson (2001) proposed an initial devaluation of the currency and a temporary exchange rate peg that would later be abandoned for a price level targeting approach. McCallum (2001b) suggested that the exchange rate should be made the target variable and base money would be used to purchase foreign exchange in order to obtain a positive inflation rate. In close relation to the previous studies, Coenen and Wieland (2003) assessed the consequences of the zero lower bound on the Japanese economy using an econometrically estimated model. Their work looked at different policy proposals that focus on depreciating the yen when nominal interest rates are zero. Interestingly, as the model is part of a three-country model including Japan, the Euro Area and the United States, the authors were able to examine the international spillovers of alternative policy proposals. They found that the beggar-thy-neighbour effects of the proposals were non-negligible and that the zero lower bound could induce significant losses in terms of output and inflation stabilization in Japan.

Empirical studies of the monetary transmission mechanism in Japan include, e.g. Morsink and Bayoumi (1999), Bayoumi (2001), Kato, Ui and Watanabe (1999), and Woo (1999). Morsink and Bayoumi (1999) examined the monetary transmission mechanism in Japan using unrestricted VARs,

as is also the case in our study. They found that banks play a crucial role in transmitting monetary shocks to economic activity. This impact is mostly evident in business investment and comes about predominantly through bank lending. The authors argued that policy measures to strengthen banks would be a prerequisite for enhancing monetary policy effectiveness in Japan. Bayoumi (2001) examined the growth slowdown of the 1990s in Japan using a VAR analysis. He tested for the significance of different explanations for the slump, including the absence of bold fiscal policy, the limitations of monetary policy, falling domestic asset prices and disruption of financial intermediation. According to Bayoumi's (2001) research, all the above explanations could have some validity; however, banking system problems seem to be the main reason for the current weakness in growth. During the economic slowdown, undercapitalized banks responded to falling asset prices by further cutting lending in order to maintain capital adequacy requirements. This mostly hit small companies, hindering them from helping to pull Japan out from recession. A similar finding was obtained in a study by Kato, Ui and Watanabe (1999). The authors built a bank loan market model where the marginal cost of managing and monitoring loans was assumed to increase as borrowers' net worth decreases. They showed that the responsiveness of equilibrium bank loan rates to changes in interbank money market rates became weaker as borrowers' net worth decreased. Estimating bank loan rate equations in Japan, the authors found that the bank loan rate in Japan would have been 0.8 percentage points lower in the 1990s if the bubble in land and stock prices had not occurred.

In contrast to the research by Bayoumi (2001) and Kato, Ui and Watanabe (1999), Woo (1999) found that the decline in capital could not have caused the slowdown in bank lending prior to 1997. His study showed that the most undercapitalized banks were actually expanding their lending most rapidly in the early 1990s. This result probably comes about due to a lack of supervision and a weak regulatory environment in the Japanese financial system. However, increasing problems in the system led to regulatory pressure and closer market scrutiny. As a consequence, Woo (1999) found that after 1997, banks with better capital positions where increasing their lending more than the undercapitalized ones.[1]

A VAR methodology was also used to examine the Japanese monetary policy in studies by Kasa and Popper (1997), Miyao (2000) and Miyao (2002). The paper by Kasa and Popper (1997) studied the objectives and operating procedures of the BOJ during 1975-1994. The authors found that the BOJ weights both variation in the call money rate and in nonborrowed reserves, with the emphasis on interest rate increasing over time. Miayo (2002) used a recursive VAR model to study the effects of monetary policy on aggregate activity and found that monetary policy shocks had a persistent effect on real output especially during the boom-and-bust economy of the 1980s. In another paper, the author found a break in the reduced form dynamic system in 1995 (Miyao 2000). Possible explanations for this finding included the appreciation of the yen, very low levels of the short-term interest rates and problems in the banking system.

[1] There have also been studies about the effect of the Basle capital requirement on Japanese banks (the requirement of the Basle Accord had to be met by March 1993). Ito and Sasaki (1998) claimed that while the risk-based capital requirement had an impact on the lending behaviour of city banks, no impact was found for other banks.

The paper is organized as follows. Firstly, the methodology of the study will be presented. This is followed by empirical evidence, where we perform a VAR and an SVAR estimation of the effects of monetary policy on output in the Japanese economy. The effect of the real ex ante interest rate on output is one necessary prerequisite for the effectiveness of price level and inflation targeting as a monetary policy rule. However, it is still necessary for the central bank to possess an additional instrument to actually make the expected higher price level credible. Using our VAR analysis, we consider the impact on the price level of alternative approaches to get the economy back to a track of positive inflation rates. This is done by extending the basic trivariate VAR by adding different variables that may be of policy interest. We will also compare the results using two alternative inflation expectation generators that have an impact on the real ex ante interest rate. These are, firstly, perfect foresight of future inflation and, secondly, the assumption that inflation follows an autoregressive (AR) process.

2 METHODOLOGY

This section will discuss the methodology of the paper. Any methodology to empirically examine the issue of price level targeting will suffer from the fact that no central bank is officially pursuing (or, with the exception of Sweden in the 1930s, has ever pursued) this monetary policy strategy[2]. Japan, however, is currently following a strategy that is very close to price level targeting. The monetary base is being targeted explicitly in order to achieve a positive change in the price level. The BOJ has committed itself to this new monetary policy framework until the CPI inflation rate stays at or above zero percent (Yamaguchi 2001). Even if we do not have data from periods of official price level targeting (or inflation, for that matter), this does not pose a significant limitation for the purpose of our study since we are actually interested in the relationship between both the real ex ante and nominal interest rate and output that of course matters for both inflation and price level targeting. The behavior of economic agents with regard to the relation between the interest rate and output is probably not affected to a large extent by the change in the monetary policy strategy of the central bank, but it might be affected by a change from an inflationary to a deflationary environment, and it is this that we tackle in the estimation below. As we find parameter constancy we believe that the Lucas-critique does not pose a problem for the methodology we have chosen.

2.1 The Unrestricted VAR Approach

For the major part of the study, we obtain estimates using an unrestricted vector autoregression (VAR), a statistical representation of output, prices and interest rate dynamics in our case. The

[2]The experience of Sweden with regard to price level targeting may provide only limited evidence for Japan about the feasibility of this policy rule in the current context. Sweden was pulled out of deflation in the 1930s by a number of external factors, such as the devaluation of the krone caused by the end of the gold standard and strong export demand from the United Kingdom. (Berg and Jonung 1998)

VAR-model can be written in its basic form as in Lütkepohl (1991).

$$x_t = \alpha_1 x_{t-1} + ... + \alpha_p x_{t-p} + u_t \tag{1}$$

where p denotes the order of the VAR-model. Here, K is the number of variables, $x_t = (x_{1t}, ..., x_{kt})\prime$ is a $(K \times 1)$ random vector, A_i are fixed $(K \times K)$ coefficient matrices and $v = (v_1, ..., v_k)\prime$ is a fixed $(K \times 1)$ vector of intercept terms. The $u_t = (u_{1t}, ..., u_{kt})\prime$ is a K-dimensional white noise process with $E(u_t) = 0$. In the benchmark trivariate VAR system we are considering, $K = 3$ (the log of the real GDP y, the log of the consumer price level cpi and the nominal interest rate i) and we allow for an intercept term to account for a nonzero mean $E(x_t)$. If necessary, we added a trend and other deterministic variables in the model setup. With these variables, we were able to obtain three equations whose features are canonical in monetary policy analysis.[3]

$$y_t = a_1 y_{t-1} + ... + a_p y_{t-p} + \beta_1 cpi_{t-1} + ... + \beta_p cpi_{t-p} + \gamma_1 i_{t-1} + ... + \gamma_p i_{t-p} + u_{1t} \tag{2}$$

$$cpi_t = \delta_1 y_{t-1} + ... + \delta_p y_{t-p} + \zeta_1 cpi_{t-1} + ... + \zeta_p cpi_{t-p} + \theta_1 i_{t-1} + ... + \theta_p i_{t-p} + u_{2t} \tag{3}$$

$$i_t = \lambda_1 y_{t-1} + ... + \lambda_p y_{t-p} + \rho_1 cpi_{t-1} + ... + \rho_p cpi_{t-p} + \varphi_1 i_{t-1} + ... + \varphi_p i_{t-p} + u_{3t} \tag{4}$$

In addition to the benchmark VAR, in order to simulate the price level/inflation targeting approach, we estimate a forward-looking VAR that is identical to the one represented by equations (2), (3) and (4), but includes the price level four periods ahead, with perfect foresight by economic agents.[4] With the aim of measuring the impact of the real interest rate on output, we estimate a bivariate VAR, with the variables log real GDP and the real ex ante interest rate (nominal interest rate - expected year-on-year inflation rate four periods ahead). The output equation can then be written as

$$y_t = k_1 y_{t-1} + ... + k_p y_{t-p} + l_1(i_{t-1} - \Delta cpi_{t+4-4}) + ... + l_p(i_{t-p} - \Delta cpi_{t+4-4}) + u_{1t} \tag{5}$$

Output being the dependent variable, equation (2) can be regarded as an IS equation. In the aggregate supply equation (3) the price level is dependent on its own lags, lagged output and lagged nominal interest rates. Equation (4) represents the central bank reaction function, the nominal interest rate depending on its own lags, on real output and the price level with lags in both the variables. The use of the expected level of prices in the central bank reaction function is justified as the central bank can be assumed to adjust its target variables in light of the expected level of the cpi[5]. This feature is similar to the approach by McCallum and Nelson (1999)[6]. Also, output reacts to

[3] As an example of a similar methodology, Leeper, Sims and Zha (1996) considered a trivariate VAR, but in their system monetary policy shocks are given by shocks in money instead of in interest rates, with the other variables being output and prices. They also considered a four-variable VAR with both money and interest rates included, similarly to our extended model.

[4] In order to evaluate the robustness of the results, we also examine the impact of the real interest rate on output assuming an AR(4) process in the future price level.

[5] This simulation is strictly speaking more close in its nature to price level than inflation targeting. Price level targeting aims at some exact future price level, necessitating a forecast of this level by the public, rather than a forecast of a range of possible inflation rates as is often the case in inflation targeting.

[6] In a forward-looking model for the Japanese economy, Kamada and Muto (2000) considered a moving average of future inflation rates in the policy reaction function.

expected inflation in the IS equation due to expectations about the real interest rate. In equation (5) output is dependent on lags, allowing for persistence, whereas the real ex ante rate -part is forward looking as we use the expected inflation rate for Δcpi. As noted by Fuhrer (2000), the presence of lagged output can be justified by a microeconomic characteristic that economic agents' preferences and utility functions feature habit persistence. The unrestricted VAR allows for the examination of the dynamics of two different channels for monetary policy transmission: we have the conventional channel in which the real interest rate affects the spending decisions of households and firms, and the expectation channel through which the central bank influences the private sector's inflationary expectations.

After the estimation of the trivariate VAR, we extend the forward-looking model by adding different variables that may be of policy interest, such as money supply, lending by commercial banks and corporate bonds. The extensions to the basic model are done by adding variables separately to the basic trivariate model rather than estimating a single VAR with a very large number of variables.[7] This approach could give rise to an omitted variables problem: i.e. we may find a stimulating effect of interest rates on output even if (and because) this effect is actually caused by a variable that should be added to the system. However, we believe that our approach can be defended in a number of ways. Firstly, we would have problems in obtaining reasonable estimates from a VAR system with a large number of variables with our rather small number of observations. This is even more the case as in the study of the monetary transmission mechanism proper inference requires a sufficient number of lags. Secondly, with a large number of variables it becomes more difficult to identify the monetary policy shock. This holds true especially in the case of including both interest rates and money: it may not be clear which variable causes the actual shock and which one is merely accomodating.

The estimation by VAR can be justified on the grounds that the variables can then be treated as endogenous. An unrestricted VAR approach further allows us to create macroeconomic dynamics based on a minimal set of assumptions. As there is a lack of consensus about the actual working of the monetary transmission mechanism (Bayoumi 2001), this is an advantage of our approach. McCallum (2001a) has argued that the VAR may not be the optimal framework within which to study the monetary policy transmission process, since emphasis should be given to systematic policy behavior instead of random shocks illustrated by impulse response functions. However, the deflation in Japan can be argued to have come about without any change in the actual systematic monetary policy strategy, as pointed out by Bullard and Cho (2002). Favero (2001) has also argued that one aim of VAR estimation is to provide evidence on the reaction of macroeconomic variables to monetary impulses, which is exactly our aim, in that we want to evaluate whether the stimulating effects of real and nominal interest rates on output exist in the Japanese case.

The unrestricted VAR is estimated for two different time periods, the first being 1980-1992 and the second 1980-2000, using quarterly data from the OECD and the BOJ. In our analysis, we use the econometrics software JMulti, developed at the Humboldt University Berlin for time series

[7] A table listing the VAR models of the study can be found in Appendix E.

analysis[8], and EViews. The period from 1980 to 1992 was one of positive inflation rates and the period from 1993 to 2000 one of disinflation or outright deflation. Then, it is possible that economic agents have changed their behavior with regard to the relation between the interest rate and output. Significant differences in the resulting estimates could point out to structural breaks in the monetary transmission mechanism. This is examined further in stability analysis for the estimated system. Also, the number of observations can be claimed to be too small to model the period 1993-2000 separately. The start date of 1980 can be further justified by the fact that a period before the bubble economy of the mid-1980s is included in the analysis. The comparison between inflationary and disinflationary regimes is a crucial difference between our work and the work by Morsink and Bayoumi (1999). In his study of the reasons for Japan's slowdown, Bayoumi (2001) recognizes that individuals might respond differently to events depending on the state of the macroeconomy. Moreover, we incorporate expectations about the future price level, which is of importance in an inflation or a price level targeting regime.

