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Monetary Policy and Japan's Liquidity Trap*

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Abstract

During the long economic slump in Japan, monetary policy in Japan has essentially consisted of a very low interest rate (since 1995), a zero interest rate (since 1999), and quantitative easing (since 2001). The intention seems to have been to lower expectations of future *interest rates*. But the problem in a liquidity trap (when the zero lower bound on the central bank's instrument rate is strictly binding) is rather to raise private-sector expectations of the future *price level*. Increased expectations of a higher future price level are likely to be much more effective in reducing the real interest rate and stimulating the economy out of a liquidity trap than a further reduction of already very low expectations of future interest rates. Therefore, monetary-policy alternatives in a liquidity trap should be assessed according to how effective they are likely to be in affecting private-sector expectations of the future price level. Expectations of a higher future price level would lead to current depreciation of the currency. Quantitative easing would induce expectations of a higher price level if it were expected to be permanent. The absence of a depreciation of the yen and other evidence indicates that the quantitative easing is not expected to be permanent. In an open economy, the Foolproof Way (consisting of a price-level target path, currency depreciation and commitment to a currency peg and a zero interest rate until the price-level target path has been reached) is likely to be the most effective policy to raise expectations of the future price level, stimulate the economy, and escape from a liquidity trap. It is the *first-best* policy to end stagnation and deflation in Japan. The Foolproof Way without the explicit exchange-rate policy, namely a price-level target path and a commitment to a zero interest rate until the price-level target path has been reached, would be a *second-best* policy. The current policy, a commitment to a zero interest rate until inflation has become nonnegative is at best a *third-best* policy, since it accommodates all deflation that has occurred before inflation turns nonnegative and therefore is not effective in inducing inflation expectations.

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Japan has suffered from a long slump since the early 1990s and experienced persistent deflation in the GDP deflator since 1995 and in the CPI since 1998. The Bank of Japan has responded with a very low instrument rate (the overnight call rate) of 50 basis points since the end of 1995, a zero instrument rate since 1999 (except an increase to 25 basis points during August 2000-March 2001), and "quantitative easing" with a zero interest rate and a large expansion of the monetary base since March 2001 (Oda and Ueda [15], Eggertsson and Ostry [7]). The Bank has also made "a commitment to continue with this ample provision of liquidity until the year-on-year rate of change in the consumer price index (excluding fresh food, on a nationwide basis) registers zero percent or higher on a sustainable basis" (Bank of Japan [2]). This monetary-policy response has so far not stopped deflation in Japan, and the Bank of Japan has not gained control of the price level. Japan is in a *liquidity trap*—a situation when the zero lower bound for the instrument rate (ZLB) is strictly binding, in the sense that it prevents the central bank from setting its instrument rate at its optimal level.

What is the problem in a liquidity trap? The problem is that, even though the instrument rate is at zero, the real (short) interest rate is too high and the economy is in a recession and/or inflation is too low, perhaps even negative. The central bank would prefer a lower real interest rate and a more expansionary monetary-policy stance, if that were possible.

But, how can the problem be solved? The real interest rate can be lowered by the central bank inducing private-sector expectations of a higher future price level. If expected inflation increases, the real interest rate falls, even if the nominal interest rate is unchanged at zero.

But, how can the central bank induce such expectations of a higher future price level? Indeed, this is the real problem in a liquidity trap.

Consequently, in assessments of policy alternatives in a liquidity trap, the focus should be on how effective the policy alternatives are in affecting expectations of the future *price level*. In contrast, the Bank of Japan's policy of a zero interest rate, quantitative easing, and the related commitment seems intended to lower expectations of future *interest rates* and in this way stimulate the economy. But any reduction of already low expectations of future interest rates are likely to be much less effective in reducing real interest rates than increased expectations of the future price level.[1]

[1] Although, in some cases, a particular path of future interest rates may induce desirable price-level expectations in equilibrium, this way of affecting price-level expectations is certainly very indirect and in practice fraught with many difficulties. Furthermore, an interest-rate commitment need not in itself be sufficient to uniquely determine the price level, as emphasized long ago by Sargent and Wallace [16] and more recently—in the context of a liquidity trap—by Benhabib, Schmitt-Grohé, and Uribe [3].

Quantitative easing would lead to expectations of a higher future price level, *if* it the quantitative easing were expected to be permanent. Expectations of a higher price level would immediately show up in a current depreciation of the yen. The absence of such a depreciation indicates that the quantitative easing is not expected to be permanent, and that the Bank of Japan has failed dramatically in inducing expectations of a higher price level.