In order to incorporate forward-lookingness in the real ex ante interest rate, we consider a case where the expectations of future inflation are perfect (perfect foresight). The expectation will be formed for inflation in the period t+4. This time period can be justified by the fact that monetary policy has an effect on inflation with a lag[9]. If there has been an inflationary shock that the central bank is expected to reverse according to the price level targeting rule, this probably cannot be attained within a period shorter than one year. The assumption concerning the perfect foresight might appear strong, but if there were indeed commitment by the central bank, the public should be able to quite accurately predict changes in the level of inflation. There seems to be wide agreement that the inflation rate follows a strong autoregressive progress. Thus, for econometric analysis it would make little difference whether forecast or actual values are used (Bofinger 2001). In addition to estimating the case of perfect inflation expectations, we also estimate the IS equation assuming that inflation follows an AR-process.

2.2 The Structural Vector Autoregression (SVAR) Approach

In order to provide further insights to the analysis, in addition to the unrestricted VAR approach, for the basic trivariate model we also consider a structural model. Let $x_t = (x_{1t}, ..., x_{kt})'$ again be a $(K \times 1)$ vector of endogenous variables. Further, $\Sigma_t = E[u_t u_t']$ is the residual covariance matrix. We will estimate the so-called AB-model of Amisano and Giannini (1997) of the form

$$\Gamma_0^* u_t = R\varepsilon_t \tag{6}$$

[8] The software is available at www.jmulti.de.

[9] In his forward-looking model on the Euro-area economy, Smets (2000) also used the inflation rate one year ahead, as he estimated p at time t+1 using annual data. However, he replaced the forward-looking component by a weighted average of a backward and a forward-looking component. In their study for Japan, Kamada and Muto (2000) considered the moving average of the future inflation rate from the current quarter to three quarters ahead in the policy reaction function. In contrast, in the optimizing IS-LM specification considered by McCallum and Nelson (1999), the expected price level one period ahead is obtained as a variable dependent on the lagged level of output.

Here u_t denote the observed (or reduced) form residuals and ε_t are the structural form innovations. We assume that the covariance matrix of ε_t is an identity matrix. This imposes the following identifying restrictions on Γ_0^* and R:

$$\Gamma_0^* \Sigma \Gamma_0^{*\prime} = RR\prime \tag{7}$$

In order to achieve identification, we need to impose $K(3K-1)/2$ additional restrictions. Similarly to the unrestricted benchmark trivariate VAR, we denote real output by y_t, i_t is the nominal interest rate and p_t is the consumer price index of the current period. The errors of the corresponding reduced form VAR are $u_t = [u_t^y, u_t^i, u_t^p]$. For our model, we impose short-run restrictions as follows. The model can be written as

$$u_t^y = b_1 u_t^i + e_t^{IS} \tag{8}$$

$$u_t^i = b_2 u_t^y + b_3 u_t^p + e_t^{CB} \tag{9}$$

$$u_t^p = e_t^p \tag{10}$$

Here equation (8) is a simple IS-curve, where output is a function of the nominal interest rate. (9) is the central bank reaction function, where the interest rate is set as a function of output and the price level, and equation (10) accounts for supply shocks. The structural impulses of the equations (8) and (9) are then a demand or 'IS-shock', and a 'monetary policy shock', respectively. Using this model, the matrix Γ_0^* becomes

$$\begin{bmatrix} 1 & -b1 & 0 \\ -b2 & 1 & -b3 \\ 0 & 0 & 1 \end{bmatrix}$$

and R is a diagonal matrix where the diagonal elements are not restricted and the other elements are all zeros.

This model is just-identified. We estimate the matrices Γ_0^* and R by the method of maximum likelihood, assuming multivariate normal innovations. The log-likelihood is maximized by the method of scoring where the gradient and the expected information matrix are evaluated analytically. Of the innovations, our interest naturally lies in the structural monetary policy innovation and its impact on real output in Japan during the inflationary and disinflationary observation periods.

In the extended model including money supply, we additionally consider the following structural model:

$$u_t^y = b_1 u_t^i + \varepsilon_t^{IS} \tag{11}$$

$$u_t^i = b_2 u_t^y + b_3 u_t^p + b_4 u_t^m + \varepsilon_t^{CB} \tag{12}$$

$$u_t^p = b_5 u_t^m + \varepsilon_t^p \tag{13}$$

$$u_t^m = b_6 u_t^y + \varepsilon_t^m \tag{14}$$

In order to achieve identification and additionally to the previous model described by equations (8), (9) and (10), we assume that the central bank takes into consideration the level of money in the economy in setting its interest rate in equation (12). Prices are dependent, in addition to structural

inflationary shocks, on money in equation (13). Finally, in equation (14) a higher level of output can be presumed to lead to a higher demand for money on the basis of transactions-demand.[10]

With this structural model, the matrix Γ_0^* becomes

$$\begin{bmatrix} 1 & -b1 & 0 & 0 \\ -b2 & 1 & -b3 & -b4 \\ 0 & 0 & 1 & -b5 \\ -b6 & 0 & 0 & 1 \end{bmatrix}$$

and again R is a diagonal matrix where the diagonal elements are not restricted and the other elements are all zeros.

3 EMPIRICAL EVIDENCE

The Japanese economy witnessed a serious deflation problem after rather normal levels of inflation in the 1980s. During the first examination period of the study, 1980 to 1992, the annual inflation rate associated with every quarter witnessed a serious decline, as it fell from 7.3% to 1.0%. From 1993Q1 to 2000Q4 the average annual inflation rate amounted to 0.17% only. During that period, there were 15 quarters when the economy actually experienced deflation. The nominal interest rate, the rate on the three-month certificate of deposit (CD), fell from 3.42% to 0.27% during 1993-2000. The zero nominal lower bound on interest rate has effectively been reached. Deflation has prevailed in the economy for the past four years and the real performance of the Japanese economy has been poor during the 1990s.

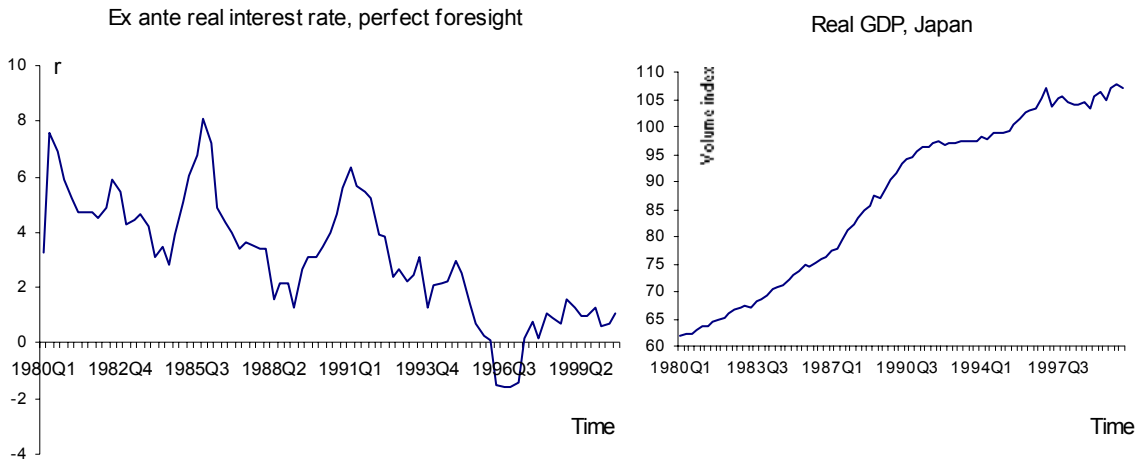


Figure 1. Ex ante real interest rate and real GDP, Japan, 1980-2000

[10] We do not include prices in this money demand relationship due to the instantaneous nature of the restrictions.

As is clear from figure 1, output was growing steadily from 1980 to 1987. It expanded rapidly during the boom years until 1991, after which it stagnated. The Japanese economy has been in a slump during the decade of 1990s, aside from a slight recovery from 1995 to 1997 prior to the introduction of the consumption tax in 1997. An interesting feature of the Japanese deflation has been that the prices of manufacturing goods have been falling, whereas the prices of services have increased slightly or remained roughly constant. Therefore, it is plausible that part of the disinflation might have been difficult for the monetary policymakers to control: imports from the still low-cost, fast-growing Asian trading partners contribute to falling prices by depressing the prices of import goods. This is a point also advocated by Bullard and Cho (2002) who claim that the Bank of Japan did not behave very differently in the 1990s than it had done during the more successful periods of the economy. Supply-side factors seem to play a continuously important role in the behavior of prices in Japan. In addition to the low cost imports that are also utilized by firms in the intensified competition, the rationalization of distribution and the effects of deregulation have also contributed to falling prices (Yamaguchi 2001). Even if deflation was "good deflation" in the sense that it has originated in technical change and deregulation, it nevertheless complicates the operation of monetary policy.

3.1 Benchmark and Forward-looking Unrestricted VAR, 1980 - 1992

In this section, we will discuss the unrestricted trivariate VARs for the period 1980-1992. We started the analysis with unit root testing of the different series. For real output, we use the seasonally adjusted quarterly observations of real GDP from the Japanese economy and transform the data into logs. An alternative approach would have been to use the output gap, as is often done in monetary policy analysis. Especially in the case of Japan, however, the output gap is a problematic variable since estimates of productivity growth vary significantly and thus very different measures are obtained. The nominal interest rate is that of the 3-month CD (certificate of deposit). It is appropriate to consider the short term nominal rate as the variable under study as the Bank of Japan has made it quite clear in the past that it wants to steer short term rates (Morsink and Bayoumi 1999). The price index is the consumer price index. We also conducted the estimations using the GDP deflator instead of the consumer price index (CPI) but did not find significant differences in the results. There was a difference between the rates of decline of the GDP deflator and the CPI as the GDP deflator fell even more rapidly in the deflation period.

We performed an Augmented Dickey-Fuller test on all the series, together with a KPSS test on some series to confirm the results. Whereas the ADF test examines the null hypothesis of a unit root against the alternative of a stationary data generating process, the KPSS test takes stationary series as the null hypothesis, based on a procedure derived by Kwiatkowski et al. (1992). The results of the ADF tests are found in Appendix A, whereas the KPSS tests are not reported for the sake of brevity. The null-hypothesis of a unit root for the GDP series could not be rejected. Testing for the unit root for the GDP series in first differences, the results were contradictory: the ADF test would point to the existence of a unit root and leads to the conclusion that the series were

actually integrated of order two, I(2). However, the KPSS test did not reject the null hypothesis of stationarity. Finally, graphical examination of the autocorrelation and partial autocorrelation plots led us to the conclusion that the GDP series were I(1). Testing for the nominal interest rate, the consumer price index and the real interest rate, we concluded that the series are integrated of order one I(1).

We built the benchmark trivariate VAR with real output, the nominal interest rate and the consumer price index, with all the endogenous variables in levels terms[11]. The estimation in levels can be justified by the fact that even if the variables were I(1), the usual tests and the t-values have their standard asymptotic properties and statistical inference can thus be made (Dolado and Lütkepohl 1996). Estimating the model in levels further facilitates the interpretation of the impulse responses, allowing for an easier comparison between the different VAR models.

The model was estimated with 3 lags in order to, on the one hand, allow for a sufficient time for the dynamics to take place and, on the other hand, not to lose too many observations out of the rather small number of 51. The errors were orthogonalized by Cholesky decomposition. The ordering of the variables is the following: real GDP, expected price index, nominal interest rate. With this particular ordering, changes in output are being assumed to be independent of the other explanatory variables and changes in the nominal interest rate dependent on changes in all of the other explanatory variables. Thus, changes in real output would be least responsive to current events, followed by the expected price index and the most responsive would be the nominal interest rate. We conducted estimations of the impulse response function 30 periods ahead. In order to construct the confidence intervals to illustrate parameter uncertainty, the Hall Bootstrap confidence interval of 95% was used, with the number of bootstrapping replications set at 5,000 (Hall 1992).

Examining the impulse response below in figure 2 (all the impulse responses can be found in Appendix B), we can see that an increase in the nominal interest rate causes a significant decrease in output. A shock of a percentage point in the interest rate leads to a decline in output by 1.2 percent.[12] The price puzzle phenomenon appears slightly right after the interest rate cut (probably due to inflation persistence) but a negative impact on the price level of an increase in the interest rates prevails, starting at 15 quarters.[13] In our model, an increase in the price level causes initially an increase in the nominal interest rate, consistently with inflation or price level targeting approaches. An interesting finding is that an inflationary shock initially has no impact on output but a negative effect appears afterwards and peaks at 12 quarters. This probably comes about through the interest rate channel; the nominal interest rate must increase, having a negative impact on output. The

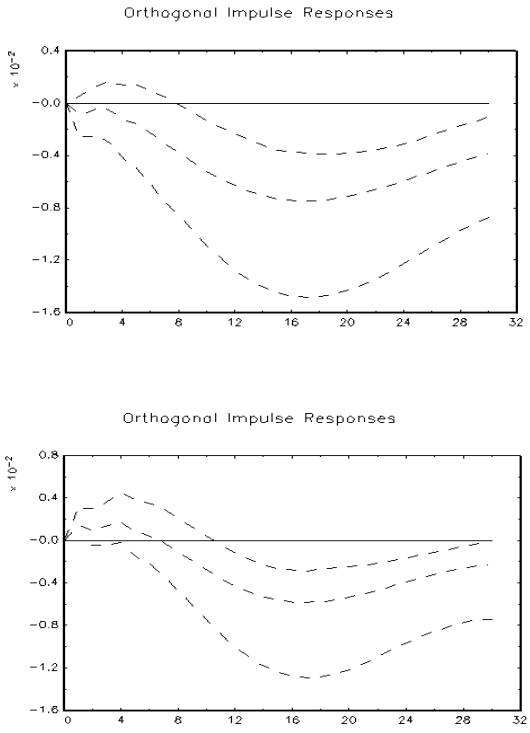
[11] We also conducted the estimations using differenced versions of the variables y, cpi and i. As a result, all the variables in the estimated VAR were stationary. This led to some 'cycling' in the impulse responses, probably as a result of over-differencing.

[12] We obtain the impact as the ratio of the fall in output (here 0.7 percent) to an interest rate shock of one standard deviation (here 0.6 percentage points).

[13] The price puzzle phenomenon, an increase in interest rates leading to an increase in inflation, is frequently encountered in VAR analysis when no commodity price variable is included.

central bank reaction function has significant coefficients on past nominal interest rates, suggesting interest rate smoothing by the Bank of Japan.

The results appear to be very similar for the forward-looking VAR, with the price index shifted four periods ahead in order to examine the inflation/price level targeting scenario. We now estimated the model with 4 lags. An increase in the nominal interest rate causes a decrease in output that is significant at approximately 8 quarters. A shock of a percentage point in the interest rate now leads to a decline in output by 1.4 percent and the price puzzle phenomenon does not appear at all.[14]



[14]Result of the fall in output (0.7 percent) to an interest rate shock of one standard deviation (here 0.5 percentage points).

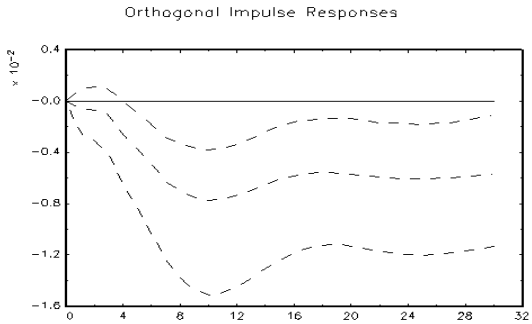


Figure 2. Impulse response of the real GDP to a shock in the nominal interest rate in the benchmark VAR (above, previous page) and the forward-looking VAR (below, previous page), and to a shock in the real ex ante interest rate (above, current page), 1980-1992

We then estimated the VAR that includes the real ex ante interest rate. Again, the two variables are I(1) and were included in the estimation in levels. Now, the impulse response analysis yielded a result of a significant impact of the real interest rate on output, with the peak after 8 quarters. The response multiplier of output here to a typical real interest rate shock is minus 1.1 percent.[15] The confidence interval is significantly different from zero from 4 quarters onwards; a positive shock in the real ex ante interest rate has a negative impact on output after one year has passed from the shock. Then, it could be used as a stimulator of the economy after a time of deflation if the central bank is credibly committed to returning the economy back to a stable price level.

In order to evaluate the robustness of the obtained estimates, we substitute the short-term interest rate (3-month certificate of deposit) by the uncollaterized overnight call rate that is more directly controllable by the central bank. There is no difference with the obtained results as the 3-month CD rate tracks the overnight call rate very closely. We also substituted the real GDP series by private consumption and fixed capital formation, respectively. The impact of the interest rate on investment is twice as high as the one of interest rate on consumption or the real output. This is a natural finding, as the interest rate can be assumed to have a major impact on fixed capital formation through the interest rate channel of monetary policy.[16]

3.2 Benchmark and Forward-looking Unrestricted VAR, 1980 - 2000

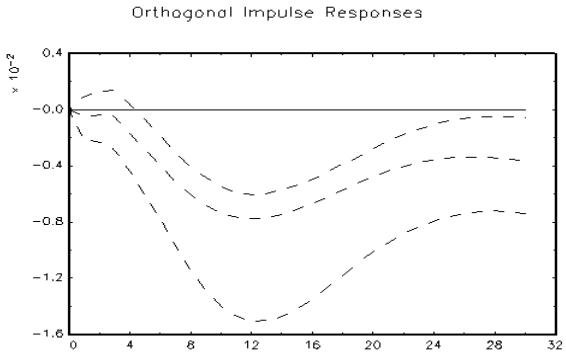
The same procedure was then used to estimate the trivariate model for the second time period of the study that includes the deflationary period 1993-2000. An impulse dummy was added to the second quarter of 1997 to improve the explanatory power of the model and to account for the jump

[15] This result is in line with the finding by Mankiw and Reis (2001), who detect a maximum impact of monetary policy on output after 7 quarters whereas the effects of monetary shocks on inflation occur immediately in sticky-price new Keynesian models. In an open-economy structural model, McCallum (2001a) also finds that the effects of interest rates on output appear faster, after approximately 2 quarters.

[16] Our result is in contrast with a study by Nakagawa and Oshima (2000), where the real interest rate was not found to stimulate private consumption in Japan. The authors suggested that the income effect of reduced interest income in Japan is strong enough to cancel out the substitution effect, i.e. higher consumption.

in the GDP series at that time[17]. We estimated the model for 4 periods, as suggested by the Akaike and FPE criteria.

A cointegration test was conducted in order to examine whether the variables share the same stochastic trend. Then, a combination of the variables could be I(0) (Lütkepohl 1991). Using the Saikkonen-Lütkepohl test with a constant and a trend, we were not able to find a cointegration relation between the variables. The test results are in Appendix A[18]. The choice of the Saikkonen-Lütkepohl test can be justified because it allows for the inclusion of dummy variables. The test estimates first the deterministic term, then subtracts it from the observations and applies a Johansen type test to the adjusted series (Saikkonen and Lütkepohl 2000). The finding from the tests was also confirmed with the Johansen trace test. This could appear as a surprising result when economic theory is taken into consideration; it would be more likely that the real interest rate would be stationary and we would thus find a cointegration relation. However, in the Japanese case the real interest rate has been decreasing. Moreover, the finding of a unit root in the real ex ante interest rate strengthens the conclusion from the Saikkonen-Lütkepohl and Johansen tests. It would also be likely that the nominal interest rate exhibits non-linearity asymptotically as the zero bound is approached. This is also suggested by graphical examination of the development of the nominal interest rate.



[17] Japan introduced a (pre-announced) consumption tax hike in April 1997.

[18] All the cointegration tests were performed using the variables as in the benchmark model, i.e. including the current price index. Many model estimations in the paper were performed using the forward-looking price level; however, the concept of a common stochastic trend between the variables seems meaningful only when looking at current relationships rather than forecast future values.

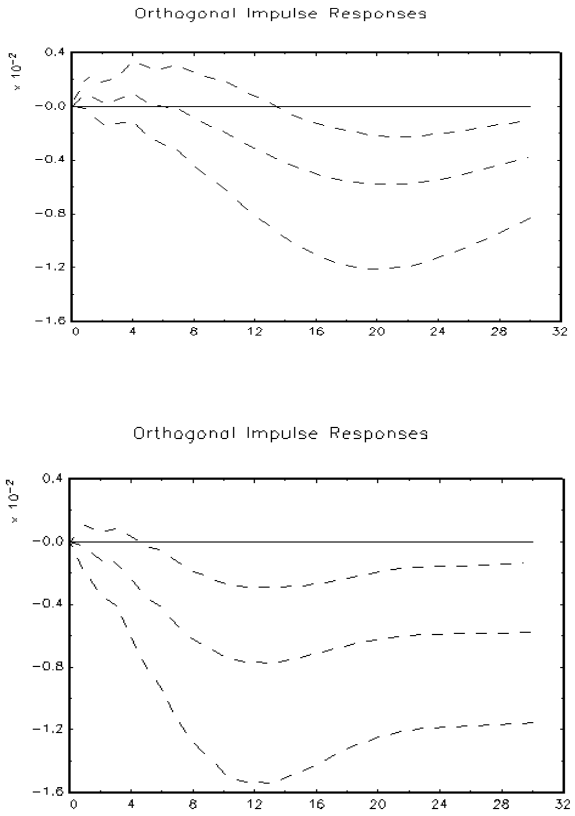


Figure 3. Impulse response of the real GDP to a shock in the nominal interest rate in the benchmark VAR (previous page), the forward-looking VAR (above, current page), and to a shock in the real ex ante interest rate (below, current page), 1980-2000

Observing the impulse responses, we find again that initially there is a price puzzle in play but this effect vanishes and turns to a negative effect of an interest rate increase on the price level. A shock in the nominal interest rate has again a significant impact on output. The quantitative impact of the shock is similar to the one obtained during a period of positive inflation rates, as a shock of one percentage point in the nominal interest rate leads to a decline in output of 1.5 percent. In the central bank reaction function, the coefficients for the lagged nominal interest rates are significant, again suggesting gradualism in the interest rate setting.

Again, the results for the forward-looking models are very similar to the ones obtained in the benchmark case. No price puzzle appears in the forward-looking VAR, and the elasticity of the nominal interest rate on output is 1.4. Also, the level of the peak impact of the real ex ante interest rate on output is very similar during both the observation periods. The inclusion of an impulse dummy for the quarter 1997Q2 is justified, as it is statistically significant. Both with perfect foresight (the forward-looking VAR) and the benchmark case, the results indicate that the nominal interest rate can stimulate output both during a period of 'normal' inflation rates and disinflation. This is an important finding as it suggests that the Lucas critique would not hold in the case of relative

monetary policy effectiveness in Japan as the disinflation and deflation period commenced[19].

In order to further determine the role of inflation expectations in the determination of the real ex ante interest rate and thus output growth, we reran the VAR estimations assuming a AR(4) process in the inflation rate. We obtain each value for the future price level by initially estimating an AR(4) process for the price level, then with the use of this equation and the lagged values of price level (4 lags for each future observation), calculate the forecasted values. The results are very similar to the ones obtained with perfect foresight and a random walk: we find that in both the observation periods, the real ex ante interest rate is able to stimulate output. The size of the impact is also similar to the one obtained with perfect foresight. This can be seen to add to the robustness of the results.

When comparing the forward-looking trivariate models for the two periods[20], we are able to see from the central bank reaction function that the central bank has reacted more aggressively towards expected inflation during the period of higher inflation rates. This is a positive finding considering the current Japanese deflation problem, as we would hope to find a more accommodating stand toward future inflation until the economy seems to be permanently out of the deflationary trap. We do not find significant coefficients for output in the central bank reaction function for either of the two periods, suggesting that interest rate decisions have been based more on the expected path of inflation than on output growth. It has been claimed that as central banks have become more credible and more predictable, private sector behavior has become more forward looking (IMF 2002). When the problem of deflation is coupled with increased forward lookingness, and the central bank is not perceived to be able to achieve a higher inflation rate, it may be more difficult to escape from the liquidity trap.

3.3 Empirical Evidence from the SVAR Approach

Here we discuss the evidence that the SVAR approach yields us, with the aim of assessing whether the results are in line with the ones obtained in the unrestricted VAR analysis. The structural

[19] When we use instead a significance level of 90% in the confidence intervals, the effect of the interest rate on output is somewhat weakened during the second examination period. This finding is similar to one obtained in a study by the IMF (2002), where the aim was to evaluate the impact of the inflation target on the effectiveness of monetary policy. This is similar to our study, if we interpret the period 1993-2000 as one of a zero inflation target and the period 1980-1992 as one with a higher inflation target. During a zero inflation target period, there is less room to decrease nominal interest rates, limiting the decrease in real interest rates. This causes output to recover more slowly, inflation to decline more and possibly end up in deflation. In the case of Japan, other explanations include the malfunctioning of the financial system and a possible decline in real interest rates due to slower productivity and potential output growth in the 1990s, as argued by Ahearne et al. (2002). It could also be that the appreciation of the yen may have offset the positive effects of lower interest rates. This was not supported in our analysis when we estimated the basic VAR adding the exchange rate as a fourth endogenous variable. This led to surprising results, such as an appreciation of the yen leading to an increase in output and to an increase in the price level. This held for the nominal exchange rate against the dollar, the nominal and the real effective exchange rates. The result could be due to the rather closed nature of the Japanese economy.

[20] Results are not reported here for the sake of brevity.

decomposition impulse responses of the SVAR approach can be found in Appendix C. We use asymptotically derived standard errors, as provided by the software EViews. Below we depict merely the impulse responses of real output to a monetary policy shock.

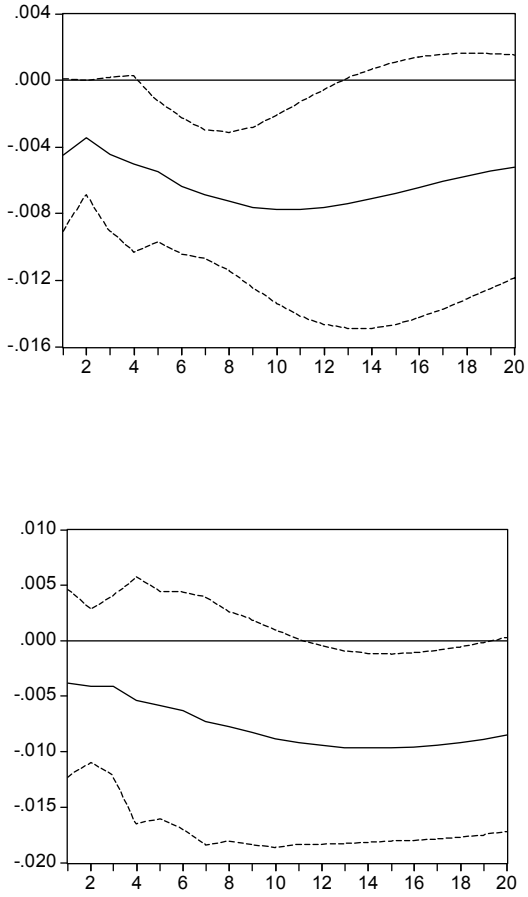


Figure 4. Impulse response of the real GDP to a structural monetary policy shock, 1980-1992 (above), 1980-2000 (below)

All in all, the impulses are similar to the ones obtained by the unrestricted VAR approach, albeit with reduced significance for some of the series. During the period 1980-1992, output declines significantly following a monetary policy shock. A similar impact is detected in the period 1980-2000; however, the significant effect appears later than in the previous period and the impact is of a lower value than the one detected in the 'inflationary' period. Both the price level and the nominal interest rate increase significantly to an output shock during both the observation periods. Moreover, the nominal interest rate increases after an inflationary shock, more during the inflationary than in the disinflationary period, although this effect is not significant. These results strengthen the conclusion from the unrestricted VAR approach that monetary policy remains potent even during a period of declining inflation rates. Yet, we do notice a slight difference in the significance and the peak of the

impact of a monetary policy shock on output[21].