In an open economy such as Japan, the Foolproof Way—consisting of (1) a price-level target path, (2) a depreciation and temporary peg of the currency, and (3) an exit strategy to a floating exchange rate and inflation or price level targeting when the price-level target has been reached (Svensson [17], [18], and [20])—is likely to be the most effective monetary policy to stimulate the economy, escape from a liquidity trap, and give the Bank of Japan control of the price level.

Indeed, the Foolproof Way with a price-level target path, a currency depreciation, and a commitment to an exchange-rate peg and a zero interest rate until the price-level target path has been reached can be seen as a *first-best* policy to end stagnation and deflation in Japan. The Foolproof Way without the explicit exchange-rate policy, namely a price-level target path and a commitment to a zero interest rate until the price-level target path has been reached, would be a *second-best* policy. The current policy, a commitment to a zero interest rate until inflation has become nonnegative is at best a *third-best* policy. The problem with this policy is that it accommodates all deflation that has occurred before inflation turns nonnegative and hence is not effective in inducing inflation expectations.

1. In a liquidity trap, the real interest is too high; the real interest rate can be lowered by expectations of a higher future price level

Let me use a small New Keynesian model for illustration. Let $x_t \equiv y_t - \bar{y}_t$ denote the output gap in the current period t, where y_t denotes (log) output and $\bar{y}_t$ denotes (log) potential output. I assume that potential output is an exogenous stochastic process. Let r_t denote the (short) real interest rate,

$$r_t \equiv i_t - \pi_{t+1|t} \equiv i_t - (p_{t+1|t} - p_t);$$

where i_t denotes the nominal interest rate, the instrument rate; $\pi_{t+1|t}$ denotes private-sector one-period-ahead inflation expectations; p_t denotes the (log) price level; and $p_{t+1|t}$ denotes the expected one-period-ahead (log) price level. Let $\bar{r}_t$ denote the neutral (real) interest rate—the Wicksellian natural interest rate, the real interest rate that would arise in a hypothetical flex-price economy

with output equal to potential output. In the simplest case, the neutral interest rate is given by

$$\bar{r}_t \equiv \rho_t + \frac{1}{\sigma}(\bar{y}_{t+1|t} - \bar{y}_t),$$

where ρ_t is the rate of time preference (an exogenous stochastic process) and the positive constant σ is the intertemporal elasticity of substitution for consumption. Hence, the neutral interest rate is determined by the rate of time preference and expected potential-output growth. The output gap depends positively on the expected future output gap, $x_{t+1|t}$, and negatively on the real-interest-rate gap, $r_t - \bar{r}_t$, according to the aggregate-demand relation,

$$x_t = x_{t+1|t} - \sigma(r_t - \bar{r}_t),$$

which follows from a first-order condition for optimal consumption choice. The aggregate-demand relation can be solved forward to period $t + T$,

$$x_t = x_{t+T|t} - \sigma \sum_{\tau=0}^{T-1} (r_{t+\tau|t} - \bar{r}_{t+\tau|t}).$$

This expression shows that the current output gap depends positively on the expected output gap T periods ahead, $x_{t+T|t}$, and negatively on the sum of the current and expected future real-interest-rate gaps, $r_{t+\tau|t} - \bar{r}_{t+\tau|t}$, for the next T periods. I choose the horizon T such that the economy is expected to then be back to normal, in the sense that the output gap is expected to then be approximately equal to zero, $x_{t+T|t} \approx 0$. The current output gap then only depends on the sum of the current and expected future real-interest-rate gaps for the next T periods. If the current output gap is negative, so there is a recession, this is because the sum of the current and expected future real-interest-rate gaps is too high—that is, because the current and expected real interest rates are too high relative to the natural interest rates.