3.4 Stability Analysis

In this section, we aim to estimate the stability of our unrestricted VAR system during the observation period 1980-2000, with the aim of detecting possible parameter instability. Instability in the system could provide information on possible structural breaks that may take place in the monetary transmission mechanism as Japan moved from positive inflation rates to deflation. In figure 4 below, we plot the results of a CUSUM-test on the benchmark trivariate VAR that includes the current price level, using the 1% significance level. The test is based on the cumulative sum of the recursive residuals, and a sum exceeding the critical lines is a sign of parameter instability.

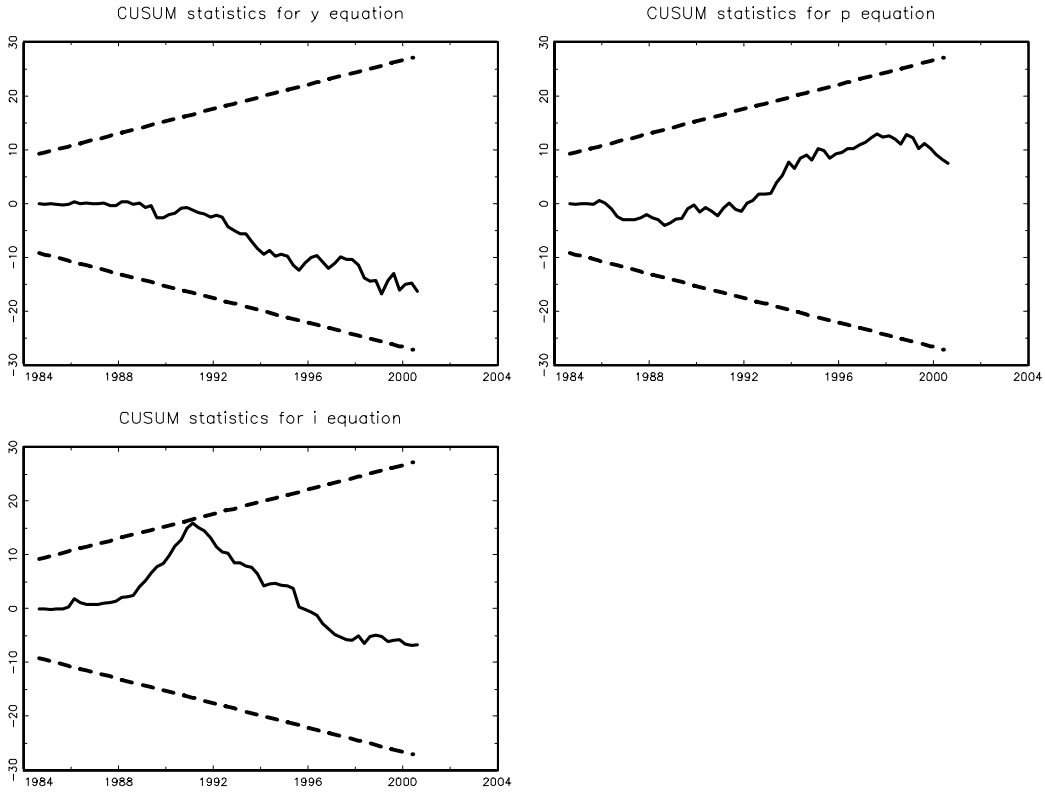


Figure 5. CUSUM test on the unrestricted trivariate VAR, 1% significance level

The test points to stability in our estimated system. Only in the nominal interest rate equation (4) (the central bank reaction function) do we find any sign of instability, yet even then the CUSUM statistic is still between the critical lines. It is interesting that this slight instability takes place in the turn of the decade from 1980s to 1990s, when Japan witnessed the bursting of the financial bubble. It is indeed highly feasible that the Bank of Japan could have changed its reaction to inflation and

[21] The finding of a smaller impact during the disinflationary period is more in line with the results from the unrestricted VARs at the 90% than at the 95% significance level that we used throughout our study.

output at that time. Once disinflation settles in, the system becomes very stable. The finding of relative stability in our system is strengthened by an examination of the recursive residuals, depicted below in Figure 6. In this case, values exceeding two standard errors can be noticed at the end of the sample period, but prior to that the equations are stable. It is again interesting that the equation for the nominal interest rate may be displaying a slight structural change in the monetary policy strategy by the BOJ, once the financial bubble burst and the disinflationary process started. In Appendix D, we also depict the recursive endogeneous coefficients on the first lag of the VAR. Similarly, in the interest rate equation there is slight evidence of a structural shift (only for its own lag), but all in all, the coefficients are stable, especially as disinflation settles in the Japanese economy.

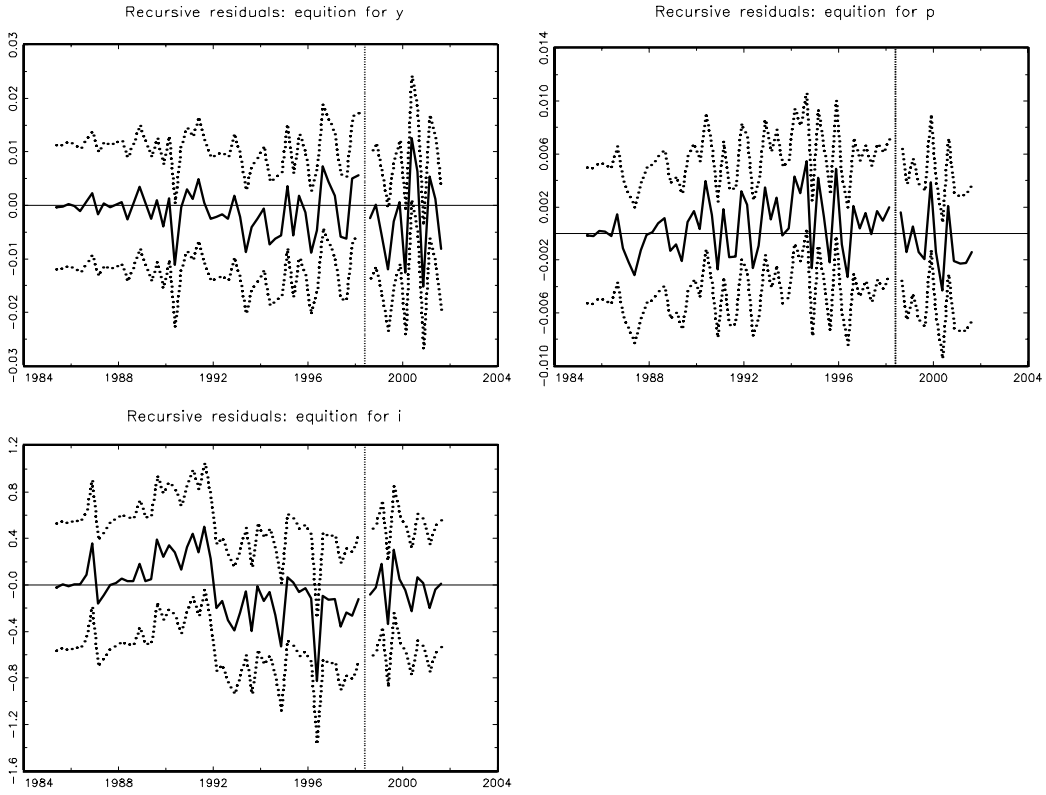


Figure 6. Recursive residuals from the unrestricted VAR system, 1% significance level

4 EXTENSIONS AND POLICY IMPLICATIONS

Equipped with the previous results, our aim in the following is two-fold. Firstly, we aim to propose a way for Japan to take advantage of the effectiveness of interest rates in stimulating output, even with the (current but not irremovable) zero interest rate floor. This is done by discussing the proposal to use Gesell money to tax the currency in circulation, thereby effectively lowering the bound on nominal interest rates. Secondly, we examine what the Bank of Japan could do in order to get

back to a path of positive inflation rates. We extend the unrestricted trivariate VAR discussed in the previous section by adding variables that can be of policy interest. These include, for example, increases in money supply, bank lending and corporate bonds. All the following estimations are based on the period including deflation, 1980-2000, with perfect foresight of future inflation. The estimates also serve the purpose of testing for the robustness for our previous findings about the interest rate channel and its impact on output.

4.1 Gesell Money, or the Tax on Currency

The finding that the interest rate channel has remained operative even as Japan entered deflation, suggests that monetary policy has in principle not lost its effectiveness. A problem then arises from the zero interest rate floor, which however does not need to be irremovable. The zero interest rate floor on government debt comes about, as investors can always hold cash that pays a zero interest. Then, if the interest rate on cash could be lowered further from the level of zero, the floor on interest rates would decline.

Recently there have been suggestions by Buiter and Panigirtzoglou (2003) and Goodfriend (2001) proposing mechanisms to lower the returns to holding cash[22]. The problem with taxing cash and currency is that they are bearer bonds; the holders are anonymous and ownership is sufficient for the bonds to be payable. This creates administrative problems, as it is difficult to make the bondholders actually pay the coupon for the issuer. A way for the Bank of Japan to get around this problem would be then to make currency subject to an expiration date and a conversion process during which the actual taxing of the currency takes place. This can take the form of attaching coupons or stamps to the currency. After a certain date, say 1st January 2005, only the yen stamped/issued/added with a coupon on and after that date by the Bank of Japan would be legal tender. Serious legal consequences need to be imposed in order to ensure that only the new currency would be a valid means of payment.

One should note that the public might not hold a significant amount of their wealth in currency, especially in cash. This can actually have several advantages if the Gesell money alternative is considered. Firstly, if only a small share of the wealth is in currency, the problem of actually converting the physical currency becomes smaller. Secondly, the currency that is held in bank accounts (or in accounts of postal offices as is regularly the case in Japan) can be taxed directly from the account, as the ownership is then well-known[23]. Thirdly, as will be discussed later in the context of monetary expansion in Japan, Gesell money may encourage investment in broader monetary components that can help in increasing the price level, as opposed to the monetary base.

Using Gesell money, any negative interest rate can be accommodated, making the interest rate channel of the monetary transmission mechanism powerful again. The additional advantage of the

[22] Buiter and Panigirtzoglou (2003) acknowledge that these proposals date to Gesell, and we will thus refer to 'Gesell money' when discussing the 'tax on currency' proposition.

[23] Of course the problem of actually transforming the physical currency held at banks remains.

Gesell money proposition is that as lower interest rates effectively lead to higher output growth (as shown in our VAR results), this would lead to persistent rather than temporary increases in future inflation[24].

4.2 Extension: Liquidity Expansion

We extend our basic trivariate system by adding monetary base (MB) as an endogenous variable. The interest in this variable is based on the fact that Japan has recently embarked on heavy monetary easing based on the quantity of liquidity. In March 2001 the BOJ adopted a new framework for money market operations by shifting the operating target to the quantity of liquidity, i.e. the outstanding balance of current accounts held at the Bank. Indeed, the growth rate of monetary base has been increasing at a rate close to 30 percent year on year (Hayami 2002b). This could support the recovery of the economy by stabilizing financial markets. The record rate of monetary easing has, however, not yet been able to bring Japan back to a situation of positive inflation rates. It has been claimed by the BOJ that the effects of monetary expansion will only be fully felt after structural reform progresses and the financial system is strengthened.[25]

Unit root tests suggested that the (log of the) index of the MB is an I(1) variable. We tested for the existence of a cointegration relation using the Saikkonen-Lütkepohl test that allows for the inclusion of dummy variables. We do find a cointegration relation; however, the test is sensitive to the particular lag length chosen. Moreover, with just a constant as the deterministic term, we obtain the result that the variables should actually be I(0) as the resulting cointegration rank is four. This led to estimation in levels terms. We built a VAR with four lags in the endogenous variables. We obtain the result that an increase in monetary base does not have a significant impact on the future price level by the conventional 95% significance interval.

We also tested whether the results differ according to the monetary aggregate used. For this purpose, we redid the VAR analysis using the broadly defined liquidity aggregate. The series in first differences displays a clear structural break and therefore we needed to include a shift dummy for the period from 1990Q2 until the end of the sample (see figure 7 below)[26]. We found that a shock in broadly defined liquidity leads to a significant increase on output. The elasticity of output to an increase in broadly defined liquidity is 0.75. Also, broadly defined liquidity does have a significant impact on the future price level, as shown in figure 8. This result suggests that a strategy of the Bank

[24] It is true that even temporary inflationary shocks would have the effect of lowering the real ex ante interest rate and increasing output. However, the Bank of Japan has stated that it would prefer a permanent return to above zero inflation rates rather than creating temporary inflationary shocks to break the period of deflation.

[25] Some observers have even commented that the BOJ has been slow in its policy response to deflation because it would first like to see action from the part of the fiscal authorities and banking supervision. In his analysis of the Japanese situation, Posen (1998) recommended an expansionary macroeconomic policy, consisting of a strong fiscal stimulus, an inflation target and a cleanup of the Japanese financial system.

[26] It could also be possible that broadly defined liquidity were actually an I(2) variable, integrated of order two. Here, however, we will conduct the estimation treating broadly defined liquidity as an I(1) variable, including a structural break.

of Japan that would emphasize a broader measure of money would be preferable to that of focusing on the monetary base. This is strengthened by pairwise Granger-causality analysis, displayed below in table 1. The results are surprisingly consistent with the findings from the VAR analysis; both the broad monetary aggregates analyzed, broadly defined liquidity and M2+CDs, were found to be leading indicators for the price level. In comparison, none of the narrow money series (monetary base, currency in circulation, deposit money), had this property.

Series	Lags	H0: *Z* does not Granger-cause *X*, *X* does not Granger-cause *Z*
z=M4, x=cpi	4	*F* =3.27 (0.02**), *F* =1.68 (0.16)
z=M2+CDs, x=cpi	4	*F* =3.10 (0.02**), *F* =0.48 (0.75)
z=Deposit money, x=cpi	4	*F* =0.50 (0.73), *F* =0.75 (0.56)
z=Currency in circulation, x=cpi	4	*F* =1.01 (0.41), *F* =1.15 (0.34)
z=Monetary base, x=cpi	4	*F* =1.34 (0.27), *F* =0.98 (0.43)

p-values for the *F*-statistics in parenthesis. Lag order chosen on the basis of the corresponding VAR-model in the paper, four lags for other series. * indicates significance at 10%, ** at 5% and *** at 1% level.

Table 1. Pairwise Granger-causality tests between components of money and the consumer price index.

Since late 1995, base money started to grow at twice the rate of the broader aggregates. This of course may be read as confirmation that the economy is in a liquidity trap, as one implication of the trap is that large increases in base money have little effect on broader monetary aggregates. This arises, as components of the broader aggregates become close substitutes. When interest rates are low, the interest rates yielded by assets other than base money might be seen by economic agents as too small to compensate for their risk or the length of the maturity. According to our results, as interest rates currently are very low, there is no asset substitution from narrow to broad money, even if narrow money is increasing at a record-high speed.

What could then be done to actually obtain portfolio adjustment among economic agents? The previous suggestion of using Gesell money/carry tax on currency would surely be helpful also in this case. This comes about as a result of a declining floor on nominal interest rates, creating a bigger interest rate differential than is the case with the zero interest rate bound. Below in figure 7, the interest rate differential between a 10-year government bond yield and the Bank of Japan deposit rate, together with the growth rate of broadly defined liquidity is depicted. It is noteworthy that the interest rate differential has declined to very low levels, again consistent with the existence of a liquidity trap, as no adequate incentives exist to adjust the portfolio from narrow to broader money. The importance of the interest rate differential in determining the demand for broad money

is additionally illustrated by the fact that the structural break in the broadly defined liquidity series occurred at the same time as a notable fall in the interest rate differential.

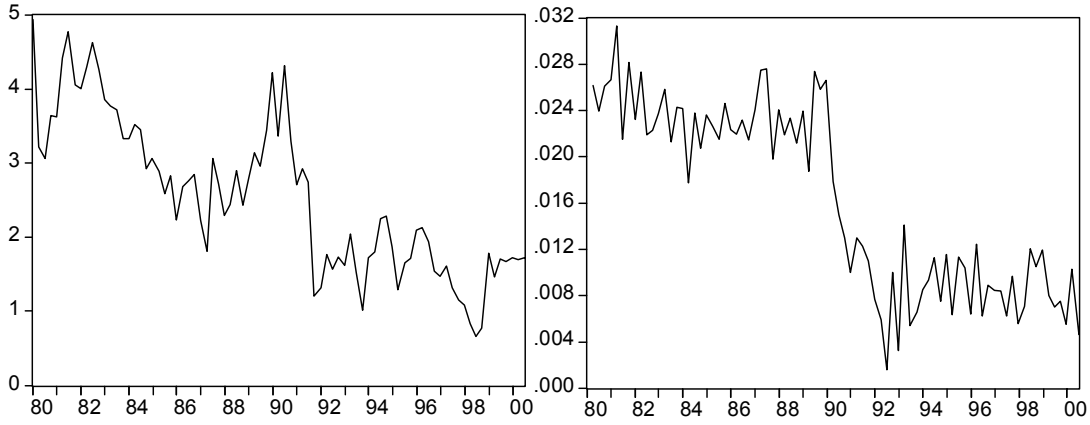


Figure 7. Interest rate differential (10-year government bond yield – central bank deposit rate) (left) and the growth rate of the broadly defined liquidity (right).

A similar effect as with the Gesell money could be obtained by lowering taxes on returns of investment and savings on components that are part of the broad monetary aggregate but not of the narrow ones. This would increase the incentive to invest in these components, effectively increasing the actual interest rate spread between narrow and broad money.

Additionally, we tested whether monetary expansion could have an impact on the prices of equities. The effect of an additional supply of current account balances could come about, firstly, by a reallocation of money from no-risk-no-return current account assets to higher risk assets, or, secondly, through effects on inflation expectations for the future. We built a four-variable VAR with the following variables and ordering: output, the nominal interest rate, monetary base, the share price index TOPIX. This particular ordering was chosen, as we can presume that share prices can react to exogenous events most rapidly, followed by money, then the interest rate and finally output. We estimated the model with 4 lags. We succeeded in finding a significant effect of money on stock prices, but the effect is quite small, as we find that the elasticity is 0.55. This could be a sign of a high risk aversion, but could also be a result of falling share prices in the 1990s and thus a meagre profit outlook in the stock market. This is also a natural consequence of the fact that before 1991, when the land prices started to fall, both equity and land prices were unsustainably high. Therefore it is not surprising that they do not react more strongly to monetary easing. Thus, according to our results, an increase in current account balances would not help in improving the banks' balance sheet in which the stock portfolio plays an important part.

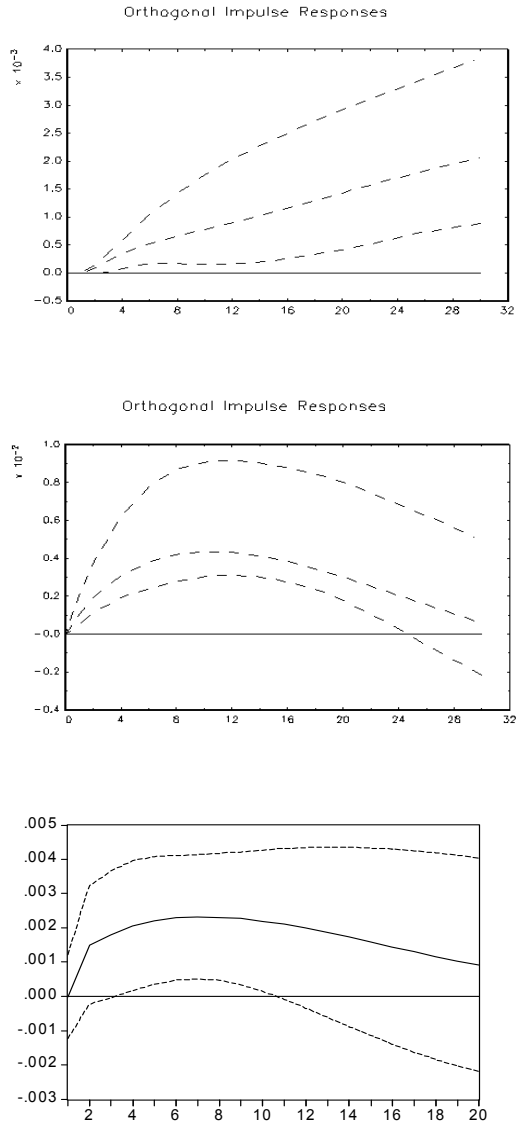


Figure 8. Impulse response of the consumer price index to a shock in broadly defined liquidity (top) and of the real GDP to a shock in lending (centre), structural impulse response of output to a broad money shock (below)

Regarding the structural VAR estimates in Appendix C, the impulse response of output to a broad money shock is very similar to the one obtained in the unrestricted VAR. Also, we do find a positive impact on the price level of a broad money shock; however, the confidence interval is only very slightly different from zero. In a structural model including broad money, the impact of the monetary policy shock working through interest rates on output is still negative but insignificant, suggesting that structural monetary policy shocks may then rather work through broad money than the nominal interest rate. Indeed, we found that an increase in broad money that usually follows after an interest rate cut, leads to increased real output.

4.3 Extension: The Role of Bank Lending

Next, we extend the unrestricted trivariate VAR by adding loans granted by the commercial banks. This is done in order to, firstly, examine the impact of loans on output, and secondly, to study their role in the monetary transmission mechanism. Again, the Saikkonen-Lütkepohl test was conducted in order to search for possible cointegration relations. We find two cointegration relations using 2 lags and both a constant and a trend as the deterministic terms. With only a constant as the deterministic term, we surprisingly find that the variables should actually be I(0) as even the null hypothesis of three cointegration relations is rejected. This strengthens the claim that the cointegration test result is not reliable in this case. This led us to build a VAR in levels with 3 lags.

The resulting estimates from the VAR suggest that the nominal interest rate is a significant variable explaining the lending behavior of commercial banks, but the confidence interval is strikingly close to the zero line. An increase in loans does, however, lead to a positive increase in output, but by a very small amount as a doubling of the amount of lending increases output by only 0.5%. The inclusion of loans in the basic trivariate model does not change the effect of the interest rate on output, suggesting that this effect is robust.

The effect of lending on output can also work through the increase in bad loans, affecting the banks' balance sheet. The amount of disposal of non-performing loans (NPLs) has exceeded the figure of 'core' profits of financial institutions in each of the eight years since 1994 (Hayami 2002a). The banks' bad loans are officially estimated to be at $345 billion, or 8% of GDP. The lending rates have not been set in line with the credit risk. During the financial bubble period, financial institutions did not put sufficient weight on examining firms' profitability when negotiating lending conditions. This was a natural consequence of the fast-increasing values of collateral and the belief that land values would never fall. We reran the VAR replacing the consumer price index with the share price index TOPIX of the Tokyo Stock Exchange. We find that loans are positively dependent on equity prices that can here be used as a proxy for asset prices in general. The multiplier in this case is 1.72. This is a qualitatively similar finding to that of Bayoumi (2001). The increase in loans induced by an increase in asset prices can come about by two basic ways: firstly, as Japanese banks hold huge equity portfolios, an increase in share prices has been beneficial to their balance sheets, increasing lending. Indeed, according to the BOJ (Yamaguchi 2001), a fall in stock prices has not only hurt the sentiment of households and firms but also weakened the capacity of financial institutions. Secondly, as asset prices increase, the value of collateral rises, together with the firms' market value as measured in share prices, facilitating the obtaining of bank funding (Bernanke et al. 1996). A reason for the current low credit demand by the private sector is the reduction in fixed investment by businesses while the firms continuously reduce their debts (Bank of Japan 2002). Also, during an economic downturn, the spreads for lending have to increase as the creditworthiness of companies decreases. However, as corporate profits decrease, there are not enough projects with sufficient profits to cover wider spreads. If the interest rates can be lowered, as is the case in an ordinary financial environment, banks' funding costs can go down and lending can actually increase.

In an environment where the interest rates are already zero, this is no longer possible. This provides a rationale for the direct funding of companies, an argument that is tackled later in this paper. But it also strengthens the argument for the tax on currency, as the possibility to decrease the interest rate floor would bring back the opportunity to increase profit margins for bank lending.

In order to examine whether the results are dependent on the country of origin of the lending bank, we performed the analysis separately for domestic banks and foreign banks located in Japan. The data were only available until the end of 1998, so the estimation period is two years shorter than the previous one. The results for domestic banks indicate that a positive shock on loans leads to a positive increase in output, consistently with former analysis. Also, the interest rate does not have an effect on loans. For foreign banks the results are different. Increases in loans do not lead to significant increases in output (actually we obtain the surprising finding that an increase in loans leads to a decrease in output but this effect is not significant), but an increased output has led to a positive increase in loans. There are some possible explanations for this result. The amount of foreign loans in Japan is very low in comparison to lending by domestic banks and could thus be rather insignificant for the growth in output. Lending by foreign banks is also considerably more volatile, possibly reflecting profit prospects for foreign banks in Japan that are dependent on output growth.

4.4 Extension: Alternative Solutions to the Japanese Problem

In September 2002, the BOJ announced it would buy the equity holdings of banks. A rationale for such a move could be concern that the falling stock markets would further destabilize the banking system due to the big equity portfolios. Therefore, the purchase could be regarded rather as a form of prudential policy than as a conventional monetary policy measure. But this rather unorthodox move has also been seen as a message from the central bank to the Financial Services Agency to act on the bad loans problem. This is especially the case as still in October 2001 the Bank of Japan announced that its law does not allow the purchase of stocks for monetary policy purposes (Yamaguchi 2001). Adding the TOPIX share price index variable in first differences into our basic trivariate VAR yields another model with four endogenous variables[27]. We find that an increase in the nominal interest rate leads to a significant decrease in share prices. Quantitatively, an increase in the interest rate of one percentage point lowers the TOPIX index by 7 percent. As such, ordinary monetary policy measures would be capable of having an effect on share prices, but as in Japan the leeway to monetary easing via lowering the interest rates is gone, this channel cannot be used to enhance the banks' equity portfolios. Would buying equities have an impact on output or lead to movements in the price level? We do find a significant positive effect of share prices on GDP, but the multiplier is only 0.07. There is a significant impact of share prices on the consumer price index but this effect is also very small (an increase in the share price index of one percent increases the consumer price index only by 0.03 percent), which is important to note for the possible pursuing of inflation or price level targeting in the future.

[27] These results are not illustrated here for the sake of brevity.

Taking into account the planned scope of share buying by the BOJ, it is clear that the effect on output and prices would be minimal and this move can rather be considered as an attempt to influence the government and the Financial Services Agency to act on the bad loans' problem. A possible risk with the plan is that the improved balance-sheet position may further delay the banks' willingness to act with the bad loans problem. Also, stocks carry more credit risk than government bonds. A central bank purchasing equities may incur a loss that it does not itself suffer as it can issue liabilities without the interest rate cost (Yamaguchi 2001). However, taxpayers will indirectly incur the loss. A final point is that the short-term interest rates being close to zero has dampened the restructuring efforts of Japanese financial institutions. This arises as many of the loans could not have been sustained in a higher interest-rate environment (Ahearne et al. 2002).