Since the economy is expected to be back to normal T periods ahead, the current output gap can be written as

$$x_t \approx -\sigma \sum_{\tau=0}^{T-1} (i_{t+\tau|t} - \pi_{t+1+\tau|t} - \bar{r}_{t+\tau|t}) = -\sigma \sum_{\tau=0}^{T-1} i_{t+\tau|t} + \sigma(p_{t+T|t} - p_t) + \sigma \sum_{\tau=0}^{T-1} \bar{r}_{t+\tau|t};$$

where the first equality uses the definition of the real interest rate, and the second equality uses the fact that the sum of future inflation equals the total change of the (log) price level. I assume that the economy is expected to be in or close to a liquidity trap during the next T periods, so the expected instrument rates for that period are approximately zero, $i_{t+\tau|t} \approx 0$ $(0 \leq \tau \leq T-1)$. Then the first term on the right side is approximately zero. For a given current price level p_t (I assume

that the current price level is sticky and in the short run approximately given), the output gap depends only on the expected price level T periods ahead, $p_{t+T|t}$, and the sum of the expected neutral interest rates during the next T periods:

$$x_t \approx \sigma(p_{t+T|t} - p_t) + \sigma \sum_{\tau=0}^{T-1} \bar{r}_{t+\tau|t}.$$

If the output gap is negative, so the economy is in a recession, this is for two reasons: The sum of the current and expected future neutral interest rates, $\sum_{\tau=0}^{T-1} \bar{r}_{t+\tau|t}$, is too low, and the sum of the current and expected future real interest rates, $\sum_{\tau=0}^{T-1} r_{t+\tau|t} \approx -(p_{t+T|t} - p_t)$, is too high. That is, the expected future price level, $p_{t+T|t}$, is too low. It follows that the real interest rate can be lowered and the negative output gap reduced or eliminated, if the central bank can induce private-sector *expectations of a higher future price level.*[2]

However, the Bank of Japan's policy has mostly been about stimulating the economy and reducing the negative output gap by inducing private-sector *expectations of lower future instrument rates.* Thus, in the case when the expected future instrument rates during the next T periods are not exactly zero but positive, they can perhaps be reduced further toward zero. However, they are already small, so what can be gained is small. Furthermore, perhaps the private-sector can be induced to expect instrument rates close to zero also *after* period T, after the liquidity trap is over. In the above framework, this would amount to creating expectations of a positive rather than a zero output gap T periods ahead, $x_{t+T|t} > 0$, which would reduce the current negative output gap. It seems likely that any such attempt to lower expectations of future instrument rates toward zero, when these expectations are already low to start with, will have very small, second-order effects on the current output gap.

In contrast, there is potentially a large first-order effect on the output gap from increasing expectations of the future price level. This is where I wish that the focus of the Bank of Japan had been.

2. How can the central bank affect expectations of the future price level?

The insight that the principal solution to the problem of a liquidity trap involves affecting private-sector expectations of the future price level is due to Krugman [13]. Krugman also noted that this principal solution immediately encounters a practical problem, a credibility problem, in that it is

[2] Jung, Teranishi, and Watanabe [11] and Eggertsson and Woodford [8] characterize the precise optimal expectations of the future price level and the related optimal credible price-level targets for escaping from a liquidity trap in a closed economy. Svensson [20] characterizes the optimal policy in a simple open-economy model.

not so easy for a central bank to purposely affect such private-sector expectations. In particular, a central bank that has built a reputation for consistent low-inflation policy, such as the Bank of Japan, finds it particularly difficult to convince the private sector that it suddenly wants the price level to increase substantially.

2.1. Expanding the money supply

One potential way to affect expectations of the future price level is by increasing the money supply. As Krugman noted, this is effective only if an increase in the money supply is perceived by the private sector to be *permanent*. Unfortunately, there is no commitment mechanism through which a modern central bank can commit itself to a particular future money supply.[3]

We can see this in the above framework. I choose the horizon T such that the liquidity trap is expected to be over and interest rates are expected to be positive beginning in period $t+T$, $i_{t+T|t} > 0$. To a first approximation, we may take demand for the monetary base to be proportional to nominal GDP when interest rates are positive. This implies (disregarding any constant),

$$p_{t+T|t} \approx m_{t+T|t} - y_{t+T|t},$$

where $m_{t+T|t}$ denotes the expected (log) monetary base T periods ahead. That is, the expected future price level is approximately directly related positively to the expected future monetary base and negatively to the expected future output level. If the central bank could affect private-sector expectations of the future monetary base, it would, everything else equal, also affect private-sector expectations of the future price level to the same extent.