In Japan, bank lending has clearly been the main method of financing for firms, as opposed to direct financing. In order to find out the relationship between our basic VAR and direct financing through the capital market, we add corporate bonds (amount outstanding) as an endogenous variable. The cointegration testing yields similar results to the case of loans and the share price index, with no clear result depending on the lag length and the chosen deterministic terms. We again estimate a simple VAR with four lags as the one lag-model suggested by the Akaike-criteria is inadequate for monetary policy analysis. The results indicate that the corporate bonds are a significant explanatory variable for both output and the consumer price index. An increase in the outstanding level of corporate bonds of one percent would increase output by 0.08 percent. A heavy increase in direct financing could thus help, but the scale needs to be substantially higher than the current level. This is also suggested by a graphical examination of the corporate bond series in comparison with the three other endogenous variables. There seems to be no correlation with increases in output and increased issues of corporate bonds in order to obtain financing during periods of economic expansion; equivalently, no further bond issuance has taken place during the slump of the 1990s at the same time as bank lending has significantly decreased due to the credit crunch. The significance of the results from the VAR suggest, however, that direct financing could be a solution worthwhile pursuing for the Japanese firms. In this way companies would be able to obtain financing while the problem of NPLs is still being tackled. During economic downturns, when bank lending may lack momentum, the bond market would provide a complementary source of financing. This would also allow for risk-based pricing that the banking system has failed so far to provide. Moreover, as claimed by the BOJ (Hayami 2002a), achieving an appropriate balance between direct and indirect financing will help to buffer external shocks, contributing to financial system stability. Allen & Gale (2000) suggest that it is likely to be a combination of markets and intermediaries that describes a sophisticated financial system, pointing to the participation costs of acquiring information and the subsequent need for financial intermediaries. The authors mention that the historically heavily banking-based Japanese financial system currently lies somewhere between a market and intermediary-based system.

There has recently been an increase in the share of corporate bonds and commercial paper in total fund raising, to around 20 percent. However, the range of markets for bonds in Japan is small. The corporate bond and commercial paper markets are significantly limited to bonds issued

by firms with relatively high credit ratings. Deepening the corporate bond market could contribute to an economic upturn and thus to a higher inflation rate. In addition, a bigger share of lending by international banks located in Japan could also provide lending to higher risk businesses and thus add to the stock of lending (recall that our results showed an insignificant share of lending by foreign banks in Japan).

4.5 Comparison of the Results from the Extended Models with the Unrestricted Trivariate VAR

Comparison of the results obtained from the extended VARs with the basic trivariate VAR yields one possible way to evaluate the robustness of these results. Most importantly, the relationship between the interest rate and output seems to be robust. We find a significant negative effect of an increase in the nominal interest rate on output. The significance of this effect is reduced only when broadly defined liquidity is included as an endogenous variable, suggesting that monetary policy effects in this case work through this variable rather than the interest rate. As was argued previously in the paper, adding money into the basic trivariate model creates an identification problem for the monetary policy shock. The negative impact of an inflationary shock on output seems also to be rather robust (we explained it to come about through the increase in the nominal interest rate, the effect of which on the consumer price index is also robust). Finally, in all of the cases studied, an output shock leads to an initial increase in the consumer price index.

5 CONCLUSIONS

Our aim in this paper was to study whether price level or inflation targeting would be appropriate monetary policy rules for Japan. This was examined by evaluating the impacts of changes in nominal and real ex ante interest rates during periods of inflation and disinflation. Results from our VAR and SVAR analysis show that the Lucas-critique does not hold for monetary policy during disinflation in Japan, as interest rates remain potent in stimulating the economy. The beneficial effect on output is obtained in both the cases of perfect foresight and assuming that inflation follows an autoregressive process, with the latter case being admittedly close to perfect foresight. As interest rates have hit the zero nominal floor, introducing a tax on currency, or 'Gesell money' would be a viable policy alternative for Japan. It would re-establish the interest rate channel, accommodating any interest rate cut, as the tax on currency can be set at any level desired by the central bank. This policy would further induce a higher interest rate differential that is necessary in order to obtain portfolio adjustment from narrow to broad monetary aggregates. Our results show that increases in broad money, M2+CDs and broadly defined liquidity, can get Japan back to higher inflation rates. However, incentives for portfolio adjustment such as higher effective interest rate differentials are necessary, as the current monetary easing is restricted to the monetary base and broad money does not grow sufficiently fast.

It is interesting to note that the suggestions by observers for Japan to adopt an inflation or a price level target come at a rather different time than was generally the case with countries that have introduced inflation targeting. Usually, inflation targeting was introduced after inflation had peaked, or after a successful disinflationary process with, as yet, no threat of deflation. The persistent deflationary environment in Japan, however, makes the context quite different. This could make the usual rationale for inflation targeting of increased monetary policy credibility invalid in the Japanese case. This can happen if the central bank together with the fiscal authorities does not adopt adequate measures to fight deflation. Inflation targeting has also been seen as increasing the independence of the central bank. Increased independence might, however, be the last thing the BOJ needs now; our results show that fiscal measures need to be implemented in unison with monetary policy in order to overcome the deflation problem.

There are some reasons why the price level targeting approach (as opposed to inflation targeting) would be especially suitable for Japan. The very low inflation rates and the consequent deflation would necessitate a positive inflation rate in the future under a price level targeting approach. Under a price level targeting strategy, the disinflationary situation would be attacked immediately and positive inflation rates would be sought. With hindsight, it is easy to argue that a price level targeting approach may have saved Japan from deflation in the 1990s. When Japan finally gets back to positive inflation rates, it may be important to adopt a price level target so that any disinflationary shock is tackled immediately, ensuring that the persistent deflationary spiral does not reappear.

Why has the BOJ been so reluctant to adopt either a price or an inflation target? The BOJ has argued that they should aim at price stability that supports medium to long-term sustainable growth, not price stability at a particular point in time (Hayami 2000). To understand this claim, one should recall Japan's experience of the financial bubble when the change in the consumer price index remained relatively small, reaching 2 percent only in April 1990 and 3 percent in the year to November 1990. Such an inflation rate would not necessarily require an increase in interest rates; however, the increase in asset prices at that time, the subsequent bursting of the financial bubble and the subsequent deflation problem suggest that attention probably should have been directed at the medium-term outlook for output and inflation, including asset price developments. Yet, it was problematic to rely on medium-term inflation forecasts when the financial bubble burst and when the asset price deflation spread to consumer prices. In 1990, actual inflation was higher than forecast values. Equivalently, when deflation became a serious problem in 1995, the one- and two-year inflation forecasts were still in positive territory.

Finally, one can claim that inflation or price level targeting would not compromise the BOJ's strategy of price stability that supports medium to long-term sustainable growth. On the contrary, through the increased clarity of the central bank strategy, the odds for actually attaining the targeted price level improve. Moreover, there is no reason for why this targeted price level should hamper long-term sustainable growth.

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Appendix A: Unit Root and Cointegration Tests

Table 1a: ADF test for unit roots, 1980-1992

Series	Deterministic term	No. of lagged differences	Test statistic	Critical values 10%	5%	1%
GDP	constant, trend	3 (AC,FPE,HQ,SC)	-1.85	-3.13	-3.41	-3.96
i	constant, trend	3 (AC,FPE,HQ,SC)	-2.80	-3.13	-3.41	-3.96
r (re)	constant, trend	3 (AC,FPE,HQ)	-3.40*	-3.13	-3.41	-3.96
		0 (SC)	-2.87	-3.13	-3.41	-3.96
r (rw)	constant, trend	0 (AC,FPE,HQ,SC)	-3.06	-3.13	-3.41	-3.96
cpi (re)	constant	0 (AC,FPE)	-2.04	-2.57	-2.86	-3.43
GDP (-1)	constant	2 (AC,FPE,HQ,SC)	-1.77	-2.57	-2.86	-3.43

Table 1b: ADF test for unit roots, 1980-2000

Series	Deterministic term	No. of lagged differences	Test statistic	Critical values 10%	5%	1%
GDP	constant, trend	4 (AC,FPE,HQ)	-1.2	-3.13	-3.41	-3.96
i	constant, trend	3 (AC,FPE,HQ)	-2.63	-3.13	-3.41	-3.96
r (re)	constant	3 (AC,FPE)	-2.36	-2.57	-2.86	-3.43
	constant	0 (HQ,SC)	-1.57	-2.57	-2.86	-3.43
r (rw)	constant	4 (AC,FPE)	-1.72	-2.57	-2.86	-3.43
	constant	0 (HQ,SC)	-1.79	-2.57	-2.86	-3.43
MB	constant, trend	2 (AC, FPE)	-1.83	-3.13	-3.41	-3.96
M4	constant, trend	2 (AC, FPE,HQ)	-1.01	-3.13	-3.41	-3.96
loans	constant, trend	9 (AC, FPE)	-2.2	-3.13	-3.41	-3.96
	constant, trend	2 (HQ,SC)	-0.33	-3.13	-3.41	-3.96
topix	constant	4 (AC, FPE)	-2.16	-2.57	-2.86	-3.43
bonds	constant, trend	8 (AC,FPE)	-1.09	-3.13	-3.41	-3.96
GDP (-1)	constant	2 (SC)	-3.02**	-2.57	-2.86	-3.43
r (re) (-1)	constant	0 (AC,FPE,HQ,SC)	-9.28***	-2.57	-2.86	-3.43
r (rw) (-1)	constant	3 (AC,FPE)	-4.75***	-2.57	-2.86	-3.43
MB (-1)	constant	0 (AC,FPE,HQ,SC)	-7.63***	-2.57	-2.86	-3.43
loans (-1)	constant, trend	1 (HQ, SC)	-3.26*	-3.13	-3.41	-3.96
topix (-1)	constant	3 (AC,FPE)	-4.24***	-2.57	-2.86	-3.43
bonds (-1)	constant	7 (AC,FPE)	-2.98**	-2.57	-2.86	-3.43

* indicates significance at 10% level, ** at 5% and *** at 1% level.

The order specification criteria in parenthesis. AC=Akaike, FPE=final prediction error, HQ=Hannan-Quinn, SC=Schwartz-criteria. Re/rw denote the cases of rational expectations and random walk, respectively.

(-1) denotes the variable in first differences.

Table 2: Cointegration test (Saikkonen-Luetkepohl test)

Series	Deterministic term	no. of lags	Cointegration rank	Test value
GDP & i & cpi & dummy	constant & trend	4 (AC,FPE)	0	17.3
			1	7.32
			2	0.45
GDP & i & cpi & dummy	constant	4 (AC,FPE)	0	20.57
			1	7.95
			2	0.88
GDP & i & cpi & dummy	constant & trend	2 (HQ)	0	24.33
			1	8.25
			2	0.1
GDP & i & cpi & MB & dummy	constant	12 (AC)	0	70.39***
			1	40.25***
			2	19.45***
			3	4.95**
GDP & i & cpi & MB & dummy	constant & trend	12 (AC)	0	57.43***
			1	22.38
			2	16.58**
			3	2.92
GDP & i & cpi & M4 & dummy	constant & trend	12 (AC)	0	90.95***
			1	31.29**
			2	24.24**
			3	2.57
GDP & i & cpi & M4 & dummy	constant & trend	2 (FPE, HQ)	0	62.68***
			1	27.12*
			2	9.64
			3	5.31
GDP & i & cpi & M4 & dummy	constant	2 (FPE, HQ)	0	60.89***
			1	16.59
			2	3.78
			3	0.02
GDP & i & cpi & loans & dummy	constant	1 (HQ, SC)	0	156.82***
			1	48.63***
			2	32.44***
			3	10.67***
GDP & i & cpi & loans & dummy	constant, trend	1 (HQ, SC)	0	76.21***
			1	31.41**
			2	12.54
			3	0.09
GDP & i & cpi & bonds & dummy	constant, trend	12 (AC)	0	96.20***
			1	50.19***
			2	9.92
			3	0.22
GDP & i & cpi & bonds & dummy	constant, trend	2 (HQ)	0	83.35***
			1	22.41
			2	1.4
			3	1.2

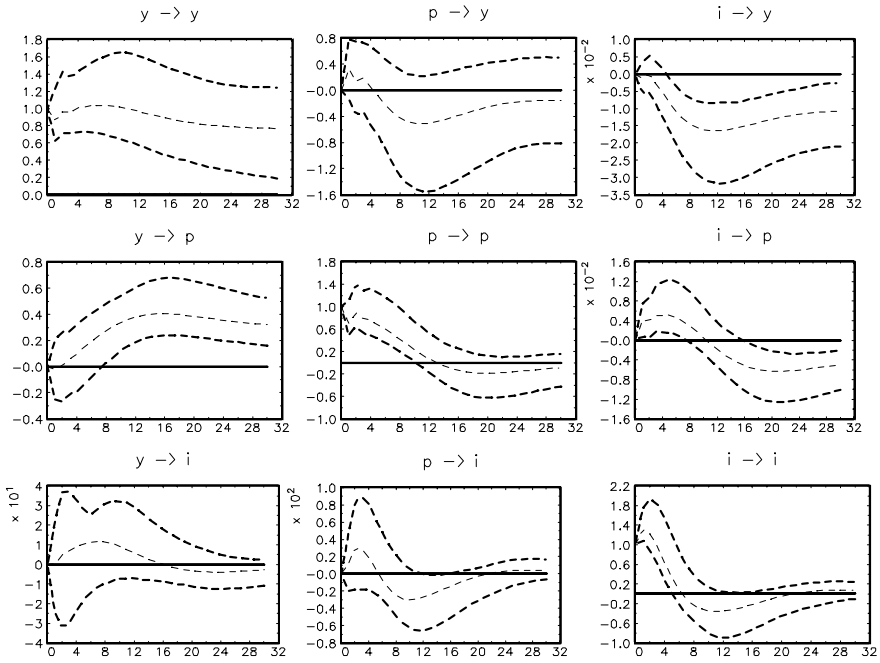
* indicates significance at 10% level, ** at 5% level and *** at 1% level.

The order specification criteria in parenthesis. AC=Akaike, FPE=final prediction error, HQ=Hannan-Quinn,SC=Schwarz-criteria.

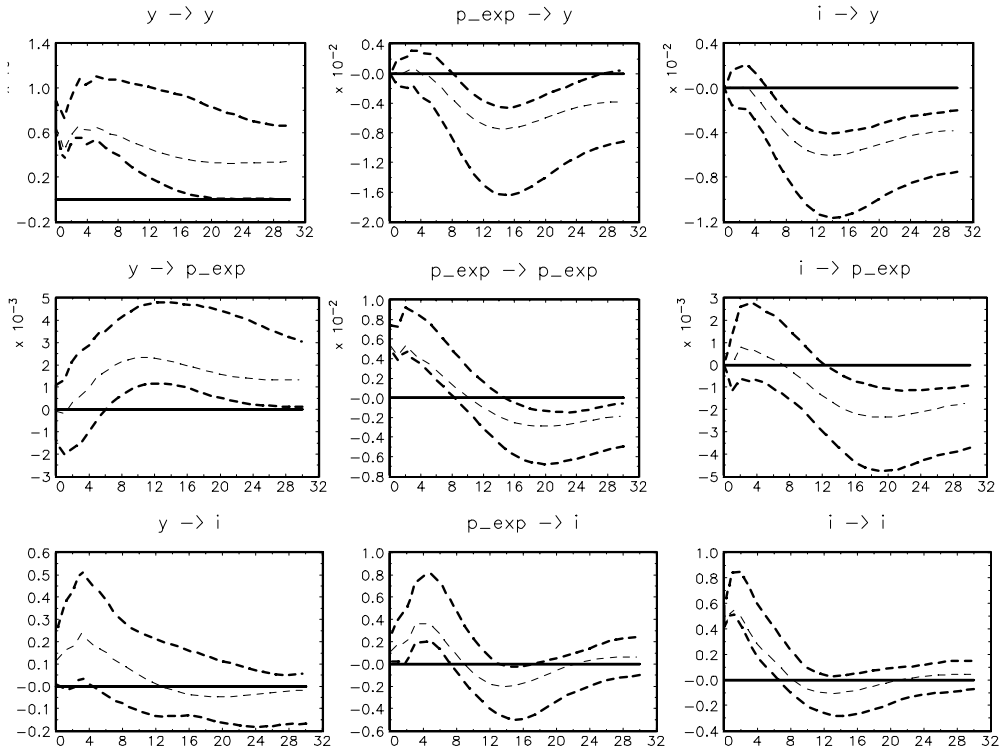
Dummy denotes an impulse dummy for 1997Q2, all the tests conducted for the period 1980-2000.

Cpi denotes the price level for the current period.

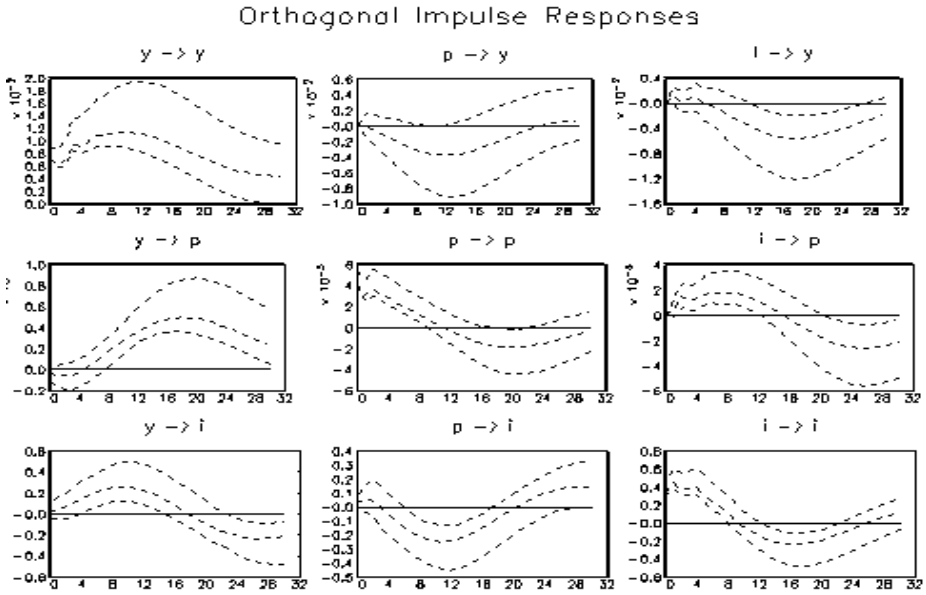
Appendix B. Impulse Responses, Unrestricted VARs



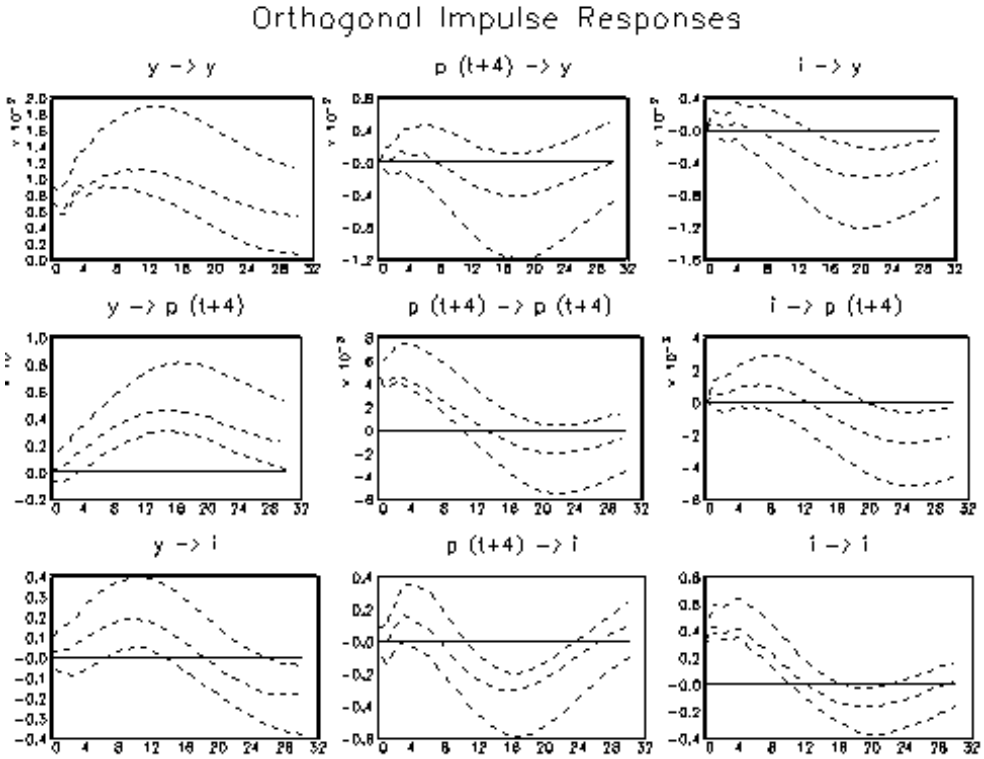
Real GDP, consumer price index (current period), nominal interest rate, 1980-1992



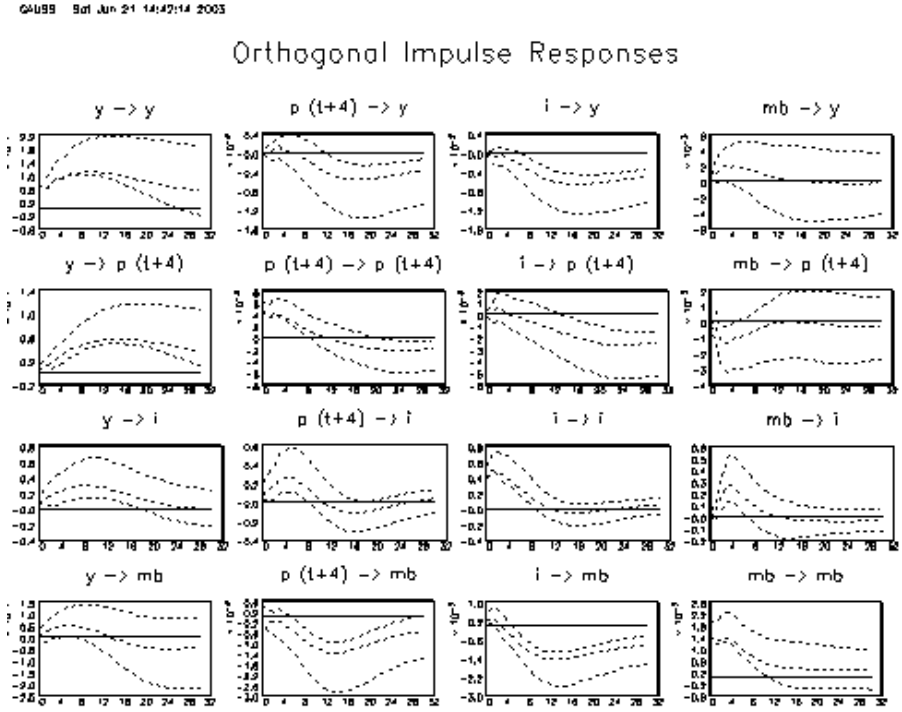
Real GDP, consumer price index (forward-looking), nominal interest rate, 1980-1992



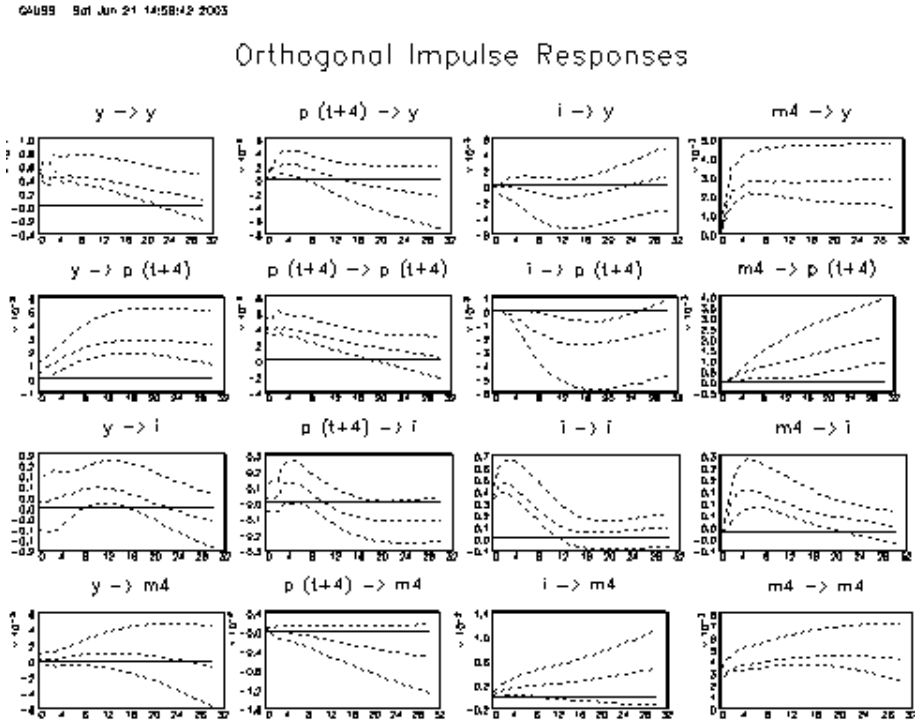
Model: Real GDP, consumer price index (current period), nominal interest rate, 1980-2000



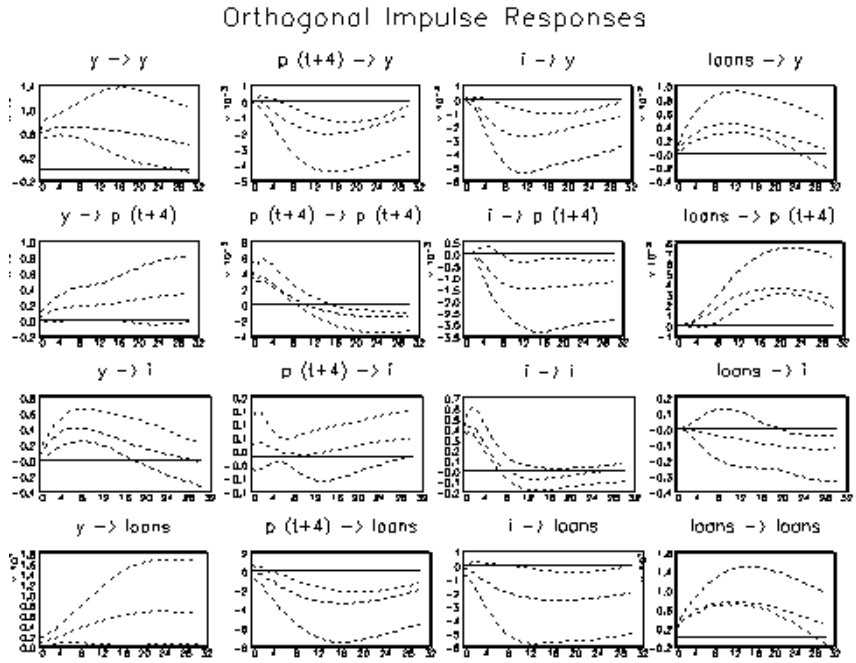
Model: Real GDP, consumer price index (forward-looking), nominal interest rate, 1980-2000