Unfortunately, it is not easy for a central bank to directly affect expectations of the future monetary base. The Bank of Japan's quantitative easing provides an unusually clear-cut example. In March 2001, the Bank of Japan initiated a dramatic expansion of the monetary base. By the summer of 2005, the monetary base had increased by about 67 percent. Suppose that the private sector would believe that an expansion of the monetary base of this magnitude is permanent. The private sector would then believe that, some time in the future (for concreteness, say in four years) when the Japanese liquidity trap is over, nominal GDP would be up by approximately 67 percent (taking nominal GDP to have been approximately constant since 2001). Suppose that the private sector believes that the Japanese GDP in the next four years will be up approximately 10 percent. The private sector would then believe that in four years the price level would be up

[3] Auerbach and Obstfeld [1] examine in some detail the effects of a permanent expansion of the money supply in a liquidity trap in some detail under the explicit assumption that the permanent expansion is credible.

by approximately $100(167/110 - 1) = 52$ percent. If this were the case, either the yen would depreciate by approximately 50 percent or long Japanese interest rates would rise substantially, or some combination thereof would occur (see below for details on this point). Obviously, neither of these events has occurred. The obvious conclusion is that the private sector does not believe that the expansion of the monetary base is permanent. The quantitative easing has not affected price-level expectations and has in this respect been a dramatic failure.

2.2. An inflation target or a price-level target

An inflation target or (better) a price-level target would be a fine solution, *if* it were credible. However, just announcing the target would not be enough: The announcement would have to be combined with statements and actions that make it credible. This seems to be a particular problem for central banks like the Federal Reserve and the Bank of Japan, since they have clearly demonstrated over many years their notorious aversion to any numerical target or other very explicit commitment.

2.3. Fiscal policy

Regarding fiscal policy, a fiscal expansion—an increase in the fiscal deficit—may or may not be expansionary and increase aggregate demand, depending on the composition of the fiscal expenditure, the degree of Ricardian equivalence, and so forth. Typically, Ricardian equivalence does not seem to hold, and a fiscal deficit is expansionary; however, private-sector behavior may be closer to Ricardian equivalence in a crisis situation with a perceived unsustainable fiscal and an expected immanent fiscal consolidation with increased taxes and/or reduced benefits. Japan has certainly tried an expansionary fiscal policy. This has not led to an escape from the liquidity trap, but it has certainly led to a dramatic deterioration of Japan's public finances.

A money-financed rather than debt-financed fiscal expansion is often proposed as a remedy against a liquidity trap. But it is often not understood that, for a given fiscal deficit and aside from any debt-induced inflation incentives for government-controlled (rather than independent) central banks, money- or debt-financing matters through exactly the same mechanism as that discussed above in regard to expanding the money supply. *Money financing of a fiscal expansion will have an effect on expectations of the future price level only to the extent that it is interpreted as a permanent expansion of the money supply.* Again, since there is no commitment mechanism for the future money supply, current money financing of a deficit does not exclude that the money supply

will be reduced in the future. Money-financing hence provides no separate mechanism to affect expectations of the future price level.

2.4. The Foolproof Way

In several papers (Svensson [17], [18], and [20] and Jeanne and Svensson [10]), I have promoted the Foolproof Way to escape from a liquidity trap (FPW) as an effective policy. The FPW involves the announcement and the implementation of (1) a price-level target, (2) a currency depreciation and a temporary peg consistent with price-level target, and (3) an exit strategy, when the price-level target has been reached, according to which the currency is floated and either inflation or price-level targeting is instituted. Because the FPW involves using the exchange rate as a policy instrument and the Ministry of Finance is formally responsible for exchange-rate policy in Japan, the implementation of the FPW would require some degree of cooperation between the Ministry of Finance and the Bank of Japan.[4]

In terms of the above framework, the purpose is to induce private-sector expectations of a higher future price level, such that the real interest rate falls and the economy expands out of the liquidity trap. Let the price level target for period $t+T$, $\hat{p}_{t+T}$, be such that price-level expectations satisfying

$$p_{t+T|t} = \hat{p}_{t+T}, \tag{2.1}$$

and zero instrument rates during the next $T-1$ periods would be adequate to achieve the desired fall in the real interest rate and increased stimulus of the economy. Price-level expectations and exchange-rate expectations will be related according to

$$p_{t+T|t} = s_{t+T|t} + p^*_{t+T|t} - q_{t+T|t}, \tag{2.2}$$

where s_t denotes the (log) exchange rate, p^*_t denotes the (log) foreign price level, and q_t denotes the (log) real exchange rate. I choose the horizon T such that the economy is expected to be back to normal; in particular, such that the real exchange rate is expected to be back to its natural/neutral/potential level, $\bar{q}_{t+T|t}$, and hence can be treated as exogenous from the point of current monetary policy. I assume that the foreign price level can be taken as exogenous. Under these assumptions, the expected future price level and the expected future exchange rate are directly related and move together.

[4] McCallum, in [14] and more recent publications, has emphasized the important role of the exchange rate as a monetary-policy instrument when the ZLB is binding.

By interest parity, the current exchange rate is related to the expected future exchange rate and the interest-rate differential between the home and foreign interest rate, $i_t - i_t^*$, by

$$s_t = s_{t+1|t} - (i_t - i_t^*) = s_{t+T|t} - \sum_{\tau=0}^{T-1} i_{t+\tau|t} + \sum_{\tau=0}^{T-1} i_{t+\tau|t}^*,$$

where the second equality follows from solving forward T periods. By (2.2), we get

$$s_t = p_{t+T|t} - \sum_{\tau=0}^{T-1} i_{t+\tau|t} + \dots ,$$

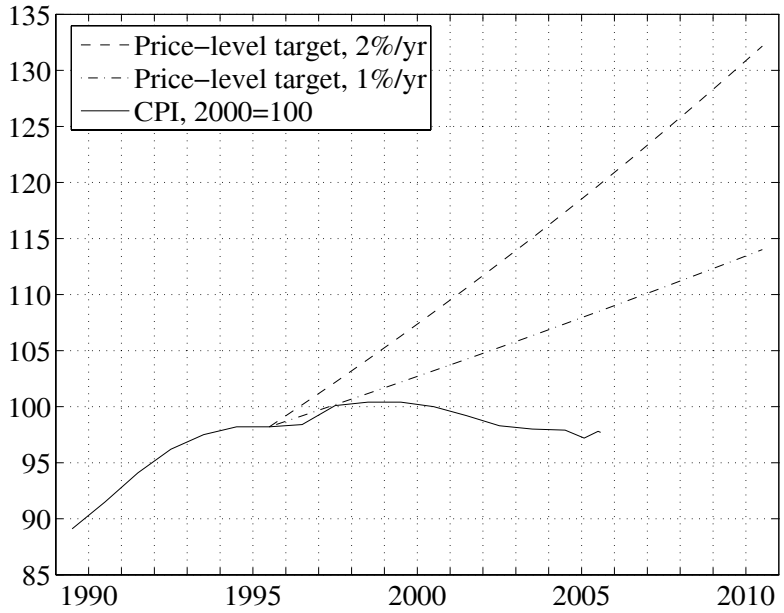
where exogenous terms have been left out. Expected future instrument rates approximately equal to zero imply that the current exchange rate is directly related to and moves together with the expected future price level. An increase in the expected future price level corresponds to an equal current depreciation of the currency. The exchange-rate peg of the FPW implements the exchange rate consistent with the future price-level target and the zero instrument rate.[5] If the FPW and its price-level target are immediately credible, the price-level expectations will rise to fulfill (2.1), and the currency will, by (2.2), depreciate by the same amount, and the peg will not be binding. Otherwise, the peg forces private-sector price-level expectations to be consistent with the price-level target.

Many comments on the FPW have suggested that a potential improving effect on the trade balance of the peg's currency depreciation may be problematic for the trading partners. However, any effects on the trade balance are exactly the same as those that would result from a credible price-level target without any peg, or a lower instrument rate, if that were not prevented by the ZLB. The truth is that any truly expansionary monetary policy would imply a currency depreciation and a trade-balance effect. Furthermore, any trade-balance net effect from expansionary monetary policy consists of income and substitution effects of opposite signs. In a liquidity trap and a deep recession, the income effect on the trade balance may be particularly strong and actually improve the trade balance for the trading partners. Finally, nothing prevents the trading partners from conducting expansionary monetary policy to counteract any contractionary effect from the FPW. In this way, an optimal world monetary expansion may be achieved (see Svensson [20] for an analysis of the international effects of the FPW).[6]

[5] The peg may need a rate of crawl to be exactly consistent with a zero home instrument rate. A constant peg would imply a home instrument rate equal to the foreign short interest rate, but the practical difference is small.

[6] One possible problem with the FPW is the possible incentive for the central bank to renege in the future by an unanticipated currency appreciation, so as to achieve a low inflation ex post. However, Jeanne and Svensson [10]—starting from (1) the fact that a currency appreciation depreciates the home-currency value of foreign exchange reserves and (2) the strong aversion towards negative central-bank capital revealed by central-bank officials and noted by central-bank commentators—show that a central bank can manage its capital such that it creates a commitment not to appreciate the currency in the future.

Figure 2.1: Alternative price-level target paths starting from 1995 and the CPI (excluding fresh food) for Japan



The FPW was first presented at a prominent international conference organized by the Bank of Japan in the summer of 2000.[7] At that time, Japan had experienced deflation in the GDP deflator for about five years and had been close to or in a liquidity trap for about two years. My guess is that most conference participants did not anticipate that Japan would still be in a liquidity trap a full five years later.

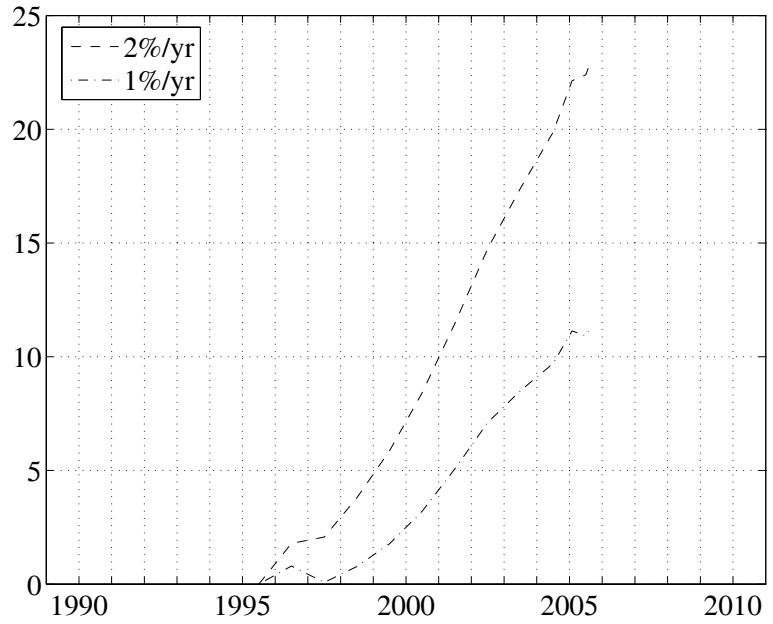
Suppose that the FPW had been implemented in the summer of 2000. Suppose that a price-level target path had been announced as the CPI (excluding fresh food) increasing at the rate of either 1 or 2 percent per year from its level in 1995, as in figure 2.1. This would have induced a "price gap" between the price-level target and the actual CPI of about either 3 or 8 percent in 2000, as in figure 2.2.[8] Thus, at that time, the required depreciation of the yen to undo those price gaps would have been about either 3 or 8 percent, depending upon which price-level target path had been announced. The peg would have been maintained (possibly in the form of a crawling peg) until the price level had started to rise and approach the price-level target path.[9] When the price

[7] The conference papers were later published in *Monetary and Economic Studies* 19(S-1) 2001.

[8] As emphasized by Bernanke [4] and [5], several years of zero or negative deflation have most likely resulted in a price gap that should be undone—a price level below previous expectations that has increased the real value of debt and deteriorated balance sheets for banks and firms.

[9] Pegging a currency that is strong and under appreciation pressure is always possible, since it can be defended by the purchase of foreign exchange at the pegged rate with domestic currency that can be issued in ever-increasing amounts. Pegging a currency that is weak and under depreciation pressure is more difficult, since its defence requires

Figure 2.2: Price gaps for alternative price-level target paths starting from 1995, percent



level would have reached the price-level target path, the peg would have been abandoned, and the Bank of Japan would have shifted to inflation or price-level targeting.

Suppose the FPW would be implemented soon in 2005. With the same price-level target paths, the required depreciation of the yen would now be about 11 or 23 percent (figure 2.2). If instead the price-level target paths would be announced as starting from the CPI in 2000, the corresponding price gaps and required currency depreciations would be about 8 or 15 percent.

3. Conclusion

In conclusion, regarding monetary-policy alternatives in a liquidity trap, it seems obvious to me that it is better to focus on policies that can affect expectations of the future price level rather than just expectations of future interest rates. The effect of changing price-level expectations and exchange rates should be much more powerful than that of changing long nominal interest rates or expectations of future short interest rates that are already rather close to zero. Obviously, there is no bound to exchange rates and price level expectations similar to that on nominal interest rates.

Japan still has the option to implement the Foolproof Way as a policy to end deflation and eventually shifting to a regime of inflation or price-level targeting that can support a sustained

the purchase of domestic currency with limited foreign exchange reserves that may eventually run out (see Svensson [17] and [18] for details).

recovery of the Japanese economy. The Foolproof Way with a price-level target path, a currency depreciation, and a commitment to an exchange-rate peg and a zero interest rate until the price-level target path has been reached can be seen as a *first-best* policy to end stagnation and deflation in Japan. The Foolproof Way without the explicit exchange-rate policy, namely a price-level target path and a commitment to a zero interest rate until the price-level target path has been reached, would be a *second-best* policy. The current policy, a commitment to a zero interest rate until inflation has become nonnegative is at best a *third-best* policy. The problem with this policy is that it accommodates all deflation that has occurred before inflation turns nonnegative and hence is not effective in inducing inflation expectations.

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Monetary Policy and Japan's Liquidity Trap

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- Long slump in Japan since early 1990s
- Persistent GDP deflation since 1995; persistent CPI deflation since 1998
- Zero interest-rate policy (zero instrument rate, o/n call rate)
- Quantitative easing
- Commitment: Zero interest rate until CPI inflation is zero or positive
- Policy has not ended deflation; BOJ still not in control of the price level
- Japan remains in a *liquidity trap*: Zero lower bound for the instrument rate (ZLB) is strictly binding

Q: What is the problem in a liquidity trap?

A: The real interest rate is too high, even though the nominal interest rate is zero.

Q: How can the problem be solved?

A: By inducing private-sector expectations of a higher future price level.

Q: But how can the central bank induce such expectations?

A: That is the *real* problem in a liquidity trap.

- Consequently, in assessments of policy alternatives in a liquidity trap, the focus should be on how effective the policy alternatives are in affecting expectations of the future *price level*.
- However, for monetary policy in Japan, the focus is mostly on affecting private-sector expectations of future *interest rates*.
- Better: Focus on *direct commitment to a higher future price level and how to make this commitment credible*

Q: What is the problem in a liquidity trap?

A: Too high a real interest rate and therefore a recession.

Output gap, $x_t \equiv y_t - \bar{y}_t$ (logs)
Real interest rate, $r_t \equiv i_t - \pi_{t+1|t} \equiv i_t - (p_{t+1|t} - p_t)$ (logs)
Neutral (natural) interest rate, $\bar{r}_t \equiv \rho_t + \sigma(\bar{y}_{t+1|t} - \bar{y}_t$
(rate of time preference, expected potential-output growth)

$$x_t = x_{t+1|t} - \sigma(r_t - \bar{r}_t)$$

Solve forward to period $t+T$

$$\begin{aligned} x_t &= x_{t+T|t} - \sigma \sum_{\tau=0}^{T-1} (r_{t+\tau|t} - \bar{r}_{t+\tau|t}) \\ &= x_{t+T|t} - \sigma \sum_{\tau=0}^{T-1} (i_{t+\tau|t} - \pi_{t+1+\tau|t} - \bar{r}_{t+\tau|t}) \end{aligned}$$

Rewrite

$$x_t = x_{t+T|t} - \sigma \sum_{\tau=0}^{T-1} i_{t+\tau|t} + \sigma(p_{t+T|t} - p_t) + \sigma \sum_{\tau=0}^{T-1} \bar{r}_{t+\tau|t}$$

Note

$$x_{t+T|t} \approx 0 \qquad \text{(back to normal, no liquidity trap, at } t+T\text{)}$$

$$\sum_{\tau=0}^{T-1} i_{t+\tau|t} \approx 0 \qquad (i_{t+\tau|t} \approx 0, \quad 0 \le \tau \le T-1)$$

$$x_t \approx \sigma(p_{t+T|t} - p_t) + \sigma \sum_{\tau=0}^{T-1} \bar{r}_{t+\tau|t} < 0$$

- Recession ($x_t < 0$) because:
  $\sum_{\tau=0}^{T-1} \bar{r}_{t+\tau|t}$ and $p_{t+T|t} - p_t$ are too low
  (exogenous) (endogenous)

Q: How can the negative output gap, the recession, be eliminated?

A: It is all about expectations: Induce expectations of a higher future price level.

- Monetary policy in Japan is mostly about increasing x_t by further reducing $\sum_{\tau=0}^{T-1} i_{t+\tau|t}$ (already small) or by increasing $x_{t+T|t}$ (by keeping $i_{t+\tau|t}$ near zero after $t+T$)
  - Affecting *interest-rate* expectations
  - But small effect, 2nd order
- But x_t can be increased by increasing $p_{t+T|t}$! (p_t is sticky)
  - Affecting *price-level* expectations
  - Potentially large effect, 1st order

Q: How to affect price-level expectations?

- Credibility problem (Krugman 98)
- Increase in money supply
  - Effective only if perceived as permanent, but no commitment mechanism (Krugman 98)

    $(i_{t+T|t} > 0$, no liquidity trap beginning in $t+T)$

    $p_{t+T|t} \sim m_{t+T|t} - y_{t+T|t}$
  - Japan, quantitative easing, monetary base +67% since Mar 2001
    - No effect on price-level expectations, exchange-rate, long interest rates
    - Hence, not perceived as permanent: Quantitative easing has been a failure

- Inflation target or (better) price-level target: OK, if credible
  - Words alone are not enough
  - Problem for the Fed and BOJ, since they are averse to numerical targets and more explicit commitments

- Fiscal policy, money-financed fiscal expansion
  - Fiscal expansion, Ricardian equivalence?
    - Japan has run big fiscal deficits
  - Money-debt financing?
    - Note: Matters *only* via $m_{t+T|t}$ and $p_{t+T|t}$, not separate effect
    - Credibility problem: No reason to believe permanent money financing, no commitment mechanism

- The Foolproof Way (to escape from a liquidity trap)
  1. Price-level target (path), $\hat{p}_t \equiv \hat{p}_0 + t\hat{\pi}$
  2. Currency depreciation and peg consistent with price-level target
  3. Exit strategy when price-level target reached: Float and inflation or price-level targeting

$$p_{t+T|t} = \hat{p}_T$$

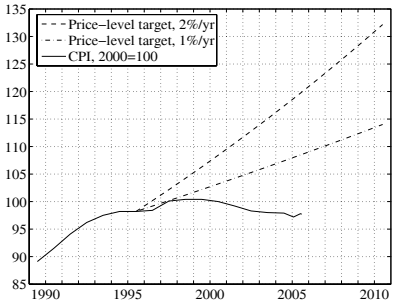
$$p_{t+T|t} = s_{t+T|t} + p^*_{t+T|t} - q_{t+T|t}$$

$$s_t = s_{t+1|t} - (i_t - i^*_t) = s_{t+T|t} - \sum_{\tau=0}^{T-1} i_{t+\tau|t} + \sum_{\tau=0}^{T-1} i^*_{t+\tau|t}$$

$$= p_{t+T|t} - \sum_{\tau=0}^{T-1} i_{t+\tau|t} + ...$$

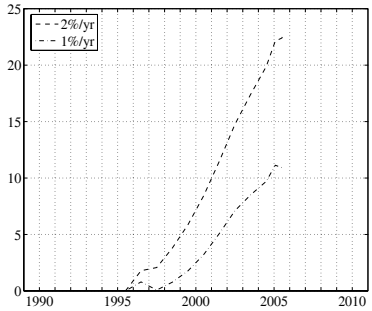
- Trade-balance effects problematic?
  No. Currency depreciation if expectations of increased future price level, more expansionary monetary policy. No difference.

Alternative price-level target paths starting from 1995 and the CPI (excluding fresh food) for Japan



- "Price gap" to undo (Bernanke): Undo unanticipated deflation (too low inflation), restore balance sheets

Price gaps for alternative price-level target paths starting from 1995, %



- Price gaps to undo
  2000: 3% or 8%
  2005: 11% or 23%

- **1st best policy commitment**, FPW: Exchange-rate peg and zero instrument rate until price level exceeds price-level target,

$$p_t \geq \hat{p}_t \equiv \hat{p}_0 + t\hat{\pi}$$

- **2nd best policy commitment**, FPW less exchange-rate peg: Zero instrument rate until price level exceeds price-level target
- **3rd best policy commitment**, current policy: Zero instrument rate until inflation turns nonnegative,

$$\pi_t \geq 0$$

  - **Deflationary!**
  - Accommodates any fall in price level before inflation turns nonnegative!
  - Does not prevent deflationary expectations!

Conclusion:

- Regarding monetary-policy alternatives in a liquidity trap, focus on policies that can affect expectations of the future price level
- 1st best:
  - Announce price-level target path
  - Use exchange rate: Depreciate and peg until price level exceeds price-level target
- 2nd best:
  - Announce price-level target path
  - Use interest rate: Zero interest rate until *price level* exceeds price-level target
- 3rd best:
  - Use interest rate: Zero interest rate until *inflation* is nonnegative

- Japan still has the option of implementing the 1st-best or 2nd-best policy instead of the current 3rd best
- That is a better way to end deflation and shift to a monetary policy that can support a sustained recovery