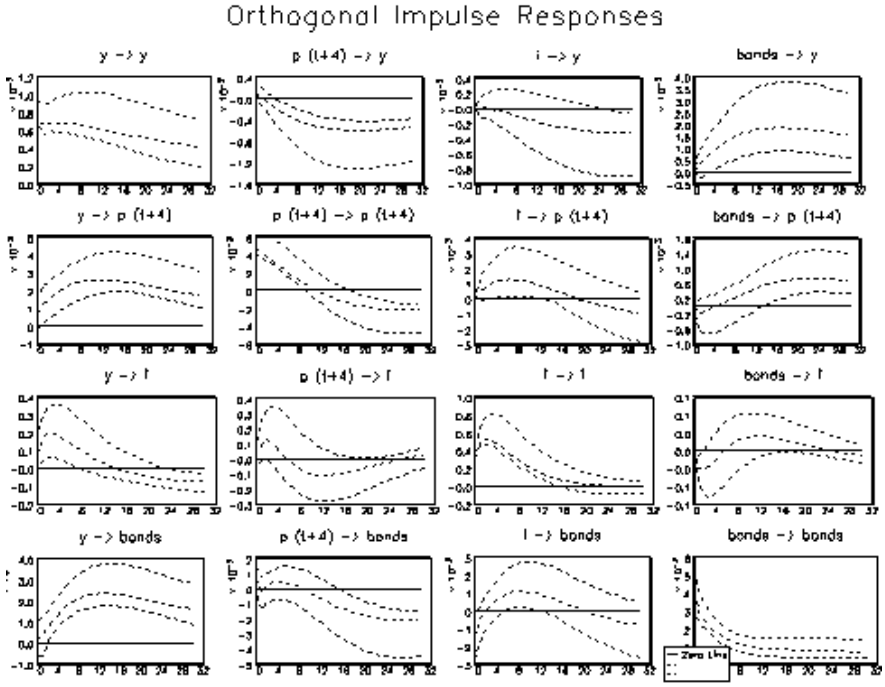
Model: Real GDP, consumer price index, nominal interest rate, monetary base, 1980-2000



Model: Real GDP, consumer price index, nominal interest rate, broadly defined liquidity, 1980-2000



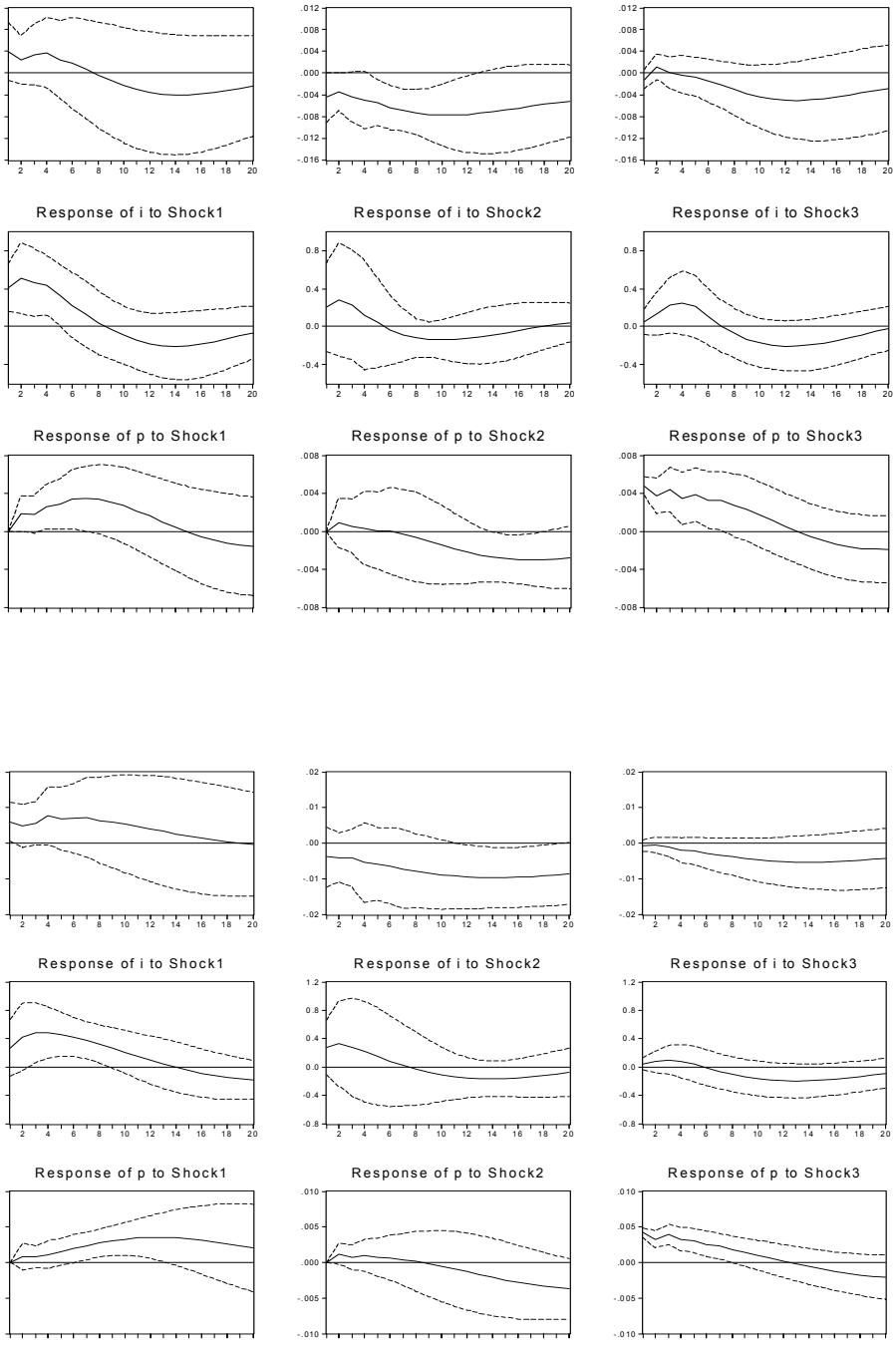
Model: Real GDP, consumer price index, nominal interest rate, lending by commercial banks, 1980-2000



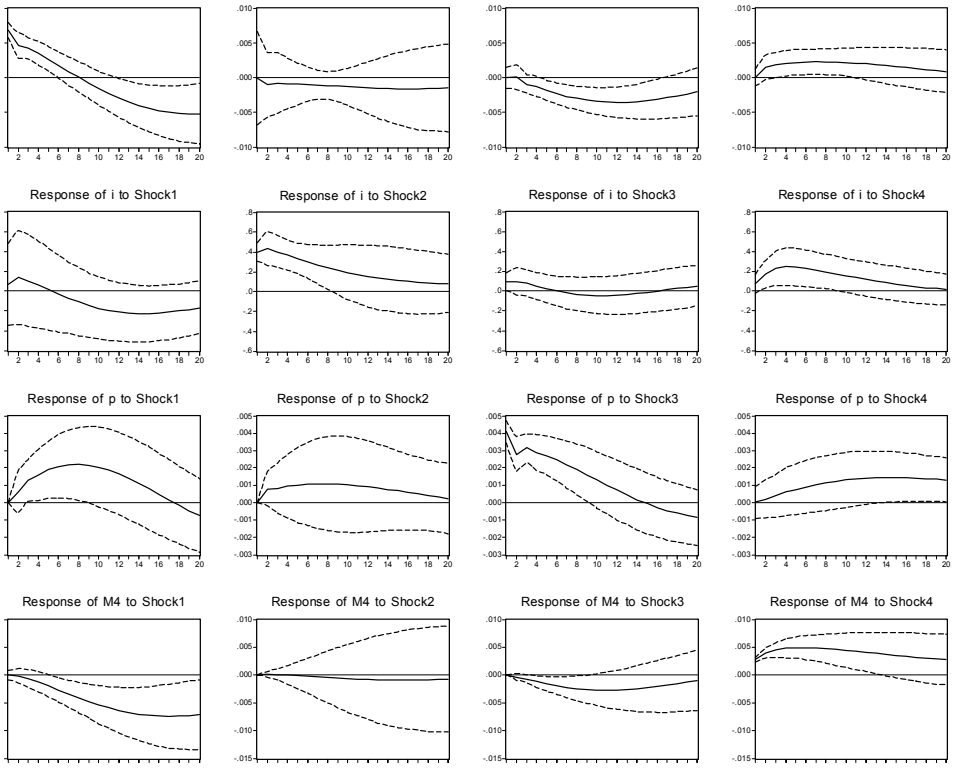
Model: Real GDP, consumer price index, nominal interest rate, corporate bonds outstanding, 1980-2000

Appendix C. Impulse Responses, SVARs

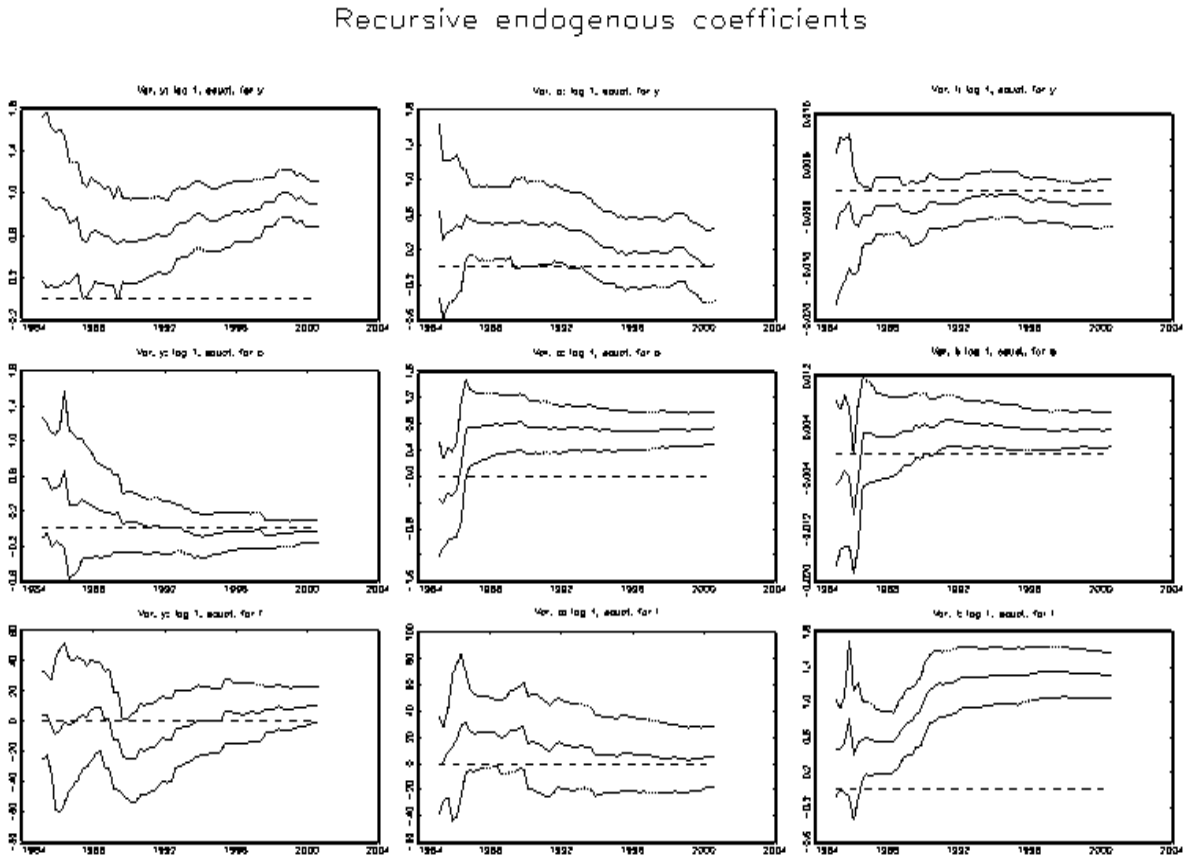
Model: y, p, i, 1980-1992 (above), 1980-2000 (below). Shock 1, 2 and 3 denote the output, monetary, and inflationary shock, respectively. Figures in first row depict the responses of output to shocks 1, 2, 3, respectively.



Model: y, i, p, broadly defined liquidity, 1980-2000. Shocks 1, 2, 3 and 4 denote an output, monetary policy, inflationary and broad money shock, respectively. Figures in first row depict the responses of output to shocks 1, 2, 3 and 4, respectively.



Appendix D. Stability Test, VARs



Recursive coefficients, first lag, benchmark unrestricted VAR, 1980-2000. Order of variables: y, p, i.

Appendix E.

Summary of Estimated VAR Models: Variables, Estimation Period and Type of Model (VAR/SVAR)

VARs
Real GDP, consumer price index, nominal interest rate, 1980-1992
Real GDP, consumer price index, nominal interest rate, 1980-2000
Real GDP, real ex ante interest rate, 1980-1992
Real GDP, real ex ante interest rate, 1980-2000
Real GDP, consumer price index, nominal interest rate, monetary base, 1980-2000
Real GDP, nominal interest rate, monetary base, TOPIX share price index, 1980-2000
Real GDP, consumer price index, nominal interest rate, broadly defined liquidity, 1980-2000
Real GDP, consumer price index, nominal interest rate, lending by commercial banks, 1980-2000
Real GDP, TOPIX share price index, nominal interest rate, lending by commercial banks, 1980-2000
Real GDP, consumer price index, nominal interest rate, TOPIX share price index, 1980-2000
Real GDP, consumer price index, nominal interest rate, corporate bonds outstanding, 1980-2000
SVARs
Real GDP, consumer price index, nominal interest rate, 1980-1992
Real GDP, consumer price index, nominal interest rate, 1980-2000
Real GDP, consumer price index, nominal interest rate, broadly defined liquidity, 1980-2